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DOE EM Industry Programs Robotics Development

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The Office of Science and Technology (OST) manages an aggressive program for RD&D, as well as testing and evaluation for the Department of Energy's (DOE's) Environmental Management (EM) organization. The goal is to develop new and improved environmental restoration and waste management technologies to clean up the inventory of the DOE weapons complex faster, safer, and cheaper than is possible with currently available technologies. OST has organized technology management activities along focus teams for each major problem area. There are currently five focus areas: Decontamination and Decommissioning, Tanks, Subsurface Contaminants, Mixed-Waste, and Plutonium. In addition, OST is pursuing R&D that cuts across these focus areas by having applications in two or more Focus Areas. Currently, there are three Crosscutting Programs: the Robotics Technology Development; Characterization, Monitoring, and Sensor Technologies; and Efficient Separations and Processing.

The Federal Energy Technology Center (FETC) administers the Industry Programs portion of OST technology development activities, as well as acting as the lead organization for the Decontamination and Decommissioning Focus Area. FETC's R&D programs focus on commercialization of technologies that will be carried out in the private sector. FETC promotes and accelerates technology development by performing or sponsoring backstop research, handling barrier issues that may arise, and interfacing continuously with stakeholders and a host of industrial partners to provide technology transfer and assure a match between R&D projects and the regulatory needs of the EM sites (i.e, the end-users) .

Industrial partnerships are the primary emphasis of FETC-sponsored programs (in addition to universities, national laboratories, and other research organizations). This active integration of the private sector, academia, and DOE labs allows all aspects of the technology to be evaluated, including worker safety and health, commercial potential, and technical merit. In Industry Programs projects, the Federal Government shares the early risk to provide a fast track to market entry, allowing new products and technologies to be commercialized in a more timely fashion. This is especially important for robotics technologies applicable to the EM arena. Many of these candidate technologies are in the early development stages and require a "catalyst," such as FETC, to bring the products to commercial maturity more rapidly.

Robotic systems reduce worker exposure to the absolute minimum, while providing proven, cost-effective, and, for some applications, the only acceptable technique for addressing challenging problems. Development of robotic systems for remote operations occurs in three main categories: tank waste characterization and retrieval; decontamination and dismantlement; and

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characterization, mapping, and inspection systems. In addition, FETC has some other projects which fall under the heading of "supporting R&D."

Remote robotics technologies are needed for the characterization and removal of wastes contained in the hundreds of underground storage tanks around the DOE complex. Robotic systems are well suited for this application, since access to the interior of the tanks is limited to a small number of portholes no larger than 42 inches. For containment purposes, operations are restricted to those that can be accomplished with the tank domes in place. In addition, because of the high levels of radiation and hazardous chemicals present in these tanks, it is desirable to remediate these tanks remotely. The large volume of wastes involved also compel DOE to automate robotic techniques wherever possible. FETC is actively sponsoring development of a vehicle-based waste retrieval system, as well as a robotic end-effector for remote tank inspection.

The clean up of the large number of contaminated facilities in the DOE complex would greatly benefit from the inherent advantages of robotics. Certain decontamination and selective equipment removal tasks can be done remotely to minimize worker exposure and costs associated with possible long-term surveillance and maintenance of the highly contaminated areas in facilities. FETC is pursuing development of several such systems, for example, an asbestos abatement robot for pipes, a dry-ice blasting concrete-decontamination robot, and a heavy-duty mobile platform for selective equipment removal, called "ROSIE." ROSIE has already been successfully deployed in a "hot environment" in the Large-Scale Demonstration Project at the CP-5 reactor dismantlement at Argonne National Laboratory.

Characterization, inspection, and mapping activities can be repetitive in nature, involve complex computations, and take place in highly contaminated areas. Robotic systems have proven over the last several decades that they are well suited to perform these types of tasks. FETC is currently involved in the development of several technologies in this field, including a miniature robot for inspecting pipe internals, a mobile 3-dimensional characterization system, two mobile drum inspection robots, data fusion and visualization software for facility mapping, and a real-time 3-dimensional vision system.

FETC also sponsors projects that have broad relevance to robotic technologies being developed for EM applications. The goal of this supporting R&D is to bridge the gaps in current programs to help ensure that the robotic systems under development will be able to perform tasks more safely, quickly, and cheaply than alternative methods. This work supports all task areas, and is generally aimed at generic, long-term technology needs, such as, innovative controls for human-machine cooperative telerobotics, a robotic task-space scene analyzer, robotic diagnostic system, and a reconfigurable operator interface for robot applications.

The central objective of all FETC robotic projects is to make robotic systems more attractive by reducing costs and health risks associated with the deployment of robotic technologies in the cleanup of the nuclear weapons complex. This will be accomplished through development of robots that are cheaper, faster, safer, and more reliable, as well as more straightforward to modify/adapt and more intuitive to operate with more autonomous capabilities and intelligent controls that prevent accidents and optimize task execution.