Robotics and Remote Systems Developments and Applications FY96 (U)

by
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SAVANNAH RIVER TECHNOLOGY CENTER
APPLIED SCIENCE & ENGINEERING TECHNOLOGY
EQUIPMENT ENGINEERING SECTION

ROBOTICS AND REMOTE SYSTEMS DEVELOPMENTS AND APPLICATIONS
FY96

October 1996

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SRS

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FY96

APPROVALS

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INTRODUCTION

The purpose of this report is to document the contributions that the Savannah River Technology Center (SRTC) has made during Fiscal Year 1996 in the Robotics and Remote Systems Technology arena. The contributions originated from the Applied Science and Engineering Technology (ASET) Department's Equipment Engineering Section (EES). Activities and deliverables for the Savannah River Site's (SRS) main operating divisions as well as contributions to new mission activities, other Department of Energy (DOE) sites and programs, intellectual property development and professional societies are described.

BACKGROUND

Robotics and Remote Systems at Savannah River Site

The Savannah River Site has been applying remote systems since the first days of operation over forty years ago. More recently, since the early 1980's, the site has also been applying robotics and telerobotics to its operations, although in a more limited fashion. Activities at SRS include nuclear material processing, hazardous waste storage and processing, and environmental restoration. The radiological nature of these activities dictates the use of remote systems to remove the human worker from direct contact with the hazardous materials.

The majority of the applications for robotics and remote systems at SRS are unique or one-of-a-kind operations. There has been limited need for "automation" of processes from a robotic material handling perspective. The primary user of automated material handling in the past was the fuel and target manufacturing area, which is now inactive. New potential uses for automated material handling do exist in new processing facilities which are at the conceptual design stage. The majority of the applications undertaken in FY96, however, arose from the need to respond to an off-normal condition, to determine the status or condition of a tank, vessel or pipe, or to build a specialized piece of electromechanical equipment that was not commercially available.

EES Robotics and Remote Systems Technologies

The unique needs of the site's operating divisions have driven EES to develop in-house expertise in five main technology areas. These areas, when leveraged with resources from industry, academia, or other DOE sites and labs, form the basis for most of the solutions delivered by EES. They also are the areas where EES can contribute most effectively to the Robotics and Remote Systems needs of offsite customers. The areas are:

- *Mobile Robots and Mobile Teleoperators* - Autonomous or man-in-the-loop systems to collect data and perform operations where the job environment makes human access undesirable. Examples include response to high level waste spills, hazardous or toxic material events, and chronic monitoring of radiation rates.
- *Pipe and Wall Crawlers* - Mobile systems adapted for special geometries. Pipe crawlers are used on the interior of piping systems, and wall crawlers attach to vertical surfaces and negotiate them. These devices have been used to collect video images and deploy ultrasonic testing (UT) probes to assess material conditions.
- *Remote Viewing Systems* - Video and still photography systems deployed in non-traditional situations. This area includes radiation hardened systems, and

determination of radiation tolerance of off-the-shelf equipment. Supporting technologies of signal transmission and multiplexing, lighting, and deployment systems are also included.

Manipulators and Tooling - Multiple degree of freedom arms, and the tooling to make them perform desired tasks. A subset of this is simply remotely operated tools, which are then deployed separately. Electric, hydraulic and pneumatic manipulators have all been successfully deployed based upon customer requirements.

Specialty Equipment Systems - Special purpose process equipment which is not available from commercial sources. These systems are built to strictly conform to customer specifications. Examples include the bagless transfer system, drum opening equipment, and Americium/Curium (Am/Cm) processing systems.

EES Customer Base

The diverse customers of EES includes the multiple operating and support divisions of SRS and a number of offsite customers such as the Office of Science and Technology (OST), Hanford, and the Los Alamos National Laboratory. Efforts are underway to expand the customer base to include non-DOE customers, such as DoD and NASA. For FY96, 70-75% of the budget for Robotics and Remote Systems technologies was derived from on-site customers. The remainder was from offsite sources and new mission activity, with OST being the single largest offsite customer. Of the site derived funding, the majority was tied to specific tasks and deliverables, with a small portion being derived from "area support." The "area support" funding provides capabilities such as mobile teleoperator fleet readiness, so that no single customer bears this cost.

EES - The Customer's Choice for Robotics and Remote Systems

Earlier in FY96, a management consulting firm was engaged to determine if commercial industry could support the site customers' remote handling needs directly. This was a reasonable scenario, as many systems on site are supplied and supported by commercial vendors. While there are many high quality suppliers of robotic and remote handling equipment, systems, or support services, the consultant was unable to identify any one vendor who could offer the combination of these to the site customers. Instead, a combination of suppliers would be required, and single point accountability would be lost.

The concept of single point accountability helps contribute to the high customer satisfaction rating that EES enjoys. EES teams with the customer to develop an innovative solution which meets their requirements, and then continues to provide service after delivery of the product. Despite the broad range of customers, variety of products and services, and tasks whose durations range from hours to years, EES customer satisfaction surveys return consistently high ratings.

EES continues to enhance their reputation for customer satisfaction by contributing to numerous long range and new mission activities at SRS, while still providing daily support to operations. EES is developing critical equipment for the Americium/Curium (Am/Cm) vitrification program and supporting site initiatives on spent nuclear fuel storage and plutonium vitrification. EES is active in the Accelerator Production of Tritium (APT) and Commercial Light Water Reactor (CLWR) programs, and has developed systems for the Actinide Packaging and Storage Facility (APSF) to meet Defense Nuclear Facility Safety Board (DNFSB) 94-1 recommendations. EES also supplies remote tools in a matter of hours or days to resolve operational difficulties, such

as a transfer jet stuck in a waste tank or an obsolete jumper support impeding installation of equipment for Defense Waste Processing Facility (DWPF) start-up. This combination of long range development programs and fast response process assistance contributes to the EES broad support to SRS.

Partners in Robotics and Remote Systems

EES cooperates with its peers at DOE's National Laboratories and other Complex sites on both OST sponsored initiatives and site specific issues. As an example, the West Valley site requested EES assistance in troubleshooting melter offgas difficulties. The Los Alamos National Laboratory teamed with EES to develop engineered equipment for plutonium processing. EES teamed with Oak Ridge and Sandia to deliver the remote handling technology currently being used to remediate the CP-5 reactor at Argonne National Laboratory. Partners on other programs included The Pacific Northwest National Laboratory, Westinghouse Hanford Company, and the Fernald Environmental Management Program.

EES is also involved in numerous interactions with academia. This enables the emerging research from the university laboratories to be leveraged with EES knowledge of operability and maintainability in remote environments to create superior solutions for customers. This type of interaction typically occurs on longer-range development programs, such as OST sponsored technology development, although numerous site-sponsored jobs have also incorporated university assistance. During FY96, EES had development programs in cooperation with the University of Michigan, the University of Florida, North Carolina A&T, the University of Alabama, the University of Texas, and the Georgia Institute of Technology.

EES utilizes the expertise found in American industry to provide equipment components and systems to meet customer requirements. By not "reinventing the wheel," EES is able to leverage the high quality products of remote handling vendors, such as PaR Systems or Schilling Robotic Systems, and apply them to the unique needs of site customers. This approach maximizes benefit to the site customer, while still retaining the post-installation support provided by EES. If the customer experiences difficulty, EES engineers can be called to the job site in a matter of minutes or hours.

FY96 ACTIVITIES

During FY96, EES provided Robotics and Remote Systems technology to a variety of customers. The nature of the activities varied from supplying a simple tool or camera in a matter of hours to conceptual design information for new facilities to be constructed after the turn of the century. Despite the broad variety in scope and time lines, EES continually met customer requirements to ensure mission success. A number of deliverables are listed below, separated into customer areas, to illustrate EES's contributions to the multiple operating and support divisions of SRS, and to offsite and new mission customers.

SRS High Level Waste (HLW) Management

Waste Tank 41 Water Jet Cutter for Stuck Transfer Jet - EES designed, developed, and operated a remote water jet cutting system to cut through a two inch thick steel clamp, allowing the removal of a failed transfer jet. The actual water jet unit was supplied by Hydro Innovations on a rental basis, minimizing the cost to the customer. This was one of the first uses of water jet technology at SRS. Use of water jet technology minimized

damage potential to the tank, and precluded explosion concerns. Tank 41 was scheduled to be the initial feed tank for In-Tank Precipitation (ITP), and was considered critical to ITP start-up.

HDB-7 Jumper Support Cutter - EES designed, developed, and delivered a remote edge grinder to remove an obsolete jumper support from the bottom of H area Diversion Box number seven (HDB-7). HDB-7 is a confined space, extends twenty feet below grade, and is a radiation and contamination area. A prototype system was demonstrated within four days of the initial request. The support was removed with a total of five cuts, contaminating the tool to over 200,000 dpm. The jumper support interfered with the installation of a jumper which would handle the DWPF recycle stream to the tank farm, and was on the critical path for DWPF start-up.

Waste Tank 25 Transfer Jet Size Reducer - EES designed, built, delivered and operated in the field a remote hydraulic shearing tool to size reduce a failed transfer jet after its removal from waste tank 25. By providing this system to HLW, tank farm personnel were able to use an existing, approved shipping and storage container to house the components going to the burial ground and salvage the connector head assembly of the transfer jet for reuse. The tool remains available for future use.

Waste Tank 15 Annulus Anomaly Sampling - EES designed and demonstrated a remote tool to collect a sample from an annulus anomaly on Tank 15. The tool featured quick disconnects for ease of use, a sampling head with integral vial, camera and lights, and magnetic clamps to hold it in the region of interest during sample collection.

Waste Tank 18 Floating Organics Sampler - EES initiated design of a remote skimmer system to sample a thin layer of suspect organics in waste tank 18. This work will continue in FY97.

Waste Tank 19 Zeolite Sampling - EES designed, fabricated and delivered a remote sampling tool which was used to remove a waste sample from waste tank 19. The sample was needed to determine the zeolite concentration and form in order to develop waste removal methods. This activity was on the critical path for closure of waste tank 19, which is a demonstration tank for closure methods.

Waste Tank 20 Samplers - EES designed, fabricated, and delivered two remote sampling tools which were used to remove waste samples from waste tank 20 in different locations. A commercially available "mudsnapper" was used directly under a riser, while a hinged joint extension system ("praying mantis") was developed to sample locations which were remote from the riser.

Waste Tank 22 Soft Salt Sampler - EES developed a modified salt sampling tool for sludge and soft salt applications. The modified tool has an external indicator to show that a sample has filled the interior void. Tools developed for waste tank 22 were subsequently deployed in waste tank 38 for scheduling reasons. Replacement tools will be fabricated in FY97.

Waste Tank 38 Sludge/Solids Sampler - EES responded to a priority request for sampling waste tank 38. Tools originally developed for waste tank 22 were modified to meet the needs of waste tank 38. The tools were modified and delivered in approximately two weeks.

Tank 48 Variable Depth Sampler - EES initiated conceptual design of a variable liquid depth sampler for the ITP reaction vessel, waste tank 48. The sampler will be lowered to the depth of interest, and remove a sample from the liquid layer at that depth. The sampler is needed to address concerns related to non-homogeneous tank contents. Work will continue in FY97.

Vendor Proposal Review Committee on Sampling - EES participated with HLW in a review of commercially available remote sampling technologies. While many vendors felt they were capable of providing samplers for high level waste tanks, none had existing equipment or proven designs for this service. HLW recognized that EES would continue to be the supplier of choice for tank sampling systems.

Waste Tank Direct Photography Rig - EES designed, fabricated and delivered a new camera housing for each of the two Direct Photography (DP) Rigs. HLW uses the DP Rig to produce photographic records of the condition of waste tank exteriors. The new camera housing allowed HLW to incorporate an automatic camera into the rig, replacing the obsolete camera previously used.

Waste Tank Wide Angle Photography System - EES designed and fabricated a remote Wide Angle Photography System for waste tank service. The design features many identical components to the DP rig, thus reducing the required spare parts inventory and improving the availability of both systems.

Waste Tank Annulus Video System - EES designed and fabricated a remote video system for inspecting the outer wall of double shelled underground waste tanks from within the annular space. The benefits of this system over the DP Rig are real-time viewing, operator-controlled lens functions, and automated deployment.

Waste Tank Interior Video Inspection System - EES designed and fabricated a remote video-based system to provide visual, real-time monitoring in a waste tank with a supersaturated atmosphere. The system is portable and can be used in tanks with access ports of 4 1/2 inches or larger.

ITP Camera System Field Support - The ITP camera system, developed several years ago by EES, continues to be used in monitoring waste tanks with a potentially explosive environment. EES provides technical support as needed to keep the systems operational.

ITP Filter Building Jumper Cord - EES designed and fabricated a 100 ft. test cable which will allow maintenance of electrical components on five different ITP process jumpers. The test cable is used to connect the electrical Hanford connectors on the process jumpers to instrument loops and control circuit interfaces located in the ECR of the Filter Building (241-096H). In addition to the test cable, two junction boxes and five adapters to connect between the test cable and the electrical Hanford connectors were fabricated.

Tank 37 Condenser Ventilation System Camera - EES designed, developed, and fabricated in two days a remote camera system to provide video surveillance of the inner drain in the condenser ventilation system of waste tank 37. The system was needed to verify the drain was not clogged prior to HEPA filter changeout.

Pump Pit 5 and 6 Drain Line Inspection Camera System & Auger Tooling - EES designed, fabricated, and delivered a camera system for inspecting a suspect plugged drain line for pump pits 5 and 6 in H-area. The drain line has a P-trap arrangement

making access difficult. Inspection efforts failed due to the turbidity of the liquid encountered; however, auger tools provided by EES were used successfully to improve the drainage rate.

2H Evaporator Lead Counterweight Removal Consultation - EES provided consultation on appropriate technologies for removing lead counterweights from the highly radioactive 2H evaporator. Customer schedule concerns dictated the counterweights be removed after the evaporator had been removed from its cell, so as not to interfere with installation of the replacement evaporator. EES identified an available 450 amp plasma torch for removing the counterweights, which was much faster than the previously selected cutting technology.

Highpoint Flush Pit Sump Drains Tapping Tool - EES designed, developed, delivered, and operated a remote threading tool for the drain of the Highpoint Flush Pit Sump. Threading the drain was necessary to allow the installation of test plugs for pressure testing the lines. Previous methods of isolating the lines for pressure testing were identified as inadequate, and resulted in the contamination of personnel involved in the testing. The new method is safer, with less contamination potential, and was fabricated within two weeks of the initial request.

Transfer Pump Siphon Breakers - EES consulted on the design of safety class siphon breakers to be installed on HLW transfer pumps to prevent uncontrolled siphoning of tank contents. An aggressive six week schedule for design, procurement, and testing was supported.

HLW Pump Pit #1 Tubing Removal Tool - EES designed, developed, and demonstrated tools for size reducing abandoned hydraulic hose, tubing, and cables which are congesting pump pit number one. Grinding tools have been successfully demonstrated, and shearing tools are being investigated to alleviate concerns over smoke generation while grinding elastomeric coatings on hoses and cables.

Outlining Riser Interference in Waste Tank Consultation - EES was requested to identify methods of ensuring the absence on interference beneath waste tank riser ports prior to installation of equipment in the risers. A vendor (Structural Integrity) was identified to supply focused array transducer ultrasonic technology for a proof of principle demonstration.

Halon Storage Tank Sampler - EES was requested to design a sampling system to remove a sample of recycled Halon for analysis. Preliminary concepts indicate that a manifold sampling system will be adequate for this task. Detailed design will continue in FY97.

Waste Tank Wall Crawler Inspection System Support - EES provided continued support for the patented EES-developed Waste Tank Wall Crawler Inspection System. The system has been used to map the wall thickness of several SRS waste tanks. EES will fabricate a second wall crawler and deployment tool during FY97.

SRS Defense Waste Processing Facility

Melter Pour Stream Viewing Camera System - EES designed, developed, fabricated and installed a miniature video camera and right angle mirror inside a protective dewar for viewing the molten glass stream in the DWPF melter pour spout. This system was

critical for diagnosing the root cause of the pour stream instability which occurred during melter start up.

Melter Pluggage Tooling - EES designed and fabricated remote tooling to modify the end of the DWPF pour spout riser so that glass samples could be extracted from the riser. Samples were desired to diagnose the causes of pour stream fluctuations during melter startup. Identification of control system component problems as the cause of the instability precluded the need for the tools to be used.

Melter Pour Spout Modifications - EES designed and prototyped a melter pour spout insert to alleviate pour stream instabilities experienced during melter startup. The insert alters the geometric relationship between the canister throat and the pour spout knife edge so that pour stream variations do not result in glass slag accumulating on cooler surfaces. Following successful testing of the prototype, an inconel insert was fabricated for installation into the melter. Control system modification precluded the need for the insert prior to radioactive operations.

Telerobotic Manipulator DWPF Specification and Consultation - EES recommended replacing an existing mechanical manipulator with an improved telerobotic manipulator to provide additional reach and lifting capacity near the melter. EES assisted in the development of specifications for procurement of the Telerobotic Manipulator (TRM) and also assisted in the bid evaluation. The TRM has been used numerous times for cleaning the melter pour spout after radioactive operations were initiated. This would not have been possible with the previous manipulator.

DWPF Telerobotic Manipulator Computer Simulation - EES developed a three dimensional solid model simulation of the Telerobotic Manipulator (TRM) for DWPF. Both the TRM and the simulation use a trackball for input. The model was designed to analyze operations which the TRM could perform, and as a training tool for TRM operators.

DWPF Pour Spout Cleanout Tooling for TRM - EES designed, fabricated, and delivered in one week two types of remote cleaning tools for removing glass accumulations beneath the knife edge in the melter pour spout. The tools were urgently needed during a short shutdown in the melter pouring schedule.

Melter Borescope Assembly Repair - EES repaired a DWPF Melter Borescope after a temperature excursion damaged the optics section. Operations personnel corrected a problem in the remote cooling and purge air connection which led to the excursion. The unit was returned to service.

DWPF Borescope Optics Design - EES, in cooperation with the University of Alabama, Huntsville, revised the optical design of the melter borescope to accommodate the high radiation environment. The design contains 16 lens elements of 10 different types. Confirmatory testing has validated the design. The borescope development is a critical path item in the acquisition of the third melter.

Burette Tip Handling Tools - EES designed, developed and delivered specialized tools to allow the mechanical manipulators to grasp burette tips in the analytical cells. The size of the burette tips made them difficult to grasp. The tools overcame this difficulty.

Analytical Cells Upgrades - EES designed, developed, fabricated and installed adapters, cable hangers, shelves and other infrastructure support to expand the capability of the

Analytical Cells. The infrastructure upgrade was required to allow installation of equipment to perform analyses which were not included in the original facility design.

Analytical Cells Microwave Oven Fan Replacement - EES designed, fabricated and installed flat fans to exhaust the analytical cells microwave ovens. The original fans supplied by the oven vendor were bulky, and consumed valuable cell space. Additionally, they were not compatible with remote operation and changeout. The replacement design overcame these difficulties.

Analytical Cells Remote Equipment Support - EES designed numerous modifications to commercial analytical equipment systems to make them compatible with the remote handling needs of the Analytical Cells. Lifting bails were added to equipment pieces such as the mixer mill, vortex mixer, hot plate stirrer, capper/decapper, centrifuge, microwave, etc. Electrical controls such as power controllers for furnaces, front panel controls for the microwave units, and others were modified to be remotely operated from outside the cell.

Analytical Cells Connector Tool - EES designed, developed, fabricated and delivered a specialized tool to allow remote connection and disconnection of large Lemo electrical connectors using the existing Analytical Cells mechanical manipulator. The large Lemo connectors were required to accommodate the additional analytical equipment added to the cells; however, its connection force exceeded the manipulator's capacity rating. The tool was developed to overcome this difficulty.

Analytical Cells Decon - EES designed and fabricated equipment hangers to be used during wash-down of the analytical cell. The hanger allows for decontamination beneath the areas where the equipment normally is located.

SRS Nuclear Materials Stabilization Program (NMSP)

FB-Line Bagless Transfer Development and Deployment - EES designed, developed, and demonstrated a new method of removing radioactive materials from gloveboxes without the use of plastic bags or organic seal materials. The welded canister is produced through a welding and cutting operation called bagless transfer. The FB-line unit was demonstrated in a non-radioactive mockup for DOE one month ahead of its award fee milestone. Installation support will continue next year as the unit is integrated into FB-line operations to ensure compliance with DOE Standard 3013-94 for long term storage of plutonium.

APSF Gantry Robot Material Handling - EES specified, procured, and installed a gantry robot for use in the Accountability Measurements (AM) demonstration process for the Actinide Packaging and Storage Facility (APSF). The robot will be used to service top loading accountability instruments.

APSF Gantry Robot End Effectors - EES designed, fabricated, and installed end effectors and associated components to remotely handle BNFL and 2R containers using the AM gantry robot. The end effectors are compatible with AM room processes, including calorimetry and digital radiography.

APSF Container Material Handling - EES researched the various shipping packages and inner containers to be processed in the APSF, and created detail drawings and a diagram to depict the actual flow of components throughout the facility. The drawings

and diagram will be used as tools in formulating a detailed strategy for material handling between areas within the APSF.

APSF Shipping Package Unpacking Conceptual Design - EES developed a conceptual design for methods to automate the shipping package unpackaging process, and to provide exposure protection to personnel during manual process steps. A final conceptual design package was submitted to the customer, along with specific design and equipment recommendations.

APSF Special Isotope Storage Conceptual Design - EES designed and developed a method to remotely handle Pu-238 containers in the Special Isotope Storage (SIS) vault. A final conceptual design package and detailed end effector drawings were submitted to the customer, along with specific design and equipment recommendations.

APSF Automatic Guided Vehicle Specification - EES developed detailed procurement specifications for the Automatic Guided Vehicle (AGV) which would service the storage vault in APSF. A qualified vendor responded to the request for bid; however, other project considerations prevented releasing the procurement in FY96.

Am/Cm Vitrification Equipment - EES designed numerous equipment systems in support of the Americium/Curium (Am/Cm) vitrification program. The Am/Cm program will convert the highly radioactive Am/Cm solutions stored in F-Canyon to a stable glass form for transportation to Oak Ridge. EES supported both the pilot facility and the design of the in-canyon processing equipment. Specific systems are noted below.

Am/Cm Pilot Facility Process Equipment - EES designed the experimental system for process development of Am/Cm vitrification. EES selected equipment for auxiliary operations such as frit feeding, and performed the procurement of commercial components. EES also designed custom items, such as the high temperature off-gas system, the melter plenum, and custom slab tanks. EES also oversaw the fabrication of the melter by the offsite vendor, and construction of the pilot plant.

Am/Cm Pilot Facility Slab Tanks - EES designed and fabricated custom slab tanks for the Am/Cm process development pilot facility. Slab tanks are used to ensure a nuclear criticality does not occur. The custom slab tanks featured viewing windows so that additional process development studies could be performed.

Am/Cm Process Facility Design - EES designed the remote process equipment layout and process for vitrification of Am/Cm. The process will be installed in the Multi-Purpose Processing Facility (MPPF) in F-Canyon. The EES design is compatible with the rack/frame system used in MPPF. EES has completed the structural design of the processing racks, and the Process and Instrument Diagram (P&ID) describing the process.

Am/Cm Process Facility Melter Module - EES designed the melter module for the Am/Cm vitrification facility. The module allows the melter to be remotely replaced, ensuring mission success even in the event of a key component failure.

Am/Cm Process Facility Tanks - EES designed the slab style process tanks for the Am/Cm vitrification facility. The tanks were designed to ASME Section VIII criteria. Nuclear criticality and decay heat concerns were also addressed.

Am/Cm Process Facility Off-Gas System - EES designed the high temperature off-gas system for the Am/Cm vitrification facility. The system is used to collect, clean, and cool the high temperature gaseous effluents from the vitrification process.

Am/Cm Process Facility Turntable - EES designed the canister turntable for the Am/Cm vitrification facility. The turntable supplies canisters to the melter for filling with molten glass. Remote operability and maintenance concerns were addressed during design of the turntable.

Am/Cm Process Facility Seal Welder - EES designed the seal welder for the Am/Cm vitrification facility. The welder produces the final closure seal on the product canisters. Remote welder operation and maintenance provisions are included in the design.

Am/Cm Process Facility Canister Handling - EES designed, developed, and fabricated specialty tooling to allow MPPF manipulators to handle vitrified Am/Cm canisters.

Am/Cm Process Facility Jumpers - EES designed numerous remote piping connections ("jumpers") for the Am/Cm vitrification program to allow remote utility connections. Standard service connections to the canyon are being designed by Design Engineering; however, EES is responsible for all on-rack and rack-to-rack connections, as well as specialty jumpers. An example of a specialty jumper is the off-gas jumper, which includes a steam jet and water quench as an integral part of its design.

Am/Cm Process Facility Remote HEPA Filter Housing - EES designed a remote HEPA filter housing for use in the Am/Cm vitrification facility. The housing accommodates standard High Efficiency Particulate Air (HEPA) filters and allows them to be replaced remotely by mechanical manipulators.

Plutonium Recovery from Heat Sources - EES designed, developed, and delivered custom chucks to hold heat source capsules in the capsule cutter. The cutter had been developed by EES in prior years for other capsule styles. The cessation of operations at the Mound Facility caused their sealed sources to be transferred to SRS for reprocessing. The custom chucks were used in the first step for material recovery.

Outfall Water Monitor Sample Collection - EES designed, prototyped, and developed an improved system for remote sample collection for water monitoring. The improved system uses a vacuum to draw the water sample through a filter. This system is significantly faster than gravity methods used previously, increasing the response time.

FB-Line Furnace Improvement - EES investigated improved insulation for an FB-Line processing furnace. The improved insulation would allow the furnace to reach temperatures of 1000° C to comply with DOE Standard 3013-94 requirements. EES also determined that additional safety features would be required if the furnace insulation were improved. This investigation also demonstrated that the furnace could be used to reprocess materials from Rocky Flats, supporting DOE's efforts to close that site.

Glovebox Window Replacement - EES is investigating methods for replacing glass windows in gloveboxes which are warped, and no longer accommodate flat plate glass. Methods being investigated include improved gasket materials, or a multiple frame and

gasket system. Successful window replacement will preclude the need to replace the gloveboxes.

Filter Housing Designs - EES designed and prototyped filter housings and filters for plutonium processing applications. The filter system is used to remove plutonium particles in a scrap recovery scheme. The EES design features a stainless steel wire mesh filter basket, and a unique sealing arrangement which meets process requirements.

Water Monitor Chamber - EES designed and prototyped an improved chamber for the on-line water monitor. The existing design is inadequate because the water film in the swirl chamber is velocity dependent and cannot be calibrated. The EES developed, custom designed, replacement chamber features a weir to assure repeatable water depth and improved shielding from background radiation.

SRS Excess Facilities and Reactors

Basin Vacuum System - EES produced a modified nozzle assembly for the basin vacuum system. The previous nozzle was subject to plugging and required time-consuming disassembly and cleaning. The EES modification reduced the occurrence of plugging to an acceptable level.

Basin Settler Tank Sludge Sampling Tool - EES initiated conceptual design and a literature search for a variable depth, variable location sampler for the reactor basin settler tank. Experience with variable depth samplers for waste tank use was leveraged to provide concepts to Reactor Engineering.

Uranium Processing Program - EES led the equipment specification and development for the Uranium Processing Project. Highly enriched uranium in existing unirradiated Mk-22 fuel assemblies required volumetric reduction to save transportation and storage costs. EES performed the trade study to determine whether existing equipment from the fuel and target fabrication area would be moved and reused, or if new equipment would be better suited. It was determined that much existing equipment was inadequate, and that the movement of existing equipment was not cost effective.

105-K Fuel Compaction Facility Press - EES performed qualitative testing to evaluate a variety of methods for volumetric reduction of unirradiated highly enriched uranium in Mk-22 fuel assemblies. Specifications were developed for procurement of a flattener/chopper which would produce cut pieces compatible with the specified shipping container.

VTS Trolley System for Basins - EES designed and fabricated load bars for a retrofit to the trolley system for the vertical tube storage (VTS) basin. The load bar is supported between two existing VTS trolleys to allow access to new storage positions which could not be accessed by either existing trolley.

Pipe Decontamination Facility - EES designed and tested a grit blast decontamination system for pipe internal surfaces. The successful decontamination of the pipe reduces the volume of low level waste generated, creating a cost avoidance for waste disposal. The first proposed use of the facility was for decontamination of Mk-22 fuel assembly storage cans.

MK-22 Storage Can Decon System - EES designed and fabricated special tooling to allow the pipe decontamination system to be used with Mk-22 fuel assembly storage

cans. By decontaminating the storage cans, the material can be recycled and low level waste disposal costs can be averted.

Storage/Handling Canister Rx Decon Facility - EES designed a storage and handling canister for the flexible exhaust hoses used with portable HEPA filters in the reactor decontamination facility. The canister enables operators to relocate the ventilation system to the area of interest or package it for storage when it is not desired.

Reactor Basin Fuel Bundle Tool - EES designed a tool to allow access to additional storage positions in new racks installed as part of the effort to increase basin storage capacity. The new tool is offset and counterbalanced to allow the operators to reach positions which cannot be accessed with straight tools due to interference with the catwalks.

Water Monitoring Probe Housing - EES designed a floating platform to deploy instrument probes into areas of the basin which are not adjacent to catwalks. This is part of a larger effort to upgrade basin monitoring.

RBOF Fuel Handling Tool - EES, in cooperation with ORNL, modified and tested a tool designed by ORNL to manipulate fuel from the ORNL High Flux Isotope Reactor (HFIR) which is stored in RBOF. EES determined during mockup tests that the initial tool did not perform as desired and initiated the modifications.

Remote Vessel Resin Sampling System - EES designed, developed, and demonstrated a system for remotely extracting a sample of deionizer resin to determine residual radioactivity prior to burial. Determination of the residual radioactivity is required to properly classify the method of disposal.

Savannah River Technology Center

735-A Remote Calibration Source Transfer - EES designed, fabricated, and demonstrated a method of remotely transferring a high level cesium source from its existing location to a shielded transport container. The source must be moved to a new facility and then reinstalled in a new calibration system. Part of the transfer process will repackage the source in a new holder compatible with the new calibration system. Prior experience with remote tooling for movement of this particular source has been identified as an ALARA good practice.

Brazil Fuel Video System - EES developed, packaged, and delivered a suitcase portable video inspection system for spent nuclear fuel examination. The irradiated fuel is currently stored in Brazil awaiting shipment to SRS. Video inspection was necessary to verify the condition of the fuel is acceptable prior to shipment. The system was successfully used during the in-situ examination.

SRTC Sand Filter Video - EES developed and deployed a low cost camera system to aid in diagnosing the cause of persistent pluggage in the SRTC sand filter sump. The sand filter is the final filtration point before air from contaminated laboratories is exhausted to the atmosphere. The video revealed that the sump was not plugged and highlighted instrumentation difficulties which had created the appearance that the sump was plugged.

Video for Arc Melter - EES designed, developed, delivered and installed two specialized video systems in a glovebox based arc melter. One camera is used to view the melt pool

during operation, while the other is used to position the glass heating arc probes prior to the melter operation. The camera is then withdrawn through a viewing port.

SRTC Conduit Inspection - EES delivered and operated remote video inspection equipment to verify the absence of water in over two hundred feet of four-inch diameter conduit. The inspection was performed within hours of the request. Water intrusion into the conduits had caused damage to electrical cables. The inspection was needed to verify that the replacement cables would not be subject to the same damage.

IWT - Gamma Counter Robot - EES replaced a failed encoder on the low level gamma sample counter robot for IWT. The robot is used to exchange sample vials after ten minute count cycles. The failed encoder prevented robot operation and was replaced with a unit scavenged from excessed equipment. An unrelated controller failure later removed the robot from routine service.

MTS - L-Basin Foreign Fuel Storage Zeolite Filter Test Apparatus - EES designed, fabricated, and delivered experimental equipment to enable the Material Technology Section (MTS) to determine the effectiveness of zeolite filters for containing cesium. The experiments are designed to determine if failed fuel elements, leaking cesium, can be stored in natural convection cooled tubes equipped with zeolite filters. This type of failed fuel containment would replace the existing "harp" design. EES supplied equipment included the test rig, a tilt table, and remote tools.

CHTS - C-154N Glovebox - EES provided installation support to the Chemical and Hydrogen Technology Section (CHTS) for a glovebox used in vitrification studies. The system had been purchased previously; however, installation was incomplete. EES completed the installation, resolved in-leakage difficulties, and expanded the number of service penetrations to support the vitrification studies for DWPF.

ITP/IWT Cells Unit Filter - EES designed and developed a compact cross flow filtration system to determine if backpulsing was a suitable means to extend filter life in the ITP process. The compact system was tested in the High Level Cells (HLC) and found to exceed expectations. Copies have been fabricated and delivered to Hanford and Oak Ridge. Idaho National Engineering Laboratory (INEL) has requested a modified unit, and Russia has requested the design.

CHTS - DC Arc Melter - EES modified a DC Arc Melter, designed by INEL, for use in a glovebox to support vitrification studies of plutonium contaminated soils. The glovebox was also modified to accommodate a hoist, trolley, and rail supports to facilitate lifting the melter top.

HLC - Manipulator Gauntlet Modification - EES is designing an improved manipulator gauntlet to make installation and removal easier. The gauntlet is used to minimize contamination of manipulators. The existing design is difficult to install, and features to allow removal sometimes fail during extended lifetimes. The improved design should remedy these difficulties.

CHTS - Acid Oxidation Support - EES designed and delivered an experimental apparatus to support organic waste destruction process development. The process, if successful, will eliminate organic waste streams, reducing them to water, carbon dioxide, and some nitrous oxides.

CHTS - Doorstop Cart Modification - EES is designing a replacement for the lifting forks on the "doorstop" cart. The "doorstop" is a heavily shielded sample container. The doorstop is lifted with the cart to the entrance hood for the intermediate level cell. The cart forks are contaminated after use. An improved method of doorstop manipulation with reduced contamination potential is being designed.

CHTS - Intermediate Level Cell Modification - EES provided a temporary solution to the problem of corroding electrical outlets in the intermediate cell. The intermediate level cell is used for laboratory work which is too radioactive for glovebox containment, but does not require use of the HLC. EES is designing a permanent solution to the corroding outlet problem which will incorporate remote maintainability.

CHTS - Peanut Vial Tool - EES is developing a remote handling system to remove radioactive sample vials ("peanut vials") from 'doorstop" shielding containers. The existing tong method contributes to increased extremity exposure. An improved method is desired.

CHTS - Gauntlet Press - EES developed and delivered equipment to pre-shape the sealing end of intermediate level cell manipulator gauntlets. The press deformed the sealing end of the gauntlet in a manner to facilitate installation, which reduced the time and radiation exposure required to perform this task.

SRS Tritium

Drop Tester Upgrades - EES designed, developed, and delivered fixtures for the Non Nuclear Reconfiguration (NNR) Drop Tester. Data traceable to NIST through the SRTC Standards Laboratory and Sandia Primary Standards Laboratory has been obtained for pulses in the 2000g and below range.

Hydride Beds - EES designed and fabricated five hydride beds for NNR. The Hydrogen Technology Section provided design input information and will be involved in the testing of the prototype beds.

Stripper System - EES initiated design and procurement of the tritium stripper system for the environmental conditioning rooms. The stripper system will isolate the test room and automatically remove airborne tritium in the unlikely event of a reservoir failure.

Welder Rotation Assist Device - EES designed and fabricated a mechanical assist device to be used during welder rotation in the loading line. Use of the device will eliminate the need for open glovebox maintenance, reducing the time required and improving safety conditions.

Calorimeter Loading System - EES developed a modified tool balancer to assist operators in loading calorimeters. Use of the device improves ergonomics for the operation and averts potential back strain injuries.

Replacement Laser Positioning System - EES designed and installed a replacement laser positioning system. The previous system used custom control equipment and was causing excessive downtime. The EES design used commercially available motion control components similar to those used in robotic applications.

Tritium Unloading Station - EES designed improved equipment for the unloading of shipping containers used in the tritium facilities. A vacuum based system to remove

loose packing material will be provided. Operator ergonomic aids will also be included to position packages in order to avoid back strain injuries. Implementation of these systems will contribute to more efficient and safer operations in the Tritium facilities.

SRS Strategic Programs & New Missions

APT Remote Handling Conceptual Design Support - EES supported the conceptual design process for the Accelerator Production of Tritium (APT). The APT is one of two proposed new sources for tritium. The System Design Description (SDD) for the Maintainability and Remote Handling system was completed. The SDD defines the material handling and remote handling in four separate APT facilities. A trade study was performed to determine the preferred alternative for replacement of highly radioactive spent modules in the Target/Blanket facility. "Area shielding" was determined to be the preferred alternative. This impacts the design of the Target/Blanket facility, and was incorporated into the estimating process.

APT LANSE Area-A Test Equipment Design - EES, along with the Materials Technology Section, designed and fabricated test assemblies for irradiation in the Los Alamos Neutron Scattering Experiment (LANSE) accelerator. The test assemblies will be used to determine the impact of accelerator operation on a variety of materials being considered for use in the APT.

CLWR Remote Handling Conceptual Design Support - EES created the System Design Description (SSD) for the Receiving, Handling and Storage system in the Commercial Light Water Reactor Tritium Extraction Facility (CLWR-TEF). The CLWR is one of two proposed new sources for tritium. In order to ensure tritium requirements will be met, the CLWR-TEF will begin construction prior to the down-select between the two sources. The SSD created by EES defines the processes associated with receipt and storage of the highly radioactive rods. The radiation rates from CLWR rods require that remote handling technology be used.

Pit Manufacturing Program Studies and Work Scope Development

Hemi-Shell Transport Basket - EES produced a conceptual design for a transport basket as part of an interim capabilities maintenance and improvements effort for LANL. The basket would protect hemi-shells as they are transported and stored during the pit manufacturing process at LANL.

Glovebox Tool and Fixture Storage System - EES produced a conceptual design for a tool and fixture storage glovebox as part of an interim capabilities maintenance and improvements effort for LANL. The glovebox would be equipped with a powered horizontal carousel to store hand tools and equipment used in the pit manufacturing process at LANL. The glovebox would be connected to a transport tunnel which services the process line.

Foundry Feed Prep Glovebox - EES produced a conceptual design for a feed preparation glovebox as part of an interim capabilities maintenance and improvements effort for LANL. The glovebox would be equipped with an automated press to crush and also precisely shear raw materials to be used in the pit manufacturing process.

Lag Storage Glovebox - EES produced a conceptual design of a lag storage glovebox for pit production as part of an interim capabilities maintenance and improvement effort for LANL. The system would provide security for components similar to vault

storage; however, it would eliminate the need to remove components from the glovebox line. The design included a robotic system to shuttle hemi-shells (within the hemi-shell transfer baskets) between the glovebox's shielded storage array and the transport tunnel.

Material Transport System - EES designed and prototyped a material transport system for glovebox use. The system featured a passive cart magnetically coupled to a drive system which was located outside of the glovebox for ease of maintenance.

Plutonium Oxide Roast Furnace - EES produced a conceptual design for an oxidation furnace for use with plutonium. The furnace featured a controlled atmosphere for proper oxidation, and features to minimize dusting.

CO2 Cleaning - EES designed and specified equipment for cleaning of metal components. The design features the use of carbon dioxide (CO2) "snow" as the cleaning agent, replacing older ultrasonically agitated solvents. The new process will generate less waste and eliminate mixed waste generation.

Enhanced Surveillance Program SQUID Microscope Automation - EES is assisting LANL in the development of the SQUID microscope by providing high precision positioning systems. The Supercooled Quantum Interference Device (SQUID) is used to detect flaws in materials which are not detectable through a surface examination. The sensitivity of the sensor requires that non-magnetic materials be used in the position system construction. Successful development of a SQUID microscope will enable material examinations of stockpile components to ensure their reliability.

Plutonium Vitrification Can-in-Can Specialty Equipment Development - EES is assisting with the specification and development of specialty equipment for a demonstration project for plutonium vitrification. EES involvement is similar to that on the Am/Cm vitrification program.

Office of Science and Technology

Tanks Focus Area Overview Stereo (OVS) Camera System - EES designed, developed, and delivered to the Hanford site a remote stand alone stereo video system to support tank waste retrieval efforts. The system is deployed through a separate riser into the tank of interest, and provides an overview of other activities, such as Light Duty Utility Arm (LDUA) deployment. The system is rated for Class 1, Division 1 flammable atmospheres, and has been deployed in a radioactive tank.

Tanks Focus Area Portable Overview System (POVS) - EES designed, developed and delivered to the Hanford site a portable version of the remote overview camera systems. The system is rated for Class 1, Division 1 flammable atmospheres, and can be deployed through a four inch riser opening.

Tanks Focus Area High Resolution Stereo Video Systems (HRSVS) - EES designed, developed and delivered several end effectors for the LDUA at Hanford. The HRSVS allows high resolution, predictable size inspection of suspect anomalies, as well as wide angle and telephoto views.

Tanks Focus Area Still Stereo Photography System (SPS) - EES designed, developed and delivered to the Hanford site a LDUA end effector to collect film based stereo documentation of tank interiors. The resolution provided by film based systems is ten

times better than comparable video systems, thus making it better suited for documentation purposes. The SPS shares a common control with the HRSVS.

Tanks Focus Area Optical Alignment Systems (OAS) - EES designed, developed and delivered to the Hanford site a specialized end effector for the LDUA to ensure collision free insertion of the LDUA during initial entry into a waste tank. Laser indicators provide the operator visual cues of concentricity to ensure proper insertion of the LDUA.

Landfill Focus Area Air Jet Vacuum System Soil Excavation Test - EES identified a vendor to provide soil vacuuming as an alternative to excavation of delicate objects, such as degraded waste storage drums. EES designed a test, using soil samples representative of various conditions found at SRS. Difficulties were noted in the manipulation of the vacuum/jet head. The test results provided a basis of comparison for other excavation technologies.

RTDP D&D Swing-Free Crane Installation at TNX - EES coordinated work with Convolve, Inc., and Whiting Services, Inc., to install and test the first swing reducing control system for an AC powered crane. The technology development was sponsored by DOE and NASA. The systems installation at SRTC allowed for thorough testing and evaluation of the control system hardware and software prior to installation in DOE's active facilities.

RTDP D&D Swing-Free Crane Installation at CP-5 - EES coordinated work with Whiting Services, Inc., and Argonne National Laboratory to provide the first installation of a swing reducing control system in an active (non-research) facility. The installation of the swing reducing control system at Chicago Pile 5 (CP-5) will allow loads to be moved more quickly and accurately during decontamination and dismantlement activities at the reactor. This is especially critical during transport of radioactive loads.

RTDP D&D Remote Systems Installation at CP-5 - EES coordinated the modification of the Chicago Pile 5 gantry crane to allow for remote operations. A rotating bottom block (hook) and a radio frequency control system were installed on the crane. The system can now be operated from a remote location, removing the operator from the high radiation fields of the loads to be lifted. In addition, the rotating hook will allow for greater flexibility as the crane delivers robotic manipulators and tooling to the reactor core area for dismantlement.

RTDP Decide Software - EES, in conjunction with JBF Associates, developed a decision making software tool that helps to determine the cost benefit of doing a task using a particular process. By comparing different processes to accomplish a task, the software can aid the decision making processes. The software can be used to compare the risks/rewards of manual and automated methods for accomplishing tasks.

D&D Focus Area SHRED Development - EES developed the System for Highly Radioactive Equipment Dismantlement (SHRED) which is a tool set to work with commercially available robotic manipulators and provide a platform for highly radioactive equipment dismantlement. The tool set includes a reciprocating saw, shears, disk grinder, and gripper, all utilizing quick disconnects. A tool changer rack and linear track base were also developed for the system.

RTDP Plutonium Process, Complex Team Lead - SRTC is the lead laboratory for robotics and automation technology development concerning EM plutonium issues. EES

coordinates a team from four DOE laboratories and interacts with the Plutonium Focus Area to support their missions. Work will continue in FY97.

RTDP Plutonium Container Unpacking System - EES initiated a development effort to automate the opening and unpacking of more than 14,000 plutonium oxide, metal and residue storage cans around the complex. If successful, the system could prevent more than 900 rem of exposure to Pu processing line personnel over the next six years. Work will continue in FY97.

RTDP Remote Drum Liner Opening and Transfer for Mixed Waste Operations - EES, as a member of a complex wide team, began development of a cost effective remote waste drum and liner handling system. EES's role is to develop a remotc liner opening and transfer system. If successful, this system will allow waste to be removed from a non-compliant drum and be transferred into a new drum from a remote location.

RTDP D&D Mobile Autonomous Characterization System - EES provided early development work in support of the Mobile Autonomous Characterization System. This system is capable of navigating a facility and detecting contamination in an autonomous manner. The system was demonstrated successfully at the Chicago Pile 5, as part of the robotics demonstration. This system could provide customers with large cost savings over conventional surveillance and monitoring techniques.

Mixed Waste Focus Area TVS Material Handling - EES, in cooperation with the Material Handling Research Center of Georgia Tech, designed, procured, and installed the material handling systems for the Transportable Vitrification System (TVS). Systems include the feed material handling system for dry bulk materials and the glass handling system for the empty and full containers for the TVS product. The TVS demonstration at Clemson was supported by EES personnel on location. Support to the Oak Ridge operation of the TVS is continuing in FY97.

Tanks Focus Area Waste Tank Sampling Tools - EES designed, developed, and delivered a variety of remote sampling systems which were used to support waste retrieval and tank closure efforts sponsored by the Tanks Focus Area. Sampler details are described by waste tank number in the SRS High Level Waste Management section of this report.

Offsite Customers

Westinghouse Hanford Company Waste Tank Inspection Crawler Consultation - EES was requested by Westinghouse Hanford to provide options and recommendations for using the patented EES wall crawler for inspection of double shelled waste tanks. Hanford had previously invested several million dollars into a commercially developed system which was deemed unsuitable for Hanford's immediate needs. A summary report was issued to Hanford with recommendations for a path forward.

Small Diameter Pipe Crawler Development CRADA - EES continued to further the technology transfer goals of the Department of Energy by participating in the Small Business CRADA program. The conceptual design of a small diameter, long distance pipe crawler was completed, documented and transmitted to the CRADA partner, who had supplied commercial needs and requirements as design inputs. The conceptual design led to an invention disclosure on the crawler propulsion mechanism.

West Valley Nuclear Services Melter Off-Gas Inspection Consultation - EES was requested to provide alternatives for inspecting a potentially plugged off-gas line on the West Valley Nuclear Services (WVNS) melter. EES recommended components which could be used to create a low cost, one time use system for viewing the area of interest from outside the melt cell.

Westinghouse Hanford Company In-Tank Camera System Deployment - EES provided field assistance to the Hanford site in deployment of camera systems supplied in prior FYs as part of the Tanks Focus Area. EES-developed cameras were deployed due to their being rated for Class 1, Division 1 flammable atmospheres. Alternative video systems developed locally at Hanford did not meet these requirements.

Westinghouse Hanford Company In-Tank Camera Systems - EES provided additional units of video systems for use in underground waste tanks to the Hanford site. Hanford first acquired EES designed units as part of the Tanks Focus Area, and desired to have additional units to support waste retrieval efforts at multiple tanks.

Compact Cross Flow Filter - EES designed and developed a compact cross flow filtration system for radioactive service. The system was originally used to determine if backpulsing was a suitable means to extend filter life in the ITP process at SRS. Copies have been fabricated and delivered to Hanford and Oak Ridge. Idaho National Engineering Laboratory (INEL) has requested a modified unit and Russia has requested the design.

INTELLECTUAL PROPERTY CONTRIBUTIONS

Activities in the Robotics and Remote Systems technical area contributed positively to the intellectual property base in SRTC. Listed below is FY96 activity in patent applications, invention disclosures, and copyrights. In addition, three licenses were granted to companies this year (US Patent number 5,473,953, "Device for Inspecting Vessel Surfaces," two licenses; US Patent number 5,398,560, "Apparatus for Inspecting Piping," one license), and one business was formed in Aiken based on SRTC Robotics and Remote Systems Technology.

Patent Applications

SRS-95-0022	Bagless Transfer Method

Invention Disclosures

SRS-96-0014	Linkage Deployment Tool for Tank Ceiling Thermo-couple/Magnet
SRS-96-0017	Snap-in Welding Electrode
SRS-96-0024	Device for Prevention of Cracking in Welding Brittle Alloys
SRS-96-0053	SphincterSeal
SRS-96-0060	Pipe Crawler with Lotus Mechanism
SRS-06-0067	High Temperature Video Camera Housing
SRS-96-0074	CO2 Snow Cleaning System
SRS-96-0075	Magnetically Propelled Cart Using Moving Permanent Magnets
SRS-96-0076	Remote Mechanical Holding Clamp
SRS-96-0086	Remote Hole Sizing Gauge
SRS-96-0095	Cutout Retaining Hole Saw/Hole Cutter

Copyright Submittals

SRS-94-020C	SWAMI Operator Interface Version 1.0
SRS-95-009C	RADMAP Version 2.0
SRS-95-130C	Robotic Torch Control System, Ver. 1
SRS-95-131C	Robotic Torch Control System, Ver. 2
SRS-96-508C	RADMAP Version 3.0
SRS-96-509C	SWAMI II Operator Interface V1.0

HONORS AND AWARDS

During the past fiscal year, activities in the Robotics and Remote Systems technical arena contributed to the internal and external recognition of SRTC. Listed below are some of the more significant awards received.

Federal Laboratory Consortium Southeast Region Award for Wall Crawler

WSRC Vice President's Award for Cells Filter Unit for ITP Studies

WSRC Vice President's Award for Am/Cm Development

Westinghouse GESCO Innovation Award: Device for Inspecting Vessel Surfaces

George Westinghouse Corporate Innovation Award: Device Inspecting Vessel Surfaces

PUBLICATIONS AND PRESENTATIONS

As further evidence of the contribution of the Robotics and Remote Systems technical area to the internal and external recognition of SRTC, listed below are some of the journal articles, publications, presentations, and reports generated and published during the fiscal year.

"Stored Waste Autonomous Mobile Inspector," NASA Technical Briefs, July, 1996, vol. 20, no. 7.

"Visual and Radiological Inspection of a Pipeline Using a Teleoperated Pipe Crawler," RadWaste Magazine, July, 1996, vol. 3, no. 4.

"How robotics will help clean up hazardous waste sites," Industry.Net Report, October 18, 1995, vol. 5, no. 14.

"Pipe Crawler Succeeds in a Big Way," Nuclear News, January, 1996, vol. 29, no. 1.

"A mobile automated system for indoor floor characterization," Service Robot: An International Journal, 1996, vol. 2, no. 1.

"MACS makes maps of contamination," Nuclear Engineering International, June, 1996, vol. 41, no. 503.

"Mobile Robot Radiation Mapping (RADMAP)," NASA Tech Briefs, January, 1996, vol. 20, no. 1.

"The All-Seeing SWAMI," Environmental Protection, August, 1996, vol. 7, no. 8.

"LabWindows Controls Robotics for Radioactive Waste Tank," User Solutions - National Instruments, 1995.

"Robotics and Automation Activities at the Savannah River Site - A Site Report for SUBWOG 39F," WSRC-MS-95-0386, October, 1995.

"Practical Risk-Based Decision Making: Good Decisions Made Efficiently," ORNL report CONF-951135-25 (a.k.a. OSTI DE96003031), November, 1995.

"Overview of Robotics and Remote Systems," LANL/SRS/SNL Tritium Workshop, (Excerpted from WSRC-MS-95-0359 and WSRC-MS-96-0225).

"Robotics & Remote Systems for Explosive Threat & Security Applications," SRS Explosive Threat Conference, (Excerpted from WSRC-MS-95-0359 and WSRC-MS-96-0225).

"SRTC Robotics Site Report," U/MRUG Annual Meeting, WSRC-MS-96-0741, May, 1996.

"Risk-Based Evaluation of Emerging Competing Technologies," AIChE 1996 Spring National Meeting, February, 1996, (Excerpted from ORNL report CONF-951135-25).

"Application of Wall Crawler Technology to DoD Applications," Surface Ships Corrosion Control Conference, June, 1996, (Excerpted from WSRC-MS-95-0115).

PROFESSIONAL SOCIETY ACTIVITIES

Active participation in professional and industrial societies was continued and enhanced during the past fiscal year. This is an important activity to ensure knowledge of current developments and capabilities is maintained. The heaviest participation during the past fiscal year was in the organization with the most applicability to site activities, namely the American Nuclear Society (ANS) Robotics and Remote Systems Division. The following professional society offices and special positions were held.

Professional Society Offices:
Vice Chair/Chair Elect - ANS Robotics & Remote Systems Division
Secretary - ANS Robotics & Remote Systems Division
Executive Committee Member - ANS Robotics & Remote Systems Division

Professional Society Special Positions:
ANS Annual Meeting D&D Panel Member

Professional Society Conference Leadership Participation:
General Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Technical Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Publications Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Publications Co-Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Registration Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Registration Co-Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Exhibition Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Exhibition Co-Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Publicity Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Arrangements Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Student Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
Guest Chair ANS 7th Topical Mtg. on Robotics & Remote Systems
"Autonomous Systems and Mobile Robots" Session Chair
"Robotics for In-Service Inspection" Session Chair
"Remote Handling for Underground Storage Tanks" Session Chair

In addition, SRTC is a corporate member and active participant in the Robotics Industry Association / Robotics for Hazardous Environments (RIA/RHE) Division. Active

participation is also maintained in the Utilities / Manufacturers Robot Users Group (U/MRUG). Individual scientist and engineers also maintain active memberships in their respective professional societies.

Just prior to the beginning of the fiscal year, SRTC members successfully bid to be the host site of the Seventh Topical Meeting on Robotics and Remote Systems to be held in Augusta in April of 1997. There has been overwhelming response to the call for abstracts for this conference. Over 210 abstracts from 12 countries were received. Conference planning is proceeding as of this writing. The conference will be held at the Radisson Riverfront Hotel and Conference Center. A full vendor exhibition will be held at the Augusta-Richmond County Civic Center. A student design competition will be held at the National Science Center's Fort Discovery. Ten SRTC Robotics and Remote Systems technical papers have been accepted by an independent review panel for inclusion in the conference.

SRS PUBLIC RELATIONS

Robotics and Remote Systems continues to positively impact site public relations activities. The robotics laboratory is always a highly requested favorite of offsite visiting groups. In addition, robotics are often requested at offsite functions supported by WSRC. Some of the functions supported by Robotics and Remote Systems during the previous year were:

Science Education Enrichment Day at USC-A

Tech Day at the Civic Center

The 1996 Site Safety Conference

SRS Explosive Threat Conference

DOE "Take Your Child to Work" day

WSI "Take Your Child to Work" day

National Engineers Week Teach-in

CONCLUSION

EES provided Robotics and Remote Systems technology to a variety of customers during FY96. The majority of applications were one of a kind systems to perform tasks which would have been dangerous, difficult, or expensive to perform without remote technology. The EES reputation for cost-effective, high quality systems helped to expand their customer base beyond the borders of SRS to include numerous other DOE customers.

EES contributed to the success of the WSRC mission at SRS. EES provided critical assistance to ensure the successful start-up of DWPF. EES supplied remote tools, samplers, and camera systems to HLW to support the waste processing and tank closure efforts. EES played a key role in the APSF and Am/Cm programs, and continues to support DNFSB 94-1 efforts. EES supported the spent fuel program with specialized tools and remote video equipment. EES also provided specialized equipment to Tritium, assisting them in meeting production requirements.

EES contributed to several DOE programs. The OST Robotic Technology Development Program (RTDP), Tanks Focus Area, Landfill Focus Area, Mixed Waste Focus Area, and

D&D Focus Area were all supported with a variety of Robotics and Remote Systems technology. Additionally, Hanford, West Valley, and LANL all received direct support from EES.

EES will continue in FY97 to support the success of WSRC and DOE. EES will serve the needs of the various site operating divisions, contribute to DOE-wide programs, and support WSRC new mission activities. EES will strive to remain the supplier of choice for Robotics and Remote Systems technology.

ACKNOWLEDGMENT

The authors would like to recognize the 100 engineers, technicians, mechanics, draftsmen, managers and support staff that comprise the Equipment Engineering Section. Although space considerations prevent listing all of these fine people by name, it is their efforts that have made EES the customer's choice for Robotics and Remote Systems technology.