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by

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MASTER

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Savannah River Technology Center Quarterly Report

Oct., Nov., Dec., 1996

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WSRC-TR-96-0100-04

**Savannah River Technology Center
Quarterly Report**

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EXECUTIVE SUMMARY

TRITIUM

- Cleaning, loading and function testing of DEV2 units has begun with approximately 60% of the work completed to-date. Prototype fixtures and heaters have been provided by EES. Fit-up and testing are complete on these items. Acoustic monitoring during the function operations has been conducted. Lifetime testing of the isolation valves used on the cleaning fixture has been completed and indicates a need for periodic cleaning operations.
- Three Acorn function tests have been completed on tritium-filled units. This work successfully demonstrated SRTC's capability to conduct Acorn function tests and demonstrated equivalency to LANL equipment/operations. The results were presented to the Navy.
- A resistance plug weld for fabrication of tritium storage vessels was developed for Los Alamos National Laboratory as part of the program to demonstrate resistance welding technology for fabrication of reservoirs. Fixtures were designed and fabricated for welding samples provided by Los Alamos. Welding conditions and joint design were determined. Mechanical tests and temperature measurements of the final configuration confirmed weld suitability. Test results indicate that resistance welding is an excellent method for assembling these vessels and should meet Los Alamos requirements. Vessels for storage will be welded when components are received from Los Alamos.
- Research conducted on metal hydrides used in tritium processing was presented at the 1996 International Symposium on Metal Hydrogen Systems in Les Diablerets, Switzerland. Drs. J. R. Wermer and J. S. Hölder presented papers on the long-term tritium aging of LANA.75 and the short-term tritium aging of palladium-rich alloys, respectively. Over 280 papers on related subjects were presented at the week long conference.
- An ultrasonic inspection method has been developed for inspection of the fill bore area of LF7 reservoirs fabricated of Type 21-6-9 stainless steel. The method has been applied to the inspection of 103 retired War Reserve LF7 reservoirs. Results of the inspections are being validated by metallography of reservoirs exhibiting ultrasonic indications of interest. Methods for inspection of 1K and 2M reservoirs are under development.
- Provided expertise and equipment to perform proof-of-principle demonstrations of viability of digital radiography/computed tomography to image and evaluate geometry and integrity of pinch welds.
- A literature survey and report, "Literature Survey of Tritiated Waste Characterization and Disposal (U)," WSRC-TR-96-0209, September 6, 1996, has been completed.
- Five secondary container designs for tritium reservoirs have been evaluated for the impact of a temperature excursion to -85°C. So long as service

conditions other than temperature remain normal, the secondary container pressure boundary should remain intact, with no rupture or leakage. However, if the reservoir inside were to leak, in addition to a temperature excursion to -85°C, the pre-load on the closure cap screws for two secondary container designs may be lost, resulting in leakage from the secondary container as well. Further evaluation of these two secondary containers has been recommended.

- Design input for the Commercial Light Water Reactor Tritium Extraction Facility (CLWR-TEF) is being generated by SRTC/CHTS personnel for the Tritium/Product Processing and Process Heating and Cooling (for hydride beds) Systems. These System Design Descriptions were approved September 30, 1996, and met the project milestone.
- SRTC/ADS is providing assistance in the design of analytical chemistry and related functions for the CLWR-TEF program.

SEPARATIONS

- Analysis of FB-Line Ion Exchange Column Venting during Resin Decomposition - The FB-Line Basis for Interim Operations postulates an accident scenario in which the ion exchange column vent lines are open during an overpressure transient. Separations Engineering asked for a calculation of the two-phase vent flow rate during such a transient. A draft report on these calculations has been prepared and is being reviewed.
- Feasibility Study for Direct Reduction of FB-Line Turnings and Sweepings - FB-Line Operations plans to add cabinet sweepings containing magnesium oxide from sand and broken crucibles to future reduction furnace charges. Engineering requested that this could be done safely. A report on the results of experiments and calculations has been issued recommending charges containing sweepings or turnings with up to 250 grams of magnesium oxide can be safely processed in each charge to the reduction furnace.
- Need for Permanganate Strike - The remaining SRS fuel is slated for reprocessing in H-Canyon. The irradiation and expected fission product data for the remaining fuel charges were reviewed and it was determined that a permanganate strike is not recommended.
- Characterization of Solids from Tank 18.3 - Following recent additions of nitric acid to Tank 18.3, the solution accountability samples contained large volumes of solids. The composition of the Tank 18.3 solution was normal. Additional samples will be taken and characterized to determine if tank conditions are now more representative.
- Spectrometer Upgrades - Old Hewlett Packard 8451 diode array spectrometers used for uranium and plutonium analyses are being upgraded including new instruments, controllers and software. Steps needed to complete the upgrade were determined and assignments started.

- Recovery of Am/Cm from Lanthanide Borosilicate Glasses - New glass formulations are currently being developed for the vitrification of the Am/Cm solution. The recoverability of the Am/Cm from the new glasses is a potential concern. Dissolution experiments were performed for three candidate lanthanide borosilicate glass formulations. Preliminary results indicate the recoverability of the Am/Cm, is essentially the same as the baseline glass formulation.
- F-Canyon Safety Support - A safety concern with the Purex process involves rejecting Pu preferentially to the waste without sufficient U to maintain nuclear criticality safety during subsequent operations. Calculations of PUREX operation were made using the best code available. The calculations showed that Pu can be rejected to the waste by increasing the U saturation of the solvent. Detection of high Pu to the waste stream is covered by the concentration check in the product stream and the existing safeguard of checking the 1BP color will also detect loss of Pu to the 1AW.
- F-Canyon Solvent Quality Parameters - A group of solvent quality parameters is measured to establish good solvent quality. For the second Pu solvent, plutonium extraction and strip pickup tests remained good, phase disengaging times fast, interfacial tension (IT) values unchanged, dibutyl phosphate (DBP) content low, and residual alpha activity well below limits.
- First cycle solvent shows quality parameters improving with continued hot operations in first cycle.
- Sand, Slag, and Crucible Processing Flowsheet - Input from Canyon technical and operating personnel, combined with results from flowsheet laboratory studies, has defined a sand, slag, and crucible (S,S,&C) processing flowsheet compatible with canyon operations. Issues addressed during the development program were criticality, dissolver corrosion, ruthenium volatility, boron and aluminum solubilities, and plutonium dissolving rates.
- Dissolution of Plastic Bags for SS&C - The flowsheet for processing of SS&C in F-Canyon requires an acid-soluble bag to replace insoluble PVC and polyethylene. Previous tests selected nylon. Tests are being conducted to measure the gases generated from the dissolution of nylon hot nitric acid, to evaluate thermal stability compared to polyethylene and to measure radiation stability.
- Plans are being made to process stored Mark 16B and Mark 22 fuel through H-Area. Although most iodine in this fuel has decayed, the isotope ^{129}I remains. Calculations were made to determine if iodine retention equipment will be required during processing of this fuel. It was determined that mitigation would be required to meet current release requirements.
- A Diode-Array Spectrophotometer (DAS) was installed as an experimental system to monitor the concentration of Uranium in the

Second Uranium Cycle. As part of restart, the Double Contingency Analysis requires additional uranium measurements and the DAS is the best way to accomplish this. System requirements have been determined including a new spectrometer, computer and software.

- Determination was made on the requirement to use the ruthenium absorber tank during processing in H-Canyon. The irradiation and expected fission product data for the remaining fuel charges were reviewed. Although the use of the ruthenium absorber is not a necessity, its demisting capabilities would add an extra measure of protection against aerosol-borne contaminants.
- The Experimental Thermal Fluids Group has been asked to demonstrate the functionality of the liquid feed system which will be used during the Americium/Curium stabilization project. The system will ultimately be used to supply the Am/Cm solution, currently stored in F-area, to a melter where it will be mixed with molten glass and then cooled to form a stable product. Air-injection and gravity feed methods are used to transport the solution. This demonstration is required in order to address operability concerns associated with elevated temperatures, including the potential for unstable feed rates and excessive evaporation which could lead to a concentrated feed solution. Testing has begun and preliminary results have been used to redesign features of the system in order to reduce the potential for operational problems.
- The Experimental Thermal Fluids (ETF) Group is currently assisting the Defense Waste Processing Technology (DWPT) Section on designing the Am/Cm melter as well as several of the flow systems connected to the melter. Several design drawings for the melter and related hardware were completed, to include the melter, the melter assembly, the melter supporting structure, and the melter drain tube assembly. Appropriate drawings were sent to the fabricator, GAFtech. Work continued on several tests, which will be done in the Thermal Fluids Laboratory. This included fabrication of the test set-ups, completion of necessary documentation, and initial shakedown testing. These tests will study the operability of the liquid-feed system, the drain-tube system, and the frit-feed system.

ENVIRONMENTAL

- The first integrator operable unit (IOU) study was completed and forwarded to EPA, Region IV and SCDHEC at the end of September. The objective of this study is to summarize the existing environmental data from a variety of media (water quality, stream sediment analyses, fish data, etc) and to assess the adequacy of that data to perform an integrated risk analysis of the impact of SRS on the Savannah River. Preliminary analysis of the existing Savannah River data indicate that three constituents of SRS origin exceed risk based human health screening levels. These constituents are: tritium, cesium-137, and strontium-90. Two constituents which exceed health based screening levels appear to be predominantly from other sources. The constituents are: cobalt-60, and mercury. No constituents have been identified as exceeding ecological risk screening levels.

- WSRC used a four-part strategy to coordinate the sampling and analysis of sediments from L Lake and soils from adjacent land areas. The data provided by these studies will be utilized for the preparation of an Environmental Impact Statement (EIS). The EIS evaluates the consequences of discontinuation of river water pumping at the SRS. The work will also provide data for the preparation of a Site Evaluation Report for the L Lake basin.
- Sampling was continuous at the tritium oxide Sampling System Controllers (SSC) for the CIF Tank Farm (TF), Process (PR) and building ventilation (HV) stack discharge locations through mid-September, 1996. The sampling enabled trouble shooting and evaluation of each tritium oxide sampling system at CIF.
- Post startup National Emission Standards for Hazardous Air Pollutants (NESHAP) monitoring was completed for the Saltstone 704-Z stack and the 210-Z stack emission points as required by 40 CFR 61, subparts A and H. The Saltstone Facility NESHAP-Emissions Monitoring report, [WSRC-TR-96-0082], was issued April 19, 1996. The Saltstone facilities were not fully functional during the monitoring period due to an inadequate feed from the ITP. The EPA has requested additional monitoring. WSRC is currently appealing this request
- Post startup NESHAP monitoring was completed during the second quarter 1996 for the Defense Waste Processing Facility (DWPF) 291-S Zone 1 stack and the Low Point Pump Pit stack emission points as required by 40 CFR 61, subpart H. The DWPF NESHAP-Emissions Monitoring report, [WSRC-TR-96-0167], was issued to satisfy the EPA requirement to summarize emission rates of all radionuclides detected during facility startup monitoring. At the time of DWPF startup, the facility was in "sludge only" operations. During this mode of operation a radioactive source term for precipitate operations in the Salt Process Cell (SPC) was not present. The SPC should be operational during December, 1996. WSRC plans to perform additional NESHAP sampling after the SPC is on-line to better estimate atmospheric discharge rates during full DWPF radioactive operations.
- Blackhawk Geometrics completed their time domain electromagnetic (TDEM) and shear wave seismic surveys of A/M Area. The main objects of the survey were to better define the competence of the Crouch Branch Confining Unit and to delineate any preferential contaminant migration pathways. The total conductivity map produced by the TDEM survey correlates well with borehole geophysical logs and shows a low conductivity area to the east and south of A/M Area.
- Drilling of soil borings to collect data for the site-wide geologic map was completed. Over 300 borings were drilled to identify near surface geologic contacts. The map will be overlaid on twelve U.S.G.S. 7.5-minute quadrangle topographic sheets that contain major portions of the Savannah River Site or are adjacent to the boundary.
- Savannah River Site personnel are planning a two- phase program in order to reduce the amount of dissolved chlorinated solvents that are being transported to the McQueen Branch via the wellbore and gravel pack zones of the A/M Area production well system. Six production wells in the A/M

Area are involved in this investigation. During Phase I of the program a commercially available inflatable packer and check valve assembly was installed inside the casing at the altitude of the McQueen Branch Confining Unit. This immediate, short term solution will eliminate the majority of the contaminant mass that is moving downward through the wellbore of the A/M Area production wells.

- Information was provided for the development of remediation technologies within the southern sector of the A/M Area that incorporate Vertical Recirculation Wells. These activities are being developed and implemented to capture and remediate those portions of the dissolved solvent plume delineated by the 500 part per billion trichloroethene isoconcentration contour. Personnel have examined the horizontal and vertical extent of the dissolved plume within the Southern Sector of the A/M Area by incorporating quarterly monitoring well data, depth discrete soil headspace data, physical laws governing groundwater flow and contaminant transport with source history information to develop a three-dimensional representation of the plume. This representation was used with a numerical flow model representative of the hydraulic conditions of the southern sector to develop an optimal remediation system for the southern sector. A final report entitled "Development of a Vertical Recirculation Well System for the A/M Area of the Savannah River Site" has been prepared.
- A numerical flow model of the Crouch Branch (Cretaceous) Aquifer is being developed to assess the extent and amount of contamination from chlorinated solvents present in this aquifer zone. The conceptual model being applied is that those confining zones in the tertiary sediments, become thin and discontinuous within the vicinity of the SRTC complex. These effects result in this area serving as a recharge source zone for the Cretaceous sediments.
- Historical photography has been completed and the scanned browsed imagery have been loaded onto "Falcon" in EMS in preparation of integrating the imagery into the browse module of the Data Atlas. There now exists a good range of digital, historical aerial photographic, browse products for the site over its operational history which can be used in the "desk top environment." These photographic data coupled with the other environmental data bases on line, make it possible for risk assessment activities, both ecological and human, to be accelerated in a timely and more cost effective manner.
- A numerical groundwater flow model for the A/M Area is under development with HydroGeologic, Inc. The model is being developed using Data Fusion techniques, a technology developed by EM-50's Characterization and Monitoring Sensor Technology Program, to incorporate mud fraction data and pump test data in the determination of local hydraulic conductivity. This project will incorporate the Data Fusion Module into the development of a numerical groundwater model for the tertiary sediments
- The Western Sector of the A/M Area addresses subsurface contamination from Dense NonAqueous Phase Liquids (DNAPLs) that were discharged to an unlined basin. Investigators from SRTC and Clemson University are currently examining the extent of DNAPL contamination in the saturated

zone. Currently investigators are incorporating regional hydrostratigraphic data with local cone penetrometer and seismic data to develop a representation of the Green Clay in the suspected NAPL zones. This surface will then be used with a combined technique of particle tracking, hydrostatic force balance, and known NAPL release volumes to develop estimates on distribution of DNAPL along the Green Clay. Preliminary results from the heuristic model indicate that the DNAPL is sitting in a depression in the confining green clay layer just east of the sewage basin. However, these investigations indicate that the current model of the surface of the green clay must be refined before the DNAPL model can be used effectively.

- A comprehensive video describing environmental remediation actions in the A/M Area is being developed to assist researchers, the public, regulators, and other concerned individuals in understanding the source history, previous and current remediation activities, and ongoing innovative remediation plans. The video will highlight the important aspects of the A/M Area remediation program using computer visualization and historical footage.
- SRTC conducted several modeling investigations to support preparation of a Corrective Measures Study and Interim Action Plan for the Burial Ground Complex southwest plume. Three-dimensional EarthVision® maps of tritium and TCE contamination were produced using concentration data and predicted groundwater flow lines. The tritium plume maps and volumetrics calculations show that about 63% of the total activity resides in a <20 foot thick "hot layer" above the "tan clay" confining zone. This activity is contained in about 12% of the volume of the overall plume (>50 pCi/ml). This understanding was used to develop a cost-effective remediation strategy involving depth-discrete, "hot layer" extraction.
- The Radiological Bioconcentration Factors report compiles and summarizes site-specific bioconcentration factors for selected radionuclides released at the Savannah River Site (SRS). A comprehensive search of the literature yielded site-specific bioconcentration factors for cesium, strontium, cobalt, plutonium, americium, curium, and tritium. Unpublished data collected at several SRS impoundments such as Par Pond and L-Lake are also included in this report. For some radionuclides, site-specific bioconcentration factors exceeded those reported in the literature.
- Water and contaminants from the F- and H-Area Seepage Basins (904-41G, 904-42G, 904-43G, 904-44G, 904-45G, 904-46G, and 904-56G) outcrop as shallow groundwater seeps downgradient from the basins. In 1990, 1991, 1993, 1994, and 1995, toxicity tests were performed on water collected from a number of these seeps, as well as from several locations in Fourmile Branch and several uncontaminated reference locations. Toxicity Identification Evaluations (TIE's) performed on representative seeps in 1994 and 1995 indicated that the toxicity at the F-Area seeps was due to aluminum, cadmium, and possibly iron. The toxicity at the H-Area seeps was most likely due to a volatile toxicant. Toxicity investigations conducted on water from Fourmile Branch upstream from all SRS inputs, and on an uncontaminated reference seep indicated that both locations were toxic due to naturally occurring concentrations of iron.

- Vadose zone contamination at the Miscellaneous Chemical Basin (MCB) was characterized using the cone penetrometer (CPT) to support the subsequent installation of a passive soil vapor extraction system (also using the CPT to install 25 remediation wells). BaroBall valve systems were installed on each of the 25 vadose zone wells to enhance natural removal by barometric pumping.
- The SRS Annual Meteorological Report for 1995 has been completed. Summaries of daily, monthly, and annual averages and extremes of each variable are provided in a tabular and graphical form.
- The analyses of critical contaminant pathway study for non-radiological liquid effluents were completed. A WSRC report was drafted and sent for technical review.
- 7Q10 flows have been calculated for each of the six Integrator Operable Units (primary stream watersheds) at SRS. The report, WSRC-RP-96-340, was approved by DOE and issued.
- A nested grid RAMS model of the SRS region was set up and tested for operational forecasting of facility effluent transport.
- Air dispersion modeling of new projected maximum emission rates of hydrochloric acid from remediation units in the vadose zone indicates that ambient concentrations at peak emissions are still likely to be undesirably high. The actual level of emissions will be modeled to confirm that air quality in the vicinity of these units is within legal limits.
- Air dispersion modeling in support of an air permit application for a new diesel air compressor at F Canyon showed that emissions from the new unit will have negligible impacts on air quality.
- Studies addressing the analysis of I-129 in SRS waters by ICPMS continue. The combined results of these studies indicate a minimum detection limit of 1.0 pCi/L. River samples are currently being spiked with I-129 in concentrations greater than 1pCi/L for determination of the effect of sample filtering prior to resin extraction.
- The article, "Plutonium in the Savannah River Site Environment", has been published in the Health Physics Journal (Health Phys. 71(3):290-299; 1996). It will serve as a significant reference for those interested in the effect of SRS operations on the environment.
- The Radiological Assessment Program (RAP) document, Assessment of Activation Products in the Savannah River Site Environment, WSRC-TR-95-0422, has been published.
- In anticipation of a toxicity testing requirement for the relocated A-01 outfall under SRS's new NPDES permit, toxicity tests were conducted. The results indicate that most of the sources are toxic, as well as the new A-01 outfall compliance point. WE-1 is not toxic.
- The final report for Chemicals, Metals, and Pesticides (CMP) arsenic in soil study was issued. A good correlation ($R^2 = 0.703$) was found between

arsenic concentration in bulk soil and clay content for CMP Pits background soils. The conclusion is that the average concentration between the waste site and CMP Pits background samples is the same.

- A cooperative research and development agreement (CRADA) with GeoCleanse International is in place (signed July 11 1996) for a full scale field demonstration of in situ oxidation of a known DNAPL target in an aquifer at SRS. The GeoCleanse Process is based on Fenton's Reaction, using only iron and hydrogen peroxide, and the reaction results in effective destruction of DNAPL components to nontoxic end products such as chloride ion and carbon dioxide. The demonstration will target a layer of DNAPL on the "green clay" near the former M Area Settling Basin where DNAPL has been confirmed.
- A demonstration of the EnviroWall Barrier System was conducted adjacent to the D-Area Coal Pile Runoff Basin (CPRB). The EnviroWall Barrier System utilizes trench and guidebox construction techniques to install high density polyethylene (HDPE) vertical barriers and other materials below grade. In its application at the CPRB, the EnviroWall vertical HDPE barrier has been installed and combined with a groundwater recovery system in the same trench to produce an interceptor well. The Interceptor Well performed essentially as designed.
- SRTC and ERD hosted a one-day workshop at the Savannah River Site for a group of offsite experts in the fields of phytoremediation and decontamination of radioactive materials.
- A laboratory study and SEM analysis have been performed and a cost estimate for a full scale system has been prepared to address the applicability of zero valent iron treatment to the TNX flood plain contamination. This information has been documented in the Permeable Wall Laboratory Study Final Report issued to the Environmental Restoration Department (ERD) on August 6, 1996. The laboratory study demonstrates that zero valent iron can treat the CVOC contaminated groundwater in the TNX flood plain to below the Primary Drinking Water Standards (PDWS), while producing less toxic final degradation products such as ethane, ethene, and methane.
- Laboratory bench-scale testing of four clay cap repair technologies is being conducted by Lawrence Berkley Laboratory (LBL) under the direction of the Environmental Sciences Section (ESS) using lysimeters designed by ESS. The four technologies being tested include use of geosynthetic clay liners (GCL), colloidal silica, polysiloxane, and removal and recompaction. Testing of three of the technologies has been completed and a draft report outlining the work accomplished in FY96 has been prepared.
- A 14-day test of the Airlift Recirculation Well (ARW) technology has been completed. Results from the 14-day test are very encouraging and show that mass removal of CVOCs can be achieved using TVR1 as an airlift recirculation well and is an effective method of introducing dissolved oxygen and other nutrient for bioremediation into the contaminated aquifer.
- A contract was awarded to Terra Vac, Inc. to provide a detailed cost and design analysis of a potential application of the six-phase in-situ soil heating (SPSH) technology at the solvent storage tanks near 321-M. The SPSH

technology was successfully tested at the Integrated Demonstration Site near the M-Area Basin in the fall of 1993. This technology is being investigated as a means of accelerating the current vadose zone clean-up program and as a means of removing residual chlorinated solvents from shallow clays

- Studies were performed to determine the utility of the commercial MAG*SEP and Empore technologies for the quantification of radionuclides in aqueous systems.
- Final laboratory testing of the autosampler for the Field Deployable Tritium Analysis System (FDTAS) was completed by Sampling Systems, Inc., and the unit was delivered to SRS. A device, which will allow for real-time statusing of the autosampler complete with software tailored for the FDTAS, is being developed. A field test of the fully interfaced autosampler and detector is scheduled at SRS for November.
- A group of scientists from the Savannah River Technology Center and Russia successfully completed a 17-day field investigation of a fractured rock aquifer at the MAYAK PA nuclear production facility in Russia. A network of 3 uncased wells was used to conduct the tests. Six packers were installed and inflated in each of the observation wells. A straddle packer assembly was installed in the pumping well to allow testing of each of the individual zones isolated in the observation wells. The test provided new information about the nature of the fractured rock aquifers in the vicinity of the Mishelyak river and will be key information in understanding the behavior of contaminants originating from process wastes discharged to Lake Karachay.
- Depth discrete core sampling was conducted at Kennedy Space Center to determine residual solvent concentrations and to map hydrogeologic strata including the primary aquifer confining unit.
- Using PHOSter, a SRTC Group Patented Technology, the Southeastern Technology Center subcontracted Freeman and Vaughn Inc. to demonstrate the technology at Jimbo's a local abandoned gas station site. The results were so good that the demonstration cleaned up the site nearly 3 months ahead of the scheduled completion time of the demo.
- American Technologies Inc. completed an air injection in the new Subtitle D section of the Columbia County Landfill under the technical direction of the Biotech Group. American Technologies is currently installing a leachate recirculation system in part of the landfill to further enhance the aerobic biodegradation technology patented by SRTC.
- A side-by-side field test of the fiber optic wind vane CRADA prototype and a commercial wind vane indicate good performance characteristics for the measurement of atmospheric turbulence and in low wind-speed conditions. The fiber optic vane performed better under low wind speed conditions when the vane remained responsive.
- The official ETEX meteorological database was received from the European Centre for Medium-Range Weather Forecasts. These data are to be used in the ATMES-II model evaluation study, in which ETS is participating.

- The Acousto-optic tunable filter spectrometer was delivered to Savannah River Site for a series of experiments.

WASTE MANAGEMENT

- C. A. Langton, N. Rajendran, and T. M. Nixon issued a report (WSRC-RP-96-554) documenting bleed water testing for CLSM issued 10/22/96. Bleed water measurements for two Controlled Low-Strength Material (CLSM) mixes were conducted to provide engineering data for the Tank 20F closure activities. The CLSM mixes tested were: CLSM Mix #1 (containing 150 lb/yd³) and CLSM Mix #2 (containing 50 lb/Cu yd³). SRS Currently uses CLSM Mix #2 for various applications.
- J. R. Cook has written an addendum to the E-Area Vaults Performance Assessment that addresses the effect of moving the point of assessment for the groundwater pathway from a hypothetical 100 meter well to Upper Three Runs. The addendum is currently undergoing WSRC-BNFL review and will be submitted to DOE-SR at the end of 11/96.
- R. A. Hane and D. B. Burns are involved in testing of Mercury (Hg) and Particulate Matter (PM) Continuous Emission Monitor Systems (CEMS), which is funded by OTD and in cooperation with, and jointly funded by the EPA Office of Solid Waste prior to the promulgation of new EPA emissions standards which will be based upon the results of these year-long tests. WSRC contracted with the Energy and Environmental Research Corporation (EERC) to perform the testing.
- L. N. Oji has demonstrated reaction conditions for the conversion of large volumes of elemental mercury into its sulfur amalgams (black and red mercuric sulfide forms). This mercury-to-sulfide conversion approach will be useful in waste treatment activities related to handling and storing of radioactively contaminated mercury on site. This work is funded by the Mixed Waste Focus Area as a Quick Win.
- Researchers continue studies associated with closure activities for Tank 20F. Analyses indicated the need for additional treatment of the residue waste prior to closure. Personnel started experiments to examine this pretreatment using samples from the tank.
- Processing of deuterated water in the High Activity Moderator process and in the Technical Purification Facility results in product with excessive mercury levels. Researchers report on investigations to use MAG*SEP materials--developed by Selenctec, Inc.--to remediate this product.
- An enclosed report summarizes recent measurements of solubility for cesium and potassium tetraphenylborate in alkaline solutions. These tests evaluate the influence of temperature as well as the influence of the potassium-to-cesium ratio on the measured soluble concentrations.
- Analyses of samples from Tank 38H and 43H confirm sub-critical conditions persist in the 2H Evaporator system. This information alleviates concern raised by the salt dissolution occurring in Tank 38H due to processing the dilute recycle stream from the Defense Waste Processing

Facility. Plans include continued sample analysis for the next 12 to 16 months to develop a database justifying long-term operations.

- The stream of molten glass pouring from the DWPF melter to a canister sometimes abruptly shifts to the side, an event called wicking. Wicking is undesirable because it causes glass to coat the walls of the pour spout region. Periodically pouring must be stopped to clean the pour spout. The Thermal Fluids Laboratory (TFL) developed optical hardware to identify and record wicking. The hardware is being installed at DWPF.
- We have selected a batch process control algorithm for the version of the ITP model which forms the first element of the parallelized HLW Integrated Flowsheet Model (IFM). We have demonstrated that this algorithm runs two times faster than dynamic batch control, and 30% faster than the previous batch control algorithm in the IFM. As a result, the revised ITP model will easily meet the performance goals of the task.
- Well understood and time tested bubbler-tube technology has been found to be a sufficiently accurate and cost effective method to measure density and liquid-level in radioactive slurry tanks. Unfortunately, in some of the DWPF slurry mixtures, bubbler tubes clog under certain conditions which require removal and cleaning to continue proper operation; this is time consuming and disruptive to the process. As a continuation of a small-scale test done in the Experimental Thermal Fluids Laboratory on redesigned bubbler tubes in 1994, a full-scale test will be conducted at TNX. After two weeks of high temperature testing and three weeks of moderate temperature operation in the SRAT/SME tank, the probes showed good results. Two types of probes were tested: large diameter (2.75" id) and porous jacket (0.62" id). All probes operated satisfactorily during the first week of testing. However, during the following weeks the large diameter probes continued to operate satisfactorily but the porous-jacketed probes began to show elevated air pressures which indicated the onset of pluggage. Because of unplanned down time, testing will continue for several weeks into January before recommendations will be made to DWPF for replacement of the Holledge probes.

GENERAL

- SRTC has provided fiscal year 1996 data input for the DOE complex wide Research and Development (R&D) Tracking Database System. Approximately 50 separate R&D work items were provided. The units of R&D work were based on each SRTC department's portion of the Level 3 Task Description Sheets in the FY96 AOP with information being updated for the complete fiscal year.
- In accordance with the DOE SRS Management Plan for Work Authorization and Control, WSRC provided DOE-SR the FY97 AOP Performance Baseline. The FY97 AOP Performance Baseline provided the summary scope of work, milestones, performance measures, budget and direct FTE resource requirements and Staffing Plan jointly approved and signed by WSRC and DOE-SR Managers.
- Packaging and Transportation (P&T) submitted for review the Onsite Assessment (OSA) for the LR-56S Radioactive Liquid Transfer Package to

DOE/SR on December 20, 1996. The French built LR-56S packaging will be used for the onsite transfer of fissile plutonium solutions from H-area to F-area for stabilization.

PROGRESS AND ACCOMPLISHMENTS

TRITIUM

Acorn Testing Support - D. L. Fish, W. J. Rogier, J. W. Johnson, M. J. King, W. D. Thompson, D. J. Trapp B. S. Bushart, M. J. Pechersky J. W. Dye

Testing of DEV2 (barstock development units) has begun. The primary goals of this testing are: (1) to develop the methodology and technical basis for cleaning, loading, and functioning procedures which will be used in the SRS Tritium facilities for the reservoir handling operations (2) demonstrate the ability to successfully clean and load multiple units simultaneously, and (3) enable qualification of the cleaning system for cleaning of the Prototype units. A technical task plan (WSRC-RP-96-406) and associated QA plan (WSRC-RP-96-407) were completed in support of this work. Procedures were also written for each of the cleaning, loading and function testing operations. A loading manifold was constructed to duplicate the Tritium mini-manifold loading system. System preparations are underway to enable cold function tests to be completed.

Cleaning, loading and function tests of the DEV2 units are well underway on a very aggressive schedule with a goal of completion by 9/30/96. This will enable approximately 1 month for completion of the report necessary for support of SRS Qualification activities. It also supports completion of applicable procedures to support initial loading of Prototype units with Tritium later this year.

**Acorn Function Testing -
D. L. Fish, Y. K. Lutz**

Three tritium-filled 3U units have been function tested. These units were originally shipped from Mound. Additional bottles were supplied by Mound in support of the function tests. The units and associated bottles were assembled in the SRS Tritium facilities. Some modification of former procedures were required prior to the assembly operations. Some additional changes were necessary

during the actual assembly operations due to problems with the assembly fixture and due to scratches observed on one of the sealing surfaces. The three tests were completed on-schedule and supported analysis of the results prior to the Program Review with the Navy in August. LANL personnel were invited to attend all three function tests. B. A. Meyer (LANL) attended the initial test and was provided with the function test raw data on an expedited basis to enable evaluation prior to the program review. LANL conducted four, 3U tritium function tests during this same approximate time period in their recently established function tester. The objectives for conducting these tests at the two labs were to: (1) provide information on the function testing of aged Acorn units, (2) demonstrate equivalency in systems and consistency in results between the function testing systems at the two laboratories and (3) to demonstrate to the Navy that the two labs can effectively serve as each other's backup for function testing of Acorn units.

The initial function test revealed a slightly slower delivery than expected. This was discovered to be due to a very small line restriction which was removed for subsequent tests. Excellent agreement was observed between the results from the two laboratories indicating that the second objective above was met. Effective demonstration of the third objective was provided by successful shipping of the two environmentally conditioned units and the good agreement between the two labs in the test results. A joint presentation of the test results was presented to the Navy at the Program Review in August by B. A. Meyer of LANL and D. L. Fish of SRTC. The presentation was favorably received.

Burst Diaphragm Storage Vessels - W. R. Kanne

A resistance plug weld for fabrication of tritium storage vessels was developed for Los Alamos National Laboratory as part of the program to develop resistance welding technology for fabrication of reservoirs. The two inch diameter plug contains two burst diaphragms. The burst diaphragm plug weld is similar to SRS side bonded reclamation welds (which, at 0.275 inch diameter, are much

smaller) and the defense waste canister closure welds (which, at 5 inch diameter, are much larger). Vessels will be loaded and placed in storage at Los Alamos National Laboratory after fabrication.

Los Alamos provided twelve weld samples representative of the vessel body and the plug. Fixturing for the Los Alamos samples was designed and fabricated. It consists of a copper ring in which the samples (and later the vessel bodies) are hung on a flange surface. This fixturing method prevents the electrical current from going through the vessel body and promotes symmetrical distribution of current during welding. A copper electrode to carry current to the top of the plug was designed and fabricated. The top electrode is contoured to match the sample surface and is centered to contact only the plug without short circuiting to the vessel body.

Development of welding conditions and joint design was completed. Welds were made on test pieces provided by Los Alamos using three different interferences between the plug and flange into which it is sealed. An interference of 0.020 inches was chosen to minimize distortion of the diaphragms installed in the plug while providing full weld strength. A welding current of 65,000 amperes and a force of 12,000 pounds was used for the final development test pieces.

A compression test was used to measure weld strength. A force of 85,000 psi was required to push out the plug of the Los Alamos test pieces. Tests showed that there is little effect on weld strength of the interference between the plug and flange.

Temperature measurements were made by T. R. Smail of EES on the Los Alamos samples. Results showed a peak temperature due to the heat from welding of 105°C in the chamber below the plug and a 200°C peak temperature in the plug approximately 0.5 inch from the weld. These temperatures are well below those which could cause a problem for vessel operation and are below the temperatures expected if the plug were welded with a fusion welding process.

Vessel components for storage are currently being machined at Los Alamos. After welding, the components will be returned to Los Alamos for further assembly, loading with tritium, and for storage.

Tritium Aging of Metal Hydrides Presented at ISMHS 96 - J. S. Hölder, J. R. Wermer

The 1996 International Symposium on Metal Hydrogen Systems, Fundamentals and Applications, (ISMHS 96) was held in Les Diablerets, Switzerland, from 25 to 30 August, 1996. This year's biannual gathering of the international metal hydride community drew over 330 participants with more than 280 scientific papers from university, governmental, and industrial research groups. The European community was well represented, along with Japan, China, Israel, nations of the former Soviet Union, Russia, Canada, and the United States.

The Savannah River Site was represented by Drs. J. R. Wermer and J. S. Hölder, who presented papers on the tritium aging of metal hydrides used in tritium processing applications. Dr. Wermer's paper was titled, "Effects of Long-Term Aging of $\text{LaNi}_{4.25}\text{Al}_{0.75}$ -Tritide Process Beds," and Dr. Hölder's paper was titled, "Short-Term Tritium Aging of Palladium-Rich Alloys." Both papers attracted interest and requests for pre-prints, particularly from scientists in France conducting similar research. University research on metal hydrides, directed and supported by CHTS, was also presented by Prof. Chandra from the University of Nevada-Reno, and Prof. Flanagan from the University of Vermont.

In general, applications are the focus of Japanese researchers, while European researchers tend to emphasize more fundamental investigations. Metal hydride batteries and high density hydrogen storage dominated the papers presented on applications; in this arena, the Chinese are conducting an incredible volume of research on AB₅-type hydrides. A Japanese team is developing technology to use hydrogen as an energy source on an industrial scale. A most interesting development was the use of yttrium

hydride thin films as an optical switch. A book of abstracts was distributed at the conference, and is available in the authors' office for those interested in details.

Bids were considered for ISMHS 98 by the International Steering Committee, and it was decided to award the next conference site to China, although Russia put forward a strong proposal. The U. S. delegation did not feel there was sufficient financial support within industry or government to host the event and did not submit a proposal. It was also thought that since the counterpart to this conference, the Gordon Research Conference on Metal Hydrogen Systems, is always held in the U. S., it is not fair to the rest of the international community for the U. S. to bid on the ISMHS. The site of the ISMHS 2000 will be decided at next year's Gordon Conference in July 1997.

Enhanced Inspection of 21-6-9 Reservoirs -
E. Majzlik, A. Placr
W. Hinz, R. Moore

The objective of this task is to develop and apply advanced ultrasonic inspection methods for inspection of the fill bore area, reclamation weld area and girth weld of LF, K and M type reservoirs manufactured from Type 21-6-9 stainless steel.

To date the fill bore area of 103 retired LF7 War Reserve reservoirs has been inspected. This concludes the initial inspection phase for LF7 reservoirs. The inspection data has been reviewed using the "echo dynamic" criterion and several reservoirs having indications of interest have been identified. Metallography is underway on those reservoirs. The preliminary results of the metallographic examinations and conclusions drawn to-date presented in detail at the Enhanced Surveillance Program Review held September 17 - 19, 1996, at the Los Alamos National Laboratory.

Field application procedures for inspection of the reclamation weld area of LF7 reservoirs are complete and circulating for approval. A total of 35 retired War Reserve reservoirs, 23 of which have been previously inspected in the fill bore area, have been transferred to the inspection facility. Inspection of the

reclamation weld area of these 35 LF7 reservoirs will be completed in October 1996.

Work on fixturing and mock-ups for the fill bore inspection of the 1K and 2M reservoirs is continuing on schedule. Five retired War Reserve reservoirs of both types have been identified for initial field application of the inspection methods. Development of reclamation weld inspection methods for these two reservoir types is continuing.

Requirements and concepts for ultrasonic inspection methods for the cap weld and girth weld of the LF, M and K type reservoirs are being considered. Funding for development of the girth weld inspection method has been requested for FY97 through the Enhanced Surveillance Program.

Digital Radiography/Computed
Tomography of Pinch Welds -
B. D. Howard, R. W. Poland, D. M. Immel,
B. Z. Meers III

All lens-coupled imaging system hardware and software needed to conduct proof-of-principle digital radiography and computed tomography imaging experiments were received and installed. Proof-of-principle digital radiography imaging experiments using a cooled, slow-scanned CCD camera with a 2K x 2K, scientific-grade imaging chip have demonstrated that pinch welds can be satisfactorily imaged and that computer software can be used to evaluate a pinch weld for conformity to Tritium Operation's dimensional acceptance standards; however, lens-coupled imaging components are not particularly suitable for a glovebox application. The principle investigators evaluated flat-panel imaging devices. Two of those devices were assessed and the investigators recommend that these devices be evaluated more thoroughly in FY97. The investigators have also visited Omega International Technology, Incorporated to see a demonstration of its ultra-precise, computed tomography system based on a unique tangential data acquisition method. Further evaluation of this technology should be included in our PCAP activities for FY97. The principle investigators have requested permission to delay issuing the final report with a definitive recommendation until flat panel

imaging devices and the tangential computed tomography system has been fully assessed.

Characterization and Disposal of Tritiated Waste - E. A. Clark

Characterizing, handling, and storing tritiated waste is challenging because of the physical and chemical properties of tritium. Tritium is soluble in and permeates into most materials, therefore, parts exposed to tritium are normally contaminated throughout the bulk, not just on the surface. The relatively low kinetic energy of the β^- decay prevents directly detecting tritium anywhere but very near the surface of materials. Tritium readily exchanges with hydrogen in water vapor, and the resulting tritiated water can permeate into many materials. Most of the tritium contamination in structural metals resides in the surface oxide film and in organic films at the surface, when exposed to tritium at ambient temperature and pressure, whether the exposure is to gas or tritiated water.

The most reliable method of assaying tritium is to dissolve samples in a proper liquid scintillant and use β^- scintillation counting. Other methods that require less time or are non-destructive (such as smear/counting) are significantly less reliable, but they can be used for routine waste characterization if sample dissolution/liquid scintillation counting is regularly employed to benchmark them.

Tritiated materials are decontaminated in numerous ways. Most common are flowing moist air, heating, aqueous detergent and other solvent cleaning. They differ in ability to decontaminate the surface versus the bulk of materials, as well as cost and facilities required. Modern methods, such as plasma cleaning and ultraviolet light/ozone cleaning, show promise to more effectively decontaminate materials.

Tritiated waste storage usually involves segregation by one or more properties including tritium content, tritium offgas rate, material, and source of the waste. Liquid and gaseous tritiated waste is normally converted or fixed to a solid form. Radiolysis can generate significant gas pressure during storage if storage containers are sealed, so either

sufficient free volume must exist in containers or the container must vent whatever radiolytic gases are produced.

The report "Literature Survey of Tritiated Waste Characterization and Disposal (U)," WSRC-TR-96-0209, 6 September 1996, documents this literature survey.

Low Temperature Materials Evaluation of Tritium Reservoir Secondary Container - W. L. Daugherty

Several secondary containers for tritium have been designed for storage at temperatures as low as -60°C . A recent review identified the need for a disciplined review of a temperature excursion to as low as -85°C (the capacity of the refrigeration unit) due to failure of the controls. Accordingly, a materials evaluation of the pressure boundary components for five secondary container designs was conducted to ensure the pressure boundary integrity would be maintained. The secondary containers typically consist of a shell, head, and various components such as valves and a pressure gage. Vendor information identified many of the components as acceptable for the lower temperatures being evaluated. For other components, low temperature material property data (strength, ductility, toughness) was reviewed to evaluate the pressure boundary integrity. Based on this review, the pressure boundary materials (304L and 316 stainless steels, 2024 Al, and copper) are acceptable for service to temperatures of -150°C or less. At such temperatures, the properties relevant to maintaining the pressure boundary are not significantly reduced below room temperature properties. In addition, the specified valves contain a stem tip made of hardened 17-4PH steel. This material is subject to low temperature embrittlement; however a fracture mechanics evaluation of the stem tip concluded that failure was not likely at -85°C .

One potential scenario of breaching the pressure boundary was identified. Two of the secondary container designs specify a torque for the closure capscrews lower than that for the other designs. These two containers will lose most of their closure preload due to differential thermal expansion of the flanges and bolting as the temperature decreases. The remaining preload is not sufficient to maintain

a seal if the tritium reservoir should also leak. In other words, the combined effect of a temperature excursion to -85°C and a reservoir leak would also lead to leakage from the secondary container. Further investigation of this scenario has been recommended -- it can likely be remedied by increasing the specified closure torque for these two designs.

Commercial Light Water Reactor Tritium Extraction Facility Support -

A. S. Poore, J. E. Klein

The Commercial Light Water Reactor (CLWR) Project will establish, by 2003, the production capability and operations systems necessary to produce tritium in a commercial reactor so that tritium can be delivered to the nuclear weapon stockpile by 2005. The Tritium Extraction Facility (CLWR-TEF) project will establish processes, equipment, and facilities for production-scale extraction of tritium which minimize personnel exposure, environmental releases and waste generation, and provide reasonable capital and operating expenses. The CLWR-TEF will have the capability to extract and purify tritium from CLWR targets and all other tritium sources, except the Accelerator Production of Tritium (APT) helium-3 target, at a rate that meets current and projected national defense requirements. The facility will also have the capability to process and deliver "readily recoverable" helium-3 (but not to separate helium-3 and helium-4).

The conceptual design phase of the CLWR-TEF project began on July 1, 1996, and the conceptual design phase report is scheduled for completion in mid-February, 1997. The project is an FY98 line item. SRTC/CHTS is providing technical support in the areas of process development and lead engineering support for the tritium processing systems.

The Tritium/Product Processing Systems in the CLWR-TEF perform elemental and isotopic separation and purification of extracted process gases from the CLWR targets as well as other tritium and/or helium-3 sources. The Tritium/Product Processing Systems also include product and flush gas evacuation systems, tritium recovery systems, and tritium process support areas. The Tritium/Product Processing Systems is divided into the six

systems: Inert Separation, Hydrogen Isotope Separation, Tritium/Product Delivery, Product Processing Support. The Process Heating and Cooling System provides support systems for hydride bed operation.

The design input for the Tritium/Product Processing Systems and the Process Heating and Cooling System has been generated in the form of System Design Description Documents (Section 1.0). They include:

- Inert Separation System
X-SYD-H-0002
- Hydrogen Isotope Separation System
X-SYD-H-0003
- Tritium/Product Delivery System X-SYD-H-0004
- Product and Flush Gas Evacuation Systems
X-SYD-H-0005
- Tritium Recovery Systems
X-SYD-H-0006
- Tritium Processing Support Systems X-SYD-H-0007
- Process Heating and Cooling
X-SYD-H-00011

These System Design Descriptions have been approved to meet the September 30, 1996, milestone date.

Process development opportunities for the CLWR-TEF Tritium/Product processing Systems have been identified. High priority areas include: hydrogen enrichment (making stackable hydrogen), zeolite bed recovery (waste-free water cracking), and passive heating and cooling for all hydride applications (including hydride material selection and bed design to minimize tritium permeation). Process models have been developed during late FY'96, which will impact the preliminary technology baseline selection due in September 1996. Other areas have also been identified as potential candidates for R & D at a lower priority. These process development areas provide some overlap with other Tritium projects.

Analytical Chemistry Design for CLWR-TEF - S. F. Peterson

I began an approximate 6-week assignment to lead the effort to provide System Design Description (SDD) documents for the analytical chemistry, accountability, and health protection functions for the Commercial Light Water Reactor Tritium Extraction Facility (CLWR-TEF) design effort. The SDDs provide conceptual-level functions, requirements, and criteria that must be satisfied by the systems to ensure that the Tritium Extraction Facility is able to fulfill its mission. The deadline for completion of the SDDs is September 30, 1996. The SDDs are used as primary input to the Conceptual Design Report, scheduled for issuance in mid-February, 1997.

The TEF analytical chemistry functions have been partitioned into three SDDs: 1) HP and Radiometric Laboratory System, which provides radiometric counting facilities for analytical chemistry and routine HP support operations, and supports general TEF waste characterization. 2) Mass Spectrometry and Accountability System, which provides measurements of specified process gases within the TEF to meet designated measurement control and accountability requirements. 3) Material and Waste Characterization Laboratory System, consisting of a remotely-operated hot cell and glove box and/or hood and bench space, in which irradiated targets may be characterized (pre or post extraction) for disposal, testing, or verification.

Tritium Support- Kirsten Aylward

EES is providing technical assistance to Tritium on the o-ring certification testing being performed in the Container Management Facility. O-ring material used in the H1616 containers must pass a helium permeation leak test. EES has completed software routines that assist in o-ring testing such as automatic auto tuning of the helium leak detector, and automatic helium clean up of the system. The o-ring software has also been revised to use the final helium standard instead of the initial. Since the test runs for 8 hours, the final standard is more representative of the final steady state leak rate.

Fabrication of loading line support brackets is complete, fabrication of the two Whitey cylinders with brazed RTD's is complete.

EES/SPS has successfully completed the burst test of four life storage secondary containers. The work was requested by Tritium pressure protection to certify the design. Two more containers will be burst tested. The six containers represent 3 different designs. During the test, real time strain gage data was obtained.

Based on a Tritium request, EES is working on an improved tool for removing pins from 993 reservoirs. EES/SPS has delivered about 40% of the requested 3T tube assemblies. Work includes brazing, proof, leak, and oil analysis of the assemblies. EES/SPS has completed the fabrication, assembly and leak testing of 30 test adapters for the H1616-2 shipping containers. The adapters are used during the post load leak test.

Design of the W78 and W76 laser unloading fixtures for the Function Test Facility are complete. Fabrication is in progress. Design of the internal bell jar piping is in progress.

EES has completed the assembly and testing of a boroscope inspection system in 723-A. The system is ready for field installation as soon as Tritium Production is ready. The system includes an optics bench, motor driven positioner, fixturing, boroscope and camera equipment.

EES delivered 11 new cryo fingers to Tritium Operations on 11/11/96 after passing radiography, proof, and leak testing. The original batch fabricated by an offsite vendor failed to meet requirements. —

EES provided a new brazing fixture and technical support to Tritium Operations in support of hydroburst operations. Using the new fixture and optimized power and time settings, operators were able to braze a high pressure fitting over the existing reservoir tubes only 0.152 inches in length. This was a significant technical issue since Los Alamos would not allow Tritium to weld a new reclamation stem into the reservoir. Once the high pressure fitting is brazed on, it can be attached to the hydroburst system for burst testing.

EES completed software upgrades to the automatic leak detectors (ALD). This modification was requested by DOE during a routine audit. The new software will allow the system engineer to print out a summary report of all runs for several months. If any system errors occurs, a detailed error message will be written to the file. The new software has been installed on both ALD systems, meeting a 11/1/96 commitment to DOE.

Temporary rack mounting of the environmental conditioning DACS is complete. Software development is underway. The EES designed system will control the operation of the drop tester and centrifuge. In addition, it will capture accelerometer data from drop tester, centrifuge and vibration table. The hardware includes a 120 MHz industrial pentium, high speed digitizers, Neff data acquisition hardware, a storage scope, filters and a custom designed control chassis.

Fabrication, proof and leak testing of the hydride beds for sample assay is complete. The beds will be delivered to HTS for developmental testing. A first stage compressor bed, second stage compressor bed, and a storage bed will be delivered.

Mounting and assembly of the Kanne instrumentation is continuing for the environmental conditioning rooms. Fabrication of the stripper piping skids is 90% complete. Design of the stripper blower skid is complete. Fabrication is expected to begin the first week of December. Fabrication of the Kanne chambers and stripper beds is 85% complete.

Labview software development for the FTS DACS has begun. A mockup of all of the computer related hardware is complete for the FTS DACS, FTS control system, and the SAVB control system.

EES provided laser unloading hardware to Lumonics in support of the new FTS laser system. The hardware is being used during functional acceptance test at the vendor.

Work on upgrades to the MRAD drop tester is continuing. Physical modifications to the large mouse trap is complete. Tritium has completed the Temp Mod paper work which will provide

temporary services to the drop tester. EES purchased and set up an instrument air compressor, after cooler, and relief devices for use during the testing. A draft procedure for drop tester operation is routing for comment. EES received the new carriage from MRAD and is in the process of performing quality inspection. All accelerometers, test equipment and high speed video is ready for testing as soon as the Temp Mods are completed by Bechtel Construction.

Tritium Construction released the FTS/SAVB relay chassis' to EES for modifications that will match the hardware to the latest Bechtel Design electrical schematics. The relay chassis' contain over 200 interlock circuits.

In support of D2 leak testing in CMF, EES has ordered two D2 standards. The new standards combined with software changes, will allow Tritium to perform automatic D2 leak testing.

SEPARATIONS

Separations Support - Jim Wong

EES was requested by HB-Line to provide testing on a portable gamma spectroscopy system. Testing of the system and computer is complete. The system has been demonstrated to the customer.

EES was requested by Separations Engineering to develop a design to perform Pu casting in the furnace in FB-Line by modifying the casting chamber and insulation. Design and fabrication of the chamber and insulation is complete and testing of the unit was performed at an independent lab in Rock Hill, SC. Two styles of insulation were tested with successful results on both. The next step will be field installation and a hot run in FB-Line.

Scintillators on H-Area alpha water monitor systems experience permanent deformation due to pressure/ temperature effects, thus imposing a requirement for weekly calibration checks and periodic replacement. EES developed and performed mockup testing of an alternate scintillator design that reduces permanent deformation and resists dynamic deformation from pressure surges in the process line that may cause spurious count rate meter alarms. Field measurements of process conditions in F-Area were taken this week to correlate results from mockup testing. The final report recommendations will include changing the scintillator base material to acrylic and to investigate modification of the water monitor system equipment components.

Actinide Packaging & Storage Facility (APSF) - Jim Wong

EES completed network based calorimetry software for the accountability/measurement (A/M) system and began software testing. EES has started development of the A/M multiplicity counter software. Work continues on the gantry gripper/fixtures. The calorimeter and lag storage mockups are complete.

EES has received the Lumonics laser engraving system and tested the chiller system. EES visited the Westinghouse fuel assembly operation in Columbia, SC to evaluate their

scanning technology for potential application to the APSF program. The laser safety enclosure construction has been completed.

EES obtained the first digital radiography (DR) images. The DR mass storage system has been received. Computer topography testing continues in 723-A. DR system control software development is ongoing.

EES completed the acoustic gas analysis final report and closed the activity.

EES recently developed a suite of new concepts which may be employed in the Actinide Packaging and Storage Facility for IAEA remote monitoring. Authentication of the accountability measurements area equipment, the automatic guided vehicle equipment, the vault portal, and complimentary systems for each item are all required for continuity of knowledge and authenticated accountability information. The key concepts were presented to IAEA during their recent visit. It was acknowledged that this is the most ambitious effort ever attempted in support of remote monitoring. No formalized agreement can be obtained at this time; however, it was stated that if the system can be proven, inspections may be reduced from 26 times/year to once/year. An effort is currently underway to establish a full mockup in Building 305-A to gain some acceptance prior to actual facility operation.

EES design package #3 was reviewed by the Am/Cm project team, and comments have been incorporated in the design drawings. The package is forecast to be issued for construction during the last week of November. This design package includes details of the solution feed system, on-rack tubing runs, on-rack cabling, canister handling/ storage, and electrical cabinet assemblies.

EES (along with ATS) is also leading the design effort on the melter film cooler. The film cooler will be used to sufficiently cool the melter offgas to ensure that particles do not adhere to the surfaces of the offgas line. Several film cooler configurations are being investigated.

EES also supported the successful restart of melter #1 at TNX. Working with T&PC, EES provided the design and installation for the melter control system and the monitoring instrumentation on the system cooling water.

EES was requested by Separations Engineering to perform testing on a replacement for the Bartex probe in HBL. The Bartex probe is a liquid level measuring probe used in the scrap recovery product hold tanks. EES performed troubleshooting of the Bartex and performed qualification testing for a replacement transducer.

Analysis of FB-Line Ion Exchange Column Venting during Resin Decomposition - J. E. Laurinat

The FB-Line Basis for Interim Operations (BIO) postulates an accident scenario in which the ion exchange column vent lines are open during an overpressure transient. Separations Engineering asked for a calculation of the two-phase vent flow rate during such a transient.

The FB-Line anion exchange columns remove plutonium from nitric acid solutions by adsorbing plutonium nitrate on a styrene-based resin. If flow to one of these columns were interrupted, the column temperature would rise due to radiolytic heating and heating from the adsorption reaction and an acid-resin decomposition reaction. This heat would selectively drive off water from the acid solution, eventually leaving an azeotropic acid solution with an atmospheric boiling point of about 121°C. Additional heating would then result in a rapid rate of vapor generation from boiling of the nitric acid and oxidation of the resin. The gases produced could cause a pressure excursion that would rupture the column. The objective of the calculation is to determine if the column vent lines are sufficiently large to relieve the pressure in the column before the column ruptures.

Transient two-phase flow calculations have been performed to determine vent flow rates during a postulated runaway resin decomposition. These calculations use pressure and temperature transients based on a series of vent tests and accelerating rate calorimetry (ARC) measurements conducted

about ten years ago by the du Pont Engineering Test Center. The thermodynamic and stoichiometric reaction parameters are derived from accelerating rate calorimetry (ARC) measurements and the reaction rates estimated from the rate of pressure increase for unvented or minimally vented heated pressure vessel tests. The reaction transients are combined with a homogeneous two-phase (gas-liquid) model of flow through the vent lines. The two-phase flow model is benchmarked with steam-water choked flow measurements.

A draft report on these calculations has been prepared and is being reviewed.

Feasibility Study for Direct Reduction of FB-Line Turnings and Sweepings - J. E. Laurinat

FB-Line Operations plans to add cabinet sweepings and turnings to future reduction furnace charges. A principal component of the cabinet sweepings and turnings is magnesium oxide from sand and broken crucibles. Operations wishes to verify that this magnesium oxide will not adversely affect the operation of the reduction furnace or reduce the plutonium button yield.

Magnesium vapor generated from magnesium oxide could potentially affect operation of the furnace by causing an overpressure transient or by attacking the copper gasket at the top of the reduction chamber. Also, the addition of magnesium oxide could hinder the separation of the plutonium button from the slag and thereby reduce the yield by either raising the melting temperature of the slag or by lowering the heat of reaction for the reduction reaction.

To address the FB-Line Operations concerns, experiments were planned to measure the melting temperatures of calcium fluoride-calcium oxide-magnesium oxide mixtures and to determine the extent of the reaction between magnesium oxide and copper gasket material. The results of these experiments were to be combined with heat balance and mass transfer rate calculations to determine if the reduction furnace can safely and effectively process charges containing sweepings or turnings.

Schenectady Materials and Processes Lab was contracted to measure the melting points of four different mixtures of calcium fluoride, calcium oxide, and magnesium oxide, the principal slag components. Subsequently, these measurements were replicated by J. W. Congdon of MTS. These measurements showed that the addition of magnesium oxide would lower the melting temperature of the slag. Thermodynamic equilibrium and heat transfer calculations showed that the presence of magnesium oxide would lower the final temperature after reduction but not sufficiently to reduce the temperature below the melting point. Therefore, the addition of sweepings or turnings would not hinder the separation of the slag from the button.

To determine if magnesium vapor would attack the copper gasket, D. G. Karraker heated a sample of the gasket with magnesium metal to 950°C under an argon atmosphere for one hour. Vapor from the magnesium metal reacted with the surface of the gasket to form a compound (probably Cu_2Mg) which melted. About a quarter of the gasket material was attacked in this manner. A mass transfer calculation showed that natural convection in the vapor space between the gasket material and the magnesium metal could account for the rate of loss of copper during this experiment. A similar calculation demonstrated that the loss of copper during a reduction run would be much lower due to the lower temperatures and lower magnesium vapor pressures in the reduction chamber.

The possibility of a pressure excursion due to generation of magnesium vapor was ruled out because any vapor generated from the slag would condense on the walls of the crucible and reduction chamber. Heat transfer calculations showed that these wall temperatures would be significantly lower than the slag temperature after reduction.

A report on the results of these experiments and calculations has been issued. This report recommends that charges containing sweepings or turnings with up to 250 grams of magnesium oxide can be safely processed in the FB-Line reduction furnace.

Characterization of Solids from Tank 18.3 - J. H. Gray and K. J. Kalbaugh

Following recent additions of nitric acid to Tank 18.3 for volume adjustment, the solution accountability samples contained large volumes of solids. Previous analyses of similar solids found a high plutonium and corrosion product content whenever the volume of solids was high. Samples of these solids have been sent to SRTC for characterization.

The composition of the Tank 18.3 solution was normal. Both boron and plutonium contents are at expected levels and quantities of other solution impurities, including zirconium, are at low levels.

The expected high plutonium content was 215 x 15⁻⁶ grams in the solids collected from a 10 ml solution sample. The iron, chromium, and nickel corrosion product content was also high. No boron was present in the solids.

Two other results were unexpected. The Pu-238/Pu-239 alpha ratio was the same in both solids and solution. Previous alpha PHA analysis of similar solids found the solids and liquids to have different Pu-238/Pu-239 alpha ratios. In addition, zirconium was the most abundant element in the solids.

Additional samples will be taken and characterized to determine if tank conditions are now more representative.

Need for Permanganate Strike - M. E. Hodges

The remaining SRS fuel is slated for reprocessing in H-Canyon. Canyon personnel requested that we determine whether a permanganate strike is required.

The irradiation and expected fission product data for the remaining fuel charges were reviewed. Based on a maximum expected activity of 3.24×10^{10} , most of which is from ^{137}Cs , it was determined that a permanganate strike is not recommended for this material.

Spectrometer Upgrades - L. C. Baylor, R. R. Livingston

Old Hewlett Packard 8451 diode array spectrometers used for uranium and plutonium analyses are being upgraded to the newer HP 8452A models. This upgrade includes new instruments, controllers and software.

A meeting was held with F and H-Area personnel to determine steps needed to complete the installation of the F-Area Laboratories systems and to bring all systems, including the one in HB-Line, under the same software package. Assignments were made and are being carried out. As a first step, SRTC delivered record copies of the HB-Line software to F-Area for storage.

Recovery of Am/Cm from Lanthanide Borosilicate Glasses - T. S. Rudisill, C. R. Arbaugh, and I. A. Reamer

New glass formulations are currently being developed for the vitrification of the Am/Cm solution stored in F-Canyon. This change is being made to address processability concerns as a result of the pilot-scale melter failure at TNX. With changes in the glass formulation, the recoverability of the Am/Cm from the new glasses is a potential concern. To address this concern, an experiment was performed to determine the dissolution behavior of surrogate glasses.

Dissolution experiments were performed for three candidate lanthanide borosilicate glass formulations proposed for Am/Cm vitrification. Preliminary results indicate the recoverability of the Am/Cm, as measured by the recovery of the lanthanide elements from the surrogate glasses as a function of time, is essentially the same as the baseline glass formulation. The experiments were performed by initially grinding the glasses to obtain a -40 to +60 mesh particle size. A 0.25 gram sample of each glass was placed in 6 Teflon vessels. Following addition of a 10 ml aliquot of 8M nitric acid, each vessel was sealed and placed in an oven at 110°C. A vessel containing a sample of each glass was then removed at 0.25, 0.5, 1, 2, 4, and 8 hours. The contents of the vessel were transferred to a 200 ml volumetric flask which was diluted to volume with deionized water. Samples were analyzed for the elemental components of the glasses by ICP-ES.

F-Canyon Safety Support - N. M. Askew and M. C. Thompson

A request was received from Tom Reilly of Criticality and Safety to make calculations showing the maximum plutonium enrichment which could be obtained in the aqueous waste (1AW) during PUREX solvent extraction operations as a result of inadvertent operation outside the Technical Standard limits. The proposed scenario involves rejecting Pu preferentially to the waste without sufficient U to maintain nuclear criticality safety during subsequent evaporation and acid stripping operations.

Calculations of PUREX operation were made using the SEPHIS-MOD4 computer code which is not a validated code according to the E7 manual. However, Hsu showed that the code can reproduce U and Pu concentrations in product streams and in stages in mini-mixer-settler tests within 1 %. The code predicted lower than observed concentrations of U and Pu in the waste under the conditions of complete recovery. This is the best code available

Calculations were made varying Pu concentration in the feed, extractant flow rates, and scrub acid concentrations. The calculations showed that Pu can be rejected to the waste by increasing the U saturation of the solvent. The maximum ratio of Pu to U in the waste did not exceed 0.6 when significant quantities of Pu were rejected to the waste stream. Higher Pu/U ratios were observed when the Pu losses to waste were less than 1 %.

Rejection of a high percent of the Pu to the high level waste stream will result in a corresponding lowering of the Pu concentration in the Pu product stream (1BP). The existing safeguard of checking the 1BP color to detect possible Pu reflux in the partitioning mixer settler (1B bank) will also detect loss of Pu to the 1AW.

F-Canyon Solvent Quality Parameters - J. H. Gray, K. N. Forrest, K. J. Kalbaugh

Measurement of aqueous/organic phase disengaging times is now included with the

group of solvent quality parameters measured to establish good solvent quality. This requirement became necessary when solids were found during recent hot operations in first uranium cycle 14.7 solvent. With the possibility of an adverse impact on second plutonium cycle solvent quality, the measurement of phase disengaging times has been added for Tank 906 material.

Any impact on second plutonium cycle solvent was never observed. Plutonium extraction and strip pickup tests remained good, phase disengaging times fast, interfacial tension (IT) values unchanged, dibutyl phosphate (DBP) content low, and residual alpha activity well below limits.

The presence of solids in first cycle solvent has occurred only once. Following flushing of affected vessels, solids have never reappeared. One possible explanation for these solids was legacy material from a first cycle vessel released by an as yet unexplained mechanism.

The two solvent quality parameters adversely affected by the presence of solids were IT and phase disengaging times. The IT valves dropped below 3 dynes/cm and phase separation needed extended periods. The other solvent quality parameters, plutonium extraction and stripping, residual alpha activity, and DBP content, never changed.

Recent measurements of IT and disengaging times for 14.7 solvent show these solvent quality parameters are improving with continued hot operations in first cycle. The IT values are now over 4 dynes/cm and disengaging times close to normal, back in the 20-40 second range.

Sand, Slag, and Crucible Processing
Flowsheet - J. H. Gray, R. A. L. Eubanks
and M. R. Price (SE), K. N. Forrest

Input from Canyon technical and operating personnel, combined with results from flowsheet laboratory studies, has defined a sand, slag, and crucible (S,S,&C) processing flowsheet compatible with canyon operations. Issues addressed during the development program were criticality, dissolver corrosion,

ruthenium volatility, boron and aluminum solubilities, and plutonium dissolving rates.

Operating constraints affecting flowsheet processing conditions included a maximum plutonium solution concentration of 1.9 grams/liter, a minimum boron concentration of two grams/liter, a maximum dissolver temperature of 95°C, and a minimum aluminum to fluoride ratio of three. In order to comply with these constraints, sand fines will be separated from slag chunks, assayed, and processed separately. Dissolver charges may include batches of fines only and/or one or two slag charges following the dissolution of fines.

The initial dissolver solution will contain 9.3 molar nitric acid, 0.013 molar fluoride (as KF), and 3 grams boron per liter. Aluminum nitrate will be used to complex fluoride during slag dissolution and before any solution is transferred from the dissolvers.

Dissolution of Plastic Bags for SS&C - R. A. Pierce

An alternate flowsheet is being studied which will permit the processing of sand, slag, and crucible (SS&C) in F-Canyon instead of FB-Line. As part of the development, studies are being conducted with acid-soluble bag materials which might replace insoluble PVC and polyethylene. Previous test selected nylon from among 14 candidate materials and conducted a wide range of tests.

Testing was conducted this week to measure the gases generated from the dissolution of nylon in hot 45% nitric acid, and to evaluate the thermal stability of nylon compared to polyethylene. A separate set of tests being conducted by J. E. Laurinat will measure nylon's radiation stability and the offgases generated from radiolytic degradation.

Thermal stability was tested by J. W. Congdon (MTS) using Thermal Gravimetric Analysis (TGA). Two samples were heated, nylon and polyethylene (from current FB-Line bag), to 300°C at a heat rate of 2°C/min. Small amounts of weight loss from the nylon occurred at 150°C with significant losses beginning at 200°C. Similarly, polyethylene showed initial weight loss at 200°C with

significant weight losses beginning to occur at 220°C.

A second experiment was conducted to identify the gases, if any, which are generated when the nylon is dissolved in hot nitric acid. The test was run in 45 wt.% nitric acid at 95-100°C with 6.25 g/L nylon (compared to the expected concentration of 0.07 g/L) to insure that any effects could be observed. The gas above the vessel was air. The nylon dissolved in a few minutes and was allowed to digest for 45 minutes. No gassing in the solution was observed. A gas sample was pulled for analysis using GC/MS which has an sensitivity of 0.25 volume percent. Analysis of the gas showed no ammonia or gaseous organic products; only nitrogen and oxygen were observed which is consistent with the air initially present in the vessel head space. This result is not surprising because research with other oxidation systems has shown that nitric acid under the above test conditions is not sufficiently strong to induce significant, if any, oxidation of plastics.

Support of H-Area Restart - M. L. Hyder

Plans are being made to process stored Mark 16B and Mark 22 fuel through H-Area. Although short-lived iodine in this fuel has long since decayed, the isotope ^{129}I (half life $>10^7$ years) remains. SRTC was asked to determine whether it would be necessary to operate iodine retention equipment during processing of this fuel.

The amount of iodine remaining in unprocessed fuel was calculated. Using prior calculations of the effective dose equivalent at the site boundary from an iodine release via the H area stack, it was determined that mitigation of the iodine releases would be required to meet current release requirements. This information was transmitted to plant technical personnel.

On-Line Uranium Measurement for H-Canyon 2nd U Cycle - R. R. Livingston

Around 1988 ADS installed a Diode-Array Spectrophotometer (DAS) as an experimental system to monitor the concentration of Uranium in the H-Canyon Second Uranium

Cycle and tested this system briefly during the final runs of the second uranium cycle. As part of H-Canyon restart, the Double Contingency Analysis indicates a requirement for additional measurements for Second Uranium Cycle operation. This measurement requirement can be satisfied by lab measurements or an online system.

A DAS system walk down was completed on 11/5/96 to determine status of the experimental system and requirements for returning the DAS to operational status. An estimate was generated to support canyon restart planning that includes replacing the spectrometer and computer with new components, improving software, completing software QA, developing procedures, and issuing controlled prints. The goal for completion of the DAS upgrade is 4/1/97.

Need for Ruthenium Absorber Vessel - M. E. Hodges

The remaining SRS fuel is slated for reprocessing in H-Canyon. Canyon personnel requested that we determine whether it is necessary to use the ruthenium absorber tank during processing.

The irradiation and expected fission product data for the remaining fuel charges were reviewed. Only about 5.8 grams (19600 Ci) of ^{106}Ru remain in the combined material. Since no permanganate strike will be needed for Zr-Nb decontamination, the ruthenium volatility associated with the permanganate strike will not be a problem. Although the use of the ruthenium absorber is not a necessity, its demisting capabilities would add an extra measure of protection against aerosol-borne contaminants. A letter is being issued that documents these findings.

Demonstration of the Am/Cm Liquid Feed System - S. T. Hargett and M. R. Duignan

Initial tests of the system showed that, at elevated solution temperatures or elevated air-injection rates, excessive liquid was carried into the vent system. A new air-liquid separator was designed, fabricated, and

installed on the test rig. Preliminary tests of the new separator indicate that it is effective in eliminating liquid carry-over into the vent line. The tests were also used to identify a problem with an in-line filter. During testing, a particle became lodged in the orifice which is used to control the feed rate into the melter, resulting in a no-flow condition from the feed line. Subsequently, it was determined that a particle of about the same size as the orifice diameter could pass through the filter. The filter was originally adequate as-designed, but a change in the required feed rate had necessitated changing to a smaller orifice diameter. The filter will be redesigned to capture smaller particles such that the likelihood of plugging the orifice is reduced, while not adversely affecting the feed rate through the filter.

The test rig is currently being modified to account for configuration changes which were made to the system design since testing first began. Testing of the feed stability will continue using a simulant solution once modifications are complete. Tests to quantify the rate of liquid-loss through the vent line, due to evaporation, are also planned.

Americium/Curium Stabilization Project
Support - M. R. Duignan, T. J. Steeper, S. T. Hargett, D. J. Adamson

To support the design of Melter 2A and to give direction to the fabricator, the necessary drawings were made, reviewed, and distributed. Melter 2A drawings have been completed and forwarded to the fabricator. Concurrently, several support hardware pieces will be made on site. The melter support structure, the heated nozzle and its support structure, have all been designed, drawn, and sent for fabrication on site. Of the planned supporting tests: the melter-feed stability test began and then was stopped to make improvements to the operation and to make customer-requested scope changes, the construction of the 17.3-tank to melter-feed test setup was almost completed and partial shakedown testing indicated no major operational problems, the long term frit-feed test was restarted to evaluate the new, larger size, glass frit, and construction began on the drain-tube heater cycle test apparatus so that testing can commence next month.

ENVIRONMENTAL

The Savannah River Integrator Operable Unit Study - C. E. Murphy, D. C. Eargle, G. P. Friday

The first integrator operable unit (IOU) study was completed and forwarded to EPA, Region IV and SCDHEC at the end of September. A briefing of the results of the study was given to the regulators on October 8th. The objective of this study is to summarize the existing environmental data from a variety of media (water quality, stream sediment analyses, fish data, etc) and to assess the adequacy of that data to perform an integrated risk analysis of the impact of SRS on the Savannah River. For this purpose, preliminary screening and evaluation of risks was performed and is presented in this report.

The study is based on the observation that the primary pathway for contamination to move from waste sites to points of exposure for offsite human or ecological receptors is through groundwater migration and discharge to surface water in streams and wetlands. Thus the Integrator Operable Unit (IOU) Program focuses on the impact of waste sites and operating facilities on the streams and the Savannah River. The streams are referred to as Integrator Operable Units because they represent the integration of potential risk from all of the waste sites and facilities (operable units) that will contribute contamination to them.

The Savannah River Integrator Operable Unit Study has been prepared as part of the Integrated Operable Unit (IOU) program. A series of data evaluation reports for each on-site stream and the Savannah River will be prepared as part of the IOU program. This report is the first in that series.

Preliminary analysis of the existing Savannah River data indicate that three constituents of SRS origin exceed risk based human health screening levels. These constituents are:

tritium,
cesium-137, and
strontium-90.

Two constituents which exceed health based screening levels appear to be predominantly from other sources. The constituents are:

cobalt-60, and
mercury.

No constituents have been identified as exceeding ecological risk screening levels. The preliminary analysis indicates that human health risk for each of the identified carcinogenic constituents falls within the risk range of 10⁻⁴ and 10⁻⁶.

L Lake Commitment - D. L. Dunn

WSRC used a four-part strategy to coordinate the sampling and analysis of sediments from L Lake and soils from adjacent land areas. The data provided by these studies will be utilized for the preparation of an Environmental Impact Statement (EIS). The EIS evaluates the consequences of discontinuation of river water pumping at the SRS. The work will also provide data for the preparation of a Site Evaluation Report for the L Lake basin. The status of each phase is described below.

Phase 1: The first phase (sampling completed June 1996) involved the sampling of surface sediments (0-1 ft depth) in submerged portions of the L Lake basin and sampling surface soils in reference (background) locations at two depths (0-1 ft and 1-4 ft depth intervals). Sampling locations in the L Lake basin were chosen based on soil type, history of contamination and types of disturbance. Dominant soil groupings within the basin and several sites that were suspected to have been used for disposal of contaminated vegetation and sediment were sampled. The analysis plan specified analyses for Target Analyte List (TAL) metals (excluding cyanide), gross alpha, nonvolatile beta, gamma pulse height analysis, plutonium-alpha series, and the uranium-alpha series. A statistical evaluation based on the unvalidated inorganic, nonradiological constituents and radiological results reported as of September 9, 1996 was summarized in a draft technical report [WSRC-TR-96-0263].

Phase 2: Deep core sediment sampling in the second phase emphasized the investigation of ash disposal areas in the submerged portions of

the L Lake basin. The ash disposal areas are believed to be the result of the burning of clean vegetation that was subsequently buried under clean soil immediately adjacent to the burning site. Samples were collected at 23 locations within L Lake between August 8 and August 22, 1996. The analysis plan specified analyses for Target Analyte List (TAL) metals (excluding cyanide), gross alpha, nonvolatile beta, gamma pulse height analysis, plutonium-alpha series, and the uranium-alpha series.

Phase 3: Gamma-emitting radionuclides of L Lake were examined in situ with an underwater High Purity Germanium (HPGe) detector and further studied by retrieving various sediment samples for analyses by very low background HPGe gamma spectrometry. The predominant man-made radionuclide detected was cesium-137. The L Lake cesium-137 activity was found to be primarily located within the submerged Steel Creek floodplain.

Phase 4: The 'Waterways Explorer', a fully equipped research vessel operated by the Waterways Experiment Station (WES), was deployed at the L Lake by WES personnel during June 1996. A subbottom hydro-acoustic survey of L Lake was conducted by WES in an effort to locate submerged burial pits within the L Lake basin. Acoustic impedance measurements resolved from the seismic reflection data are directly related to identification of sediment interfaces and characterization of the subbottom sediments.

Consolidated Incineration Facility Tritium Oxide Monitoring - D. L. Dunn

Sampling was continuous at the tritium oxide Sampling System Controllers (SSC) for the CIF Tank Farm (TF), Process (PR) and building ventilation (HV) stack discharge locations through mid-September, 1996. No tritium oxide analyses were scheduled. The sampling enabled trouble shooting and evaluation of each tritium oxide sampling system at CIF. Collection Canister Module (CCM) software upgrades were made to provide summary records for the collection period and to make the CCM protocol compatible with all current versions of the SSC.

A baseline summary report, Monitoring Tritium Effluents At The Savannah River Site Consolidated Incineration Facility (WSRC-TR-96-0333) was issued to describe the development and deployment of the tritium oxide SSC at CIF. The summary documented baseline sampling that occurred during February, March, April, and September, 1996. Per the request of CIF Operations, all work in support of tritium oxide sampling was suspended during early October. The dedicated sampling equipment described in the report was inventoried and stored in a manner that will enable quick redeployment should the decision be made to resume tritium oxide sampling, analyses, and reporting.

NESHAP-Radionuclide Emission Monitoring at Saltstone - D. L. Dunn

Post startup National Emission Standards for Hazardous Air Pollutants (NESHAP) monitoring was completed for the Saltstone 704-Z stack and the 210-Z stack emission points as required by 40 CFR 61, subparts A and H. The NESHAP test was completed on March 25, 1996 in accordance with the Environmental Protection Agency (EPA) approved sampling and analysis protocol.

The Saltstone Facility NESHAP-Emissions Monitoring report, [WSRC-TR-96-0082], was issued April 19, 1996. The Saltstone facilities were not fully functional during the monitoring period due to an inadequate feed from the ITP. The EPA has requested additional monitoring for a two-month period when the Saltstone facilities are fully operational. WSRC is currently appealing this request and is recommending a shorter sampling period to summarize emission rates of all radionuclides detected during routine and fully operational Saltstone radiological operations.

NESHAP-Radionuclide Emission Monitoring at DWPF - D. L. Dunn

Post startup NESHAP monitoring was completed during the second quarter 1996 for the Defense Waste Processing Facility (DWPF) 291-S Zone 1 stack and the Low Point Pump Pit stack emission points as required by 40 CFR 61, subpart H.

The DWPF NESHAP-Emissions Monitoring report, [WSRC-TR-96-0167], was issued to satisfy the EPA requirement to summarize emission rates of all radionuclides detected during facility startup monitoring.

At the time of DWPF startup, the facility was in "sludge only" operations. During this mode of operation a radioactive source term for precipitate operations in the Salt Process Cell (SPC) was not present. The SPC should be operational during December, 1996. WSRC plans to perform additional NESHAP sampling after the SPC is on-line to better estimate atmospheric discharge rates during full DWPF radioactive operations.

Time Domain Electromagnetic and Shear Wave Seismic Survey of A/M Area -

**M. E. Denham, C. A. Eddy-Dilek,
R. Van Pelt**

Blackhawk Geometrics completed their time domain electromagnetic (TDEM) and shear wave seismic surveys of A/M Area. The main objects of the survey were to better define the competence of the Crouch Branch Confining Unit and to delineate any preferential contaminant migration pathways. The total conductivity map produced by the TDEM survey correlates well with borehole geophysical logs and shows a low conductivity area to the east and south of A/M Area. The preliminary interpretation is that this represents an area where the Crouch Branch Confining Unit is sandier either because of erosion of the clays or facies changes. The shear wave seismic data is not definitive, but is consistent with the TDEM interpretation. The final report will address these issues.

Site-wide Geologic Map-M. E. Denham

Drilling of soil borings to collect data for the site-wide geologic map was completed. Over 300 borings were drilled to identify near surface geologic contacts. This provides the maximum control for any geologic map of the SRS to date. The map will be overlaid on twelve U.S.G.S. 7.5-minute quadrangle topographic sheets that contain major portions of the Savannah River Site or are adjacent to the boundary. These will be available as South Carolina Geological Survey Open-file reports

and on the site Geographical Information Systems.

Modifications to the A/M Area Production Wells - D. G. Jackson, B. B. Looney, B. Beavers, M. Jones, T. F. Kmetz, R. S. Van Pelt, J. J. Kuper D. G. Wells, H. Campbell,

Savannah River Site personnel are planning a two- phase program in order to reduce the amount of dissolved chlorinated solvents that are being transported to the McQueen Branch via the wellbore and gravel pack zones of the A/M Area production well system. Six production wells in the A/M Area are involved in this investigation. During Phase I of the program a commercially available inflatable packer and check valve assembly was installed inside the casing at the altitude of the McQueen Branch Confining Unit in wells 905-20A and 905-53A. This immediate, short term solution will eliminate the majority of the contaminant mass that is moving downward through the wellbore of the A/M Area production wells. During the packer installation process several pre- and post- installation testing activities were completed to aid SRS investigators in understanding the dynamics of the flow conditions and effectiveness of the installed assembly.

Vertical Recirculation Well System for the Southern Sector of the A/M-Area - D. G. Jackson, B. B. Looney, R. S. Van Pelt

Information was provided for the development of remediation technologies within the southern sector of the A/M Area that incorporate Vertical Recirculation Wells. These activities are being developed and implemented to capture and remediate those portions of the dissolved solvent plume delineated by the 500 part per billion trichloroethene isoconcentration contour. In order to design and develop an effective remediation system, it was necessary to develop an understanding of the highly three-dimensional distribution of the dissolved plume within Southern Sector of the A/M Area. Personnel have examined the horizontal and vertical extent of the dissolved plume within the Southern Sector of the A/M Area by incorporating quarterly monitoring well data, depth discrete soil headspace data, physical laws governing groundwater flow and

contaminant transport with source history information to develop a three-dimensional representation of the plume. This representation was used with a numerical flow model representative of the hydraulic conditions of the southern sector to develop an optimal remediation system for the southern sector. Due to the relatively low concentrations of dissolved solvent in the southern sector and the large plume size, optimum southern sector cleanup should incorporate carefully located wells screened vertically within the flow path trajectory to optimize the volume of contaminant removed. The numerical model developed is based upon the previously developed fully three-dimensional model of the A/M Area and incorporates the results of recent aquifer tests and field studies within the southern sector. A final report entitled "Development of a Vertical Recirculation Well System for the A/M Area of the Savannah River Site" has been prepared and is currently being reviewed for release.

Development of a Cretaceous Model for the A/M Area - D. G. Jackson
R. S. Van Pelt

A numerical flow model of the Crouch Branch (Cretaceous) Aquifer is being developed to assess the extent and amount of contamination from chlorinated solvents present in this aquifer zone. The conceptual model being applied is that those confining zones in the tertiary sediments, the Green Clay and the "Upper" and "Lower" Clays of the Crouch Branch Confining Unit, become thin and discontinuous within the vicinity of the SRTC complex. These effects result in this area serving as a recharge source zone for the Cretaceous sediments which results in a locally strong downward gradient from the Tertiary to the Cretaceous sediments. Characterization data obtained during the modifications to the A/M Area production well system are being incorporated into the model development.

Remote Sensing Photographic Milestone Completed- H. E. Mackey

Historical photography has been completed and the scanned browsed imagery have been loaded onto "Falcon" in EMS in preparation of integrating the imagery into the browse module

of the Data Atlas. These data can be made available site-wide to anyone interested in doing a quick history of any location on the SRS; for example, waste site histories, landuse/land cover changes to support biodiversity studies and resource management, watershed changes over time, etc.. Nine hundred twenty-nine files (929) (photographs) were scanned at low resolution (70 to 100 dots per inch), geo-referenced, and loaded onto the SRS computer system. There now exists a good range of digital, historical aerial photographic, browse products for the site over its operational history which can be used in the "desk top environment." This is a significant step forward in supporting site-wide programs, such as waste site closure activities in a cost effective and efficient manner. Now for the first time, the history of any location (i.e., any waste unit on SRS) can at least be given a browse level review for pre-SRS conditions, an overview of operational history and changes, location of activities, period of use and operation, etc. These photographic data coupled with the other environmental data bases on line, make it possible for risk assessment activities, both ecological and human, to be accelerated in a timely and more cost effective manner.

Development of a Fully Three Dimensional Groundwater Flow Model for the A/M Area using Data Fusion - D. G. Jackson, R. S. Van Pelt

A numerical groundwater flow model for the A/M Area is under development with HydroGeologic, Inc. The model is being developed using Data Fusion techniques, a technology developed by EM-50's Characterization and Monitoring Sensor Technology Program, to incorporate mud fraction data and pump test data in the determination of local hydraulic conductivity. Application of this state-of-the-art technology aids in the refinement and calibration of groundwater flow models. A model developed and calibrated using the data fusion technique provides investigators with a superior distribution of the parameters that effect groundwater flow over conventional modeling techniques. This project will incorporate the Data Fusion Module into the development of a numerical groundwater model for the tertiary

sediments (principally the M-Area and Lost Lake Aquifer Zones) of the A/M Area.

The model has been developed and calibrated to the steady-state groundwater levels for 4Q95 based upon the available monitoring wells within the domain. The hydraulic conductivity field that the model incorporates will be determined using the data fusion algorithms to minimize the residuals of the estimated hydraulic conditions. Inputs to the data fusion algorithm include hydraulic conductivities derived from mud fraction data, aquifer pump tests, and laboratory permeability tests, along with quarterly monitoring well data.

Western Sector: A Heuristic DNAPL Model for Estimating the Extent and Thickness of DNAPL on the Green Clay Confining Zone - Tamra Payne, D. G. Jackson, B. B. Looney R. S. Van Pelt

The Western Sector of the A/M Area addresses subsurface contamination from Dense NonAqueous Phase Liquids (DNAPLs) that were discharged to an unlined basin. These contaminants serve as a long-term source zone for groundwater contamination in the A/M Area. Investigators from SRTC and Clemson University are currently examining the extent of DNAPL contamination in the saturated zone. The migration and distribution of DNAPL beneath the water table will be controlled by the finer grained sediments, the Green Clay Confining Zone. Thus an understanding of the topology of the Green Clay is important in the characterization and prediction of DNAPL migration. Currently investigators are incorporating regional hydrostratigraphic data with local cone penetrometer and seismic data to develop a representation of the Green Clay in the suspected NAPL zones. This surface will then be used with a combined technique of particle tracking, hydrostatic force balance, and known NAPL release volumes to develop estimates on distribution of DNAPL along the Green Clay. The numerical tools to perform this analysis have been developed and are being tested and verified for simple geometries. Once the method is validated for the simple geometries, it will be applied to the geometry of the Green Clay. Preliminary results from the heuristic model indicate that the DNAPL is sitting in a depression in the confining green

clay layer just east of the sewage basin. However, these investigations indicate that the current model of the surface of the green clay must be refined before the DNAPL model can be used effectively. A report describing the migration of DNAPL along the surface of the Green Clay is currently being developed.

Initial Summary of Remote Sensing Data for the Savannah River Site, An Inventory, WSRC-RP-96-468 - H. E. Mackey, Jr., R. S. Riley

The Savannah River Site (SRS) has a rich history of remote sensing data and activities. Since its formation in the early 1950's, remote sensing data have been used to evaluate the natural resources of the SRS and to assist with the monitoring and understanding of the environmental effects of operations. From the very initial phases of the plant site, vertical aerial photography was used by the US Forest Service to plan and manage the timber resources on the SRS. Therefore, photography is available on a repeated bases of every few years from the 1950's until currently in 1996. Documentation of the plant facilities and operations is included in this photography. Numerous other over flights have been conducted, both by other programs, such as the National High Altitude Program, but also by the extensive over flights of the Remote Sensing Laboratory (RSL) operated for DOE/NV, Las Vegas, Nevada. Other documentation of past operations has been in the form of low altitude oblique photography and video acquisitions principally by RSL. These data frequently are utilized in public relation items, presentations, or other support activities such as training. Low altitude aerial gamma over flights, especially with repeated over flights at every 5 to 10 years after 1974, provide valuable information on the areas of low-level contamination of man-made radioactive on the SRS and represent a reasonable alternative for surveying large areas effectively and efficiently. More recently specialized airborne remote sensing scanners (Multispectral Scanners (MSS)) provide coverage and/or studies of areas of special interest, such as evaluation of the effects of thermal releases to the wetlands of the SRS. Satellite data (SPOT and Thematic Mapper Landsat most commonly) provide large scale

synoptic views of the site as with landuse/landcover mapping, not easily obtained with ground based surveys. As data have accumulated and technologies advanced, much of the remote sensing data are now becoming available in digital format in easy to use Geographic Information Systems (GIS), instead of manual or hardcopy format. As the site moves to more emphases on remediation activities, these historical data bases will become a portion of the baseline for waste site characterization and evaluation to permit faster and more efficient cleanup, closure, and monitoring of the SRS to occur in the future.

Video Presentation of the A/M Area Environmental Remediation Activities

**D. G. Jackson, B. B. Looney ,
R. S. Van Pelt, C. L. Bergren,
E. L. Funderburk**

A comprehensive video describing environmental remediation actions in the A/M Area is being developed to assist researchers, the public, regulators, and other concerned individuals in understanding the source history, previous and current remediation activities, and ongoing innovative remediation plans. The video will highlight the important aspects of the A/M Area remediation program using computer visualization and historical footage. A preliminary storyboard has been developed that highlights the following subjects: Background and Information on A/M Area, Purpose of the A/M Area, Subsurface Contaminants, Hydrostratigraphy, Application of Sectors as a Management Tool, and Cost Effective/Innovative Characterization Techniques. Video Services has provided historical footage that is currently being reviewed for applicability. Historical footage has been gathered and will be screened and incorporated with animated results from recent modeling activities in the A/M Area.

Modeling support for Corrective Measures Study and Interim Action Plan; Southwest Plume - Burial Ground Complex - G. Flach, M. Harris

SRTC conducted several modeling investigations to support preparation of a Corrective Measures Study and Interim Action Plan for the Burial Ground Complex southwest

plume. Three-dimensional EarthVision® maps of tritium and TCE contamination were produced using concentration data and predicted groundwater flow lines. The tritium plume maps and volumetrics calculations show that about 63% of the total activity resides in a <20 foot thick "hot layer" above the "tan clay" confining zone. This activity is contained in about 12% of the volume of the overall plume (>50 pCi/ml). This understanding was used to develop a cost-effective remediation strategy involving depth-discrete, "hot layer" extraction.

Various remedial scenarios were designed to provide data for an economic analysis of alternatives, and then analyzed to determine their effectiveness in reducing future tritium discharges to surface water. The technologies considered fall into four categories: no action, vertical barriers, pump-treat-reinject, and vertical recirculation wells (VOC treatment). Future tritium releases to Fourmile Branch can be reduced by roughly 50% by employing technologies carefully targeted to address the hot layer and installed immediately upgradient of the F-area effluent ditch seep line.

Radiological Bioconcentration Factors for Aquatic, Terrestrial, and Wetland Ecosystems at the Savannah River Site

**G. P. Friday, C. L. Cummins,
A. L. Schwartzman**

The Radiological Bioconcentration Factors report compiles and summarizes site-specific bioconcentration factors for selected radionuclides released at the Savannah River Site (SRS). A comprehensive search of the literature yielded site-specific bioconcentration factors for cesium, strontium, cobalt, plutonium, americium, curium, and tritium. These seven radionuclides have been the primary radionuclides studied at SRS because of their long half-lives or because they are major contributors to radiological dose from exposure. Unpublished data collected at several SRS impoundments such as Par Pond and L-Lake are also included in this report. For some radionuclides, site-specific bioconcentration factors exceeded those reported in the literature. This report also summarizes some conditions that affect radionuclide bioavailability and bioconcentration for aquatic and terrestrial organisms.

Toxicity Investigations in the Vicinity of the F/H Seepline - W. L. Specht

Water and contaminants from the F- and H-Area Seepage Basins (904-41G, 904-42G, 904-43G, 904-44G, 904-45G, 904-46G, and 904-56G) outcrop as shallow groundwater seeps downgradient from the basins. In 1990, 1991, 1993, 1994, and 1995, toxicity tests were performed on water collected from a number of these seeps, as well as from several locations in Fourmile Branch and several uncontaminated reference locations. In all, water from 21 locations was tested. The results of the toxicity tests indicated that most of the seeps were toxic to some extent, but that water from Fourmile Branch in the vicinity of the F/H seeps was usually not toxic. The toxicity of the seeps appeared to be variable, probably due to dilution by rainfall. Most of the reference locations were also toxic, but usually were less toxic than the F/H seeps. Toxicity Identification Evaluations (TIE's) performed on representative seeps in 1994 and 1995 indicated that the toxicity at the F-Area seeps was due to aluminum, cadmium, and possibly iron. The toxicity at the H-Area seeps was most likely due to a volatile toxicant, but the specific toxicant could not be identified because the toxicity disappeared midway through the TIE. Toxicity investigations conducted on water from Fourmile Branch upstream from all SRS inputs, and on an uncontaminated reference seep indicated that both locations were toxic due to naturally occurring concentrations of iron.

Characterization and Remedial System Installation at the Miscellaneous Chemical Basin - J. Rossabi, B. D. Riha, B. E. Pemberton, R. S. Van Pelt

Vadose zone contamination at the Miscellaneous Chemical Basin (MCB) was characterized using the cone penetrometer (CPT) to support the subsequent installation of a passive soil vapor extraction system (also using the CPT to install 25 remediation wells). The entire characterization and remediation installation effort was completed in three weeks. BaroBall valve systems were installed on each of the 25 vadose zone wells to enhance natural removal by barometric pumping.

Baseline subsurface concentration data were collected in the form of depth-discrete gas and soil samples. Pressure, flow, and concentration data will be monitored through the coming fiscal year to determine contaminant removal rates and cost data on the remediation system.

D Area Oil Seepage Basin - J. Radway, E. Becker, C. J. Berry, K. H. Lombard, T. C. Hazen

The D Area Oil Seepage Basin (DOSB) was a site used for disposal of waste oil and chlorinated solvents from 1952 to 1975. Results indicate that soil gas and downgradient groundwater samples contain measurable levels of chlorinated solvents, and that active microbial degradation of contaminants is already occurring at the DOSB. Baseline data are being collected in order to optimize the bioremediation of the basin. It is expected that the injection of air and nutrients will stimulate these naturally occurring processes and accelerate remediation of the site. This site will utilize gaseous injection of nutrients via the PHOSter™ process.

Southern Sector Bioremediation ERD Support - R. L. Brigmon

The Southern Sector Bioremediation effort is an assessment of the intrinsic bioremediation and phytoremediation of select chlorinated hydrocarbons in the Southern Sector of the A/M-Area. A subsurface plume of trichloroethylene (TCE), and tetrachloroethylene (PCE) is predicted to impact the area in the next 15 years. Analysis of samples from selected sites within the impact zone are presently underway. Preliminary TCE biological treatability studies of the A/M Area Southern Sector are being combined with microbiological and chemical analysis. Results show that certain sites have endogenous bacteria in the soil which can degrade TCE within 6 weeks from a concentration of 20 ppm to 50 ppb. This appears to be a combination of aerobic and anaerobic degradation. In addition, the soil in this area has shown to have a microbial population of methanotrophic bacteria which utilize the enzyme methane monooxygenase (MMO) that can cometabolize TCE. Presently the installation of piezometers is planned to

monitor methane levels in the rhizosphere or root area of the soils. This specific activity is related to methane analysis as it applies to quantifying the activity level of TCE degrading bacteria in the Southern Sector. These studies will help determine the rate at which endogenous microbes in the soil will degrade TCE as the plume moves. This work will allow design of a phytoremediation system incorporating the natural occurring microorganisms for complete degradation of these groundwater contaminants with minimum cost and environmental impact. This natural or intrinsic bioremediation will reduce the TCE before allowing contaminant break through to surface waters at Tims Branch Creek in the sector.

108-4R Basin Groundwater ERD Support -
F. A. Washburn, D. J. Altman, C. J. Berry

In support of ERD the Biotechnology Group is looking at the feasibility of bioremediation at the 108-4R overflow basin. The 108-4R Overflow Basin is an unlined basin that was used to contain overflow from the diesel storage sumps in R-Area. Past operating practices allowed diesel storage tanks to be filled daily. Temperature changes over the course of a day would cause the tanks to overflow and spill into a sump. The sump was then subsequently pump to the overflow basin. Wells were drilled and developed in this area for further characterization of the soil and groundwater. The Biotech Group responded to an immediate ERD need for handling of investigation derived waste. The Biotech Group moved a 2,500 gal tank to 108-4R to collect water from the new well development. This water was found to be clean and discharged at the site. A study of to determine the effectiveness of bioremediation on the sediment has also been initiated. Sediment concentrations of Total Petroleum Hydrocarbons in the basin are extremely high. ESS's Biotechnology group has sampled the sediment and water in the basin. Bioremediation treatability studies are in progress. The current remedial philosophy is to test biosparging in a soil pile contained in the basin proper.

1995 Annual Meteorological Report
C. H. Hunter and C. P. Tatum

The SRS Annual Meteorological Report for 1995 has been completed.

The SRS Annual Meteorological Report for 1995 summarizes data collected during the year for temperature, precipitation, relative humidity, wind speed and direction, barometric pressure and solar radiation. Summaries of daily, monthly, and annual averages and extremes of each variable are provided in a tabular and graphical form. Comparisons to long-term climatology are also provided, where appropriate. Copies of this report can be obtained from C. H. Hunter, Building 773-A.

Critical Contaminant/Pathway -K. Chen

The analyses of critical contaminant pathway study for non-radiological liquid effluents were completed. The historical records measured by Environmental Monitoring Department from 1989 to 1995 were used for source-term calculations. A WSRC report was drafted and sent for technical review.

The health risks for an individual exposed to contaminants released from SRS outfalls from 1989 to 1995, through various exposure pathways were estimated. The exposure pathways studied are ingestion of drinking water, ingestion of contaminated fish and dermal contact with contaminants in water while swimming. The estimated total exposure cancer risks vary from 3.0×10^{-6} to 1.0×10^{-5} . The estimated total exposure chronic noncancer hazard indices vary from 6.0×10^{-2} to 1.0×10^{-2} . The critical contaminants were ranked based on their cancer risks and chronic noncarcinogenic hazard quotients. For cancer risks, the critical contaminants released from SRS outfalls are arsenic, tetrachloroethylene, and benzene. For chronic noncarcinogenic risks, the critical contaminants released from SRS outfalls are cadmium, arsenic, silver, chromium, mercury, selenium, nitrate, manganese, zinc, nickel, uranium, barium, copper, tetrachloroethylene, cyanide, and phenol. The critical pathways in decreasing risk order are ingestion of contaminated fish, ingestion of drinking water, and dermal contact with contaminants in water while swimming. The results will serve as the rationale bases and

design criteria for the SRS Environmental Monitoring Program.

7Q10 Flow for Integrator Operable Units - K. Chen

7Q10 flows have been calculated for each of the six Integrator Operable Units (primary stream watersheds) at SRS. The report, WSRC-RP-96-340, was approved by DOE and issued. The 7Q10 flow is the lowest average flows for seven consecutive days that has an average recurrence interval of 10 years. To help prioritize and manage the SRS Emergency Response program, ETS was requested to predict these flows based on historical records.

Operational Use of RAMS for Southeastern Region - D. P. Griggs

A nested grid RAMS model of the SRS region was set up and tested for operational forecasting of facility effluent transport.

The RAMS prognostic atmospheric model and the LPDM particle model have been run for a regional-scale domain centered on SRS and extending out more than 400 km in each direction. The RAMS nested grid capability is being used to provide more detail near the site, where a grid spacing of about 1.7 km is used. A 48-hour forecast was performed starting at 8:00 a.m. EDT on September 15, 1996, followed by a simulation of effluent transport and diffusion using the LPDM lagrangian particle model. This retrospective analysis showed that any airborne effluents released on September 15, 1996, would have been transported off the Site toward the north.

M-Area Remediation Units - J. Stewart

Air dispersion modeling of new projected maximum emission rates of hydrochloric acid from remediation units in the vadose zone indicates that ambient concentrations at peak emissions are still likely to be undesirably high.

Additional modeling support was provided in support of Environmental Restoration Engineering. Increases are being considered to the emissions of hydrochloric acid, trichloroethylene and perchloroethylene being released from the vadose zone remediation

units in M Area. Higher emission rates for these pollutants would allow SRS to expedite the remediation of the contaminated areas. Modifications to the current air permits would be necessary. Environmental Restoration Engineering has requested that ETS model modified projected levels of releases from the M-Area remediation units so that the impacts on air quality in the work place can be evaluated. ETS has now modeled a second set of projected emissions from the remediation units with "background" emissions from over 200 other sources onsite added in. The results show that the concentration levels of HCl in the vicinity of several of the M-Area units would still be sufficiently high to warrant reevaluation of the proposed emission levels with a view to selecting still smaller increases. Meanwhile, the actual levels of emissions will be modeled to confirm that air quality in the vicinity of these units is within legal limits.

Portable Diesel Units - J. Stewart

Air dispersion modeling in support of an air permit application for a new diesel air compressor at F Canyon showed that emissions from the new unit will have negligible impacts on air quality.

Air quality modeling support was provided in support of a SCDHEC air permit application for a portable air compressor assigned to F Area. Emissions of criteria pollutants from this unit were modeled. The contribution made by the emissions to concentrations at the site boundary were found to be minute. They represented no compliance problem, making only negligible additions to concentrations produced by all site sources of criteria pollutants.

Dosimetry Technical Support - A. A. Simpkins, G. T. Jannik, and W. H. Carlton

Technical support for this quarter included:

- performing CAP88 analysis for D. Zecha
- assisting W. Frazier with Risk Assessment comment resolution
- providing dose calculations for disposal of 232-F debris

- providing dose calculations for disposal of railroad ties performing CAP88 analysis for Tank 20-F closure
- providing various data to HNUS for the River Water Shutdown EIS
- performing CAP88 analysis for a hood removal in 772-F
- evaluating ETMOD (Environmental Tritium Model) computer code
- performing RESRAD analysis of dose from disposal of contaminated railroad cross ties
- performing RESRAD analysis of dose from disposal of 232-F debris
- performing CAP88 analysis for 773-A Hanford high level waste treatability study
- performing CAP88 analysis for SW&ER
- reviewing L Lake risk-based strategy
- performing CAP88 analysis for HWCTR
- performing CAP88 analyses for E Area
- providing comments on L Lake sediments risk-based strategy
- performing CAP88 analysis for K-Area plasma in situ vitrification demonstration
- performing CAP88 analysis for H-Area waste minimization demonstration

Plutonium in the Savannah River Site Environment - W. H. Carlton, C. E. Murphy, Jr.

The article, "Plutonium in the Savannah River Site Environment", has been published in the Health Physics Journal (Health Phys. 71(3):290-299; 1996). This article is an abbreviated version of WSRC-RP-92-879, Rev. 1, and discusses the history and environmental significance of plutonium released to the SRS environment. It will serve as a significant reference for those interested in the effect of SRS operations on the environment.

Evaluation of the Analysis of Iodine-129 by ICPMS - P. R. Cable, S. Reboul, and S. Nappier

Studies addressing the analysis of I-129 in SRS waters by ICPMS continue. Several 98- mL aliquots of deionized water were spiked with varying amounts of I-129 in an effort to more completely determine detection limits for the technique. Standard addition and internal standardization were used to determine initial

concentrations of the samples. In addition to this experiment, four samples of P4 well water were analyzed for determination of the background contribution in the 129m m/z range. The combined results of these studies indicate a minimum detection limit of 1.0 pCi/L. River samples are currently being spiked with I-129 in concentrations greater than 1pCi/L for determination of the effect of sample filtering prior to resin extraction.

Assessment of Activation Products in the SRS Environment Published W. H. Carlton, M. Denham

The Radiological Assessment Program (RAP) document, Assessment of Activation Products in the Savannah River Site Environment, WSRC-TR-95-0422, has been published. This is the eleventh in a series of documents on radionuclides and heavy metals released from SRS. Documents on tritium, Cs, I, U, C, Sr, Pu, Hg, Tc, and noble gases have been issued, and a document on selected fission products is being drafted. A copy may be obtained from W. H. Carlton, 773-A.

Toxicity Testing at A-01 Outfall - W. L. Specht, M. Boerste

In anticipation of a toxicity testing requirement for the relocated A-01 outfall under SRS's new NPDES permit, toxicity tests were conducted in June and July using Ceriodaphnia dubia at contributing effluent sources in A-area, including A-03, A-04, A-05, and the three waste streams that combine to form the old A-01 outfall. Toxicity tests were also performed at the new A-01 outfall, at WE-1 one kilometer downstream and at source A-06 which joins between the two. The results indicate that most of the sources are toxic, as well as the new A-01 outfall compliance point. WE-1 is not toxic. Toxicity Identification Evaluations (TIEs) initiated in July and August indicate that metals (primarily copper) and to a lesser extent chlorine, are responsible for the observed toxicity. A contemporaneous engineering study tied the metals to corrosion in the supply water distribution lines and ranked preventative and corrective options. Small-scale testing of corrosion inhibitors and pH control/adjustment (preferred options) is underway, with initial positive indications. Current environmental

effects are being assessed through water effects ratio analyses and a macroinvertebrate study of the stream. Initial screenings indicate some mitigation of theoretical toxicity.

CMP Arsenic in Soil Treatability Study Report Issued - S. M. Serkiz, H. Uhal, and M. Findley—IWT

The final report for CMP arsenic in soil study was issued. This work supported the Environmental Restoration Department's Feasibility Study for this waste site. A study was conducted to perform additional characterization of soils from the Chemicals, Metals, and Pesticides (CMP) Pits operable waste unit. CMP Pits background soil samples were analyzed for soil pH, carbon content, surface area, moisture content, specific gravity, particle size analysis, cation exchange capacity, mineralogy, toxicity characteristic leaching procedure (TCLP) analysis, and chemical composition by total and partial digestions. Additional SRS background soils were analyzed for comparison purposes. Arsenic concentrations ranged from 0.163 to 1.806 ppm (with a mean value of 0.834 ppm) in CMP Pits background soils, and from 0.076 to 0.791 ppm (with a mean value of 0.502 ppm) in the SRS background soils. A good correlation ($R^2 = 0.703$) was found between arsenic concentration in bulk soil and clay content for CMP Pits background soils. With the collection of additional CMP Pits background data, the conclusion is that the average concentration between the waste site and CMP Pits background samples is the same. This is the identical conclusion made previously when analyzing the 1994 data only. A local elevated area at the zero to one foot interval appears in one corner of the CMP Pits. Further surface sampling within the pit area could be conducted to determine if this is a localized mineralogical or geochemical effect or is a result of SRS activities. Although the power of the non-parametric test used was relatively low (since the SRS Site background had only ten samples), the CMP Pits waste site and CMP Pits background soil arsenic concentrations appear to be significantly elevated over the SRS Site background levels.

Field Support For Lab Studies To Validate Biopraxis Process - F. C. Sappington, M. A. Phifer

The Biopraxis process is a remediation technology to remove metals and radionuclides from groundwater using selected indigenous microbe cultures and magnetic separation technology. The microbe cultures are introduced into the groundwater and precipitates are formed from the metals and/or radionuclides. This mixture is then passed through a high gradient magnetic separator (HGMS) and the microbially produced metal precipitates are removed. The treated ground water may either be recycled or discharged from the process.

The area of focus for this task is the remediation of metals contaminated groundwater. The site chosen (D-Area Coal Pile Run Off Basin), from which the samples will be taken, for the evaluation of the Biopraxis process offers a significant challenge due to the nature of the contaminants present.

WSRC's role in this project is to host the kick off meeting, support of on site sampling performed by Biopraxis, participation in project meetings, participate in the evaluation of the field prototype, and to provide bulk samples. Additional sample collection, field data collection, studies or analytical request will be limited by the current proposed budget. To most effectively utilize the current funding WSRC will coordinate with Biopraxis in determining priorities for additional support.

Activities completed or underway to date include: the kick off meeting held at the Savannah River Site, on site soil sampling performed by Biopraxis, providing bulk samples of groundwater, evaluation of funding and analytical costs for additional analytical support, field data collection, and the submission of new and historical data to Biopraxis.

Demonstration of Innovative DNAPL Characterization and Remediation

Technologies - B. B. Looney, J. Rossabi, K. M. Jerome, R. M. White, D. M. Tuck, C. A. Eddy-Dilek, R. A. Sigg, J. E. McCarty, R. S. Van Pelt, J. J. Kubar, D. G. Wells,

M. Simmons

The overall objective of the SRS DNAPL program is demonstration of a coordinated suite of characterization and clean up technologies for DNAPL in soil and groundwater. DNAPLs are chemicals that have a low water solubility and a density greater than water, such as the industrial solvents used in M Area. Disposal of DNAPLs results in formation of distinct areas of residual pure solvent contamination in soils and groundwater. The activity supports the DOE Office of Science and Technology Subsurface Contamination Focus Area.

The central themes emphasized in developing environmentally responsible remediation methods are: careful targeting of the thin discrete areas of DNAPL accumulation, minimizing wastes, improving remediation safety and speed, and emphasizing lifecycle costs/impacts. Based on these criteria, in situ destruction represents one of the most promising DNAPL remediation approaches. Subsurface access can be designed to optimize DNAPL-reagent contact and typical DNAPL layers (thin and laterally extensive) can be treated without the inefficient removal step. Screen zones in the access wells are placed in the DNAPL zone (<1 m thick) providing efficient access while minimizing treatment chemicals needed and minimizing waste generation.

A cooperative research and development agreement (CRADA) with GeoCleanse International is in place (signed July 11 1996) for a full scale field demonstration of in situ oxidation of a known DNAPL target in an aquifer at SRS. The GeoCleanse Process is based on Fenton's Reaction, using only iron and hydrogen peroxide, and the reaction results in effective destruction of DNAPL components to nontoxic end products such as chloride ion and carbon dioxide. The demonstration will target a layer of DNAPL on the "green clay" near the former M Area Settling Basin where DNAPL has been confirmed. This will be the first demonstration of the GeoCleanse technology in the DOE complex. The test plan for the demonstration has been completed. Regulatory permits have been initiated and submitted to EPD for transmittal to SCDHEC.

Site required approvals have been initiated. Procurement of drilling services have been initiated. The requests for proposals should be sent to prospective drilling companies by October 31. The demonstration team decided to use either resonant sonic or rotasonic drilling technologies for installation of all wells due to minimal generation of investigation derived waste.

Several innovative DNAPL characterization tests are underway. Notably, alcohol injection extraction tests were completed at six wells. The purpose of the alcohol injection/extraction test was to determine if this process was feasible as a qualitative characterization technique for the presence of DNAPL. The alcohol injection/extraction testing was completed August 13 with analysis continuing through mid-September. DNAPL was collected from well MSB3D prior to testing that well, adding to the total pounds of solvent removed from the subsurface for 1996. All six wells were tested using both the bromide and ethanol injectates. One of the ER student intern's assisted with the testing resulting in her submittal to ER of a paper presenting the bromide analyses completed during the alcohol injection/extraction test. The final report on the alcohol injection/extraction test is in draft form and will be incorporated into a summary report of several DNAPL related projects conducted this summer.

DNAPL mobilization studies, led by Dave Tuck, using the synchrotron facility at Cornell and research facilities at the University of South Carolina - Aiken, yielded important results. Critical interfacial tension values (below which the bulk DNAPL is mobile) were identified for a variety of important sediment types and emplacement scenarios. This data will be used at SRS, and by others, in developing operational controls for DNAPL remediation and for setting permit limits for such work. An innovative network theory modeling approach was developed that predicts the mobilization observed in key synchrotron runs and laboratory columns. The model is based on theories of packing spheres and the use of advanced mathematics to generate the pore network (the portion of the volume not occupied by the packing). Also, lab experiments indicated that the colored dyes

often used in DNAPL experiments significantly alter the interfacial tension characteristics of DNAPL solvent and may influence their migration behavior. This is significant because lab and field experiments are generally performed with such dyes.

**Subsurface Contamination Focus Area
Radionuclides Removal in Vegetation -**

E. Wilde, C. Murphy, B. Blundy

Ed Wilde and Chas Murphy of SRTC and Bob Blundy of ERD hosted a one-day workshop at the Savannah River Site on 9/17/96 for a group of offsite experts in the fields of phytoremediation and decontamination of radioactive materials. Representatives from DOE-SR were in attendance. The workshop involved discussions and tours of waste sites with contaminated vegetation at SRS as well as discussions of regulatory commitments and mitigation schedules.

**Poland Initiative for Subsurface
Contamination Focus Area - K. Lombard,**
T. Hazen, M. Franck, C.B. Fliermans

As FY 96 activities for the Polish Initiative come to a close, we can look back on a highly successful year for the DOE, the Institute and SRTC. Many "firsts" were accomplished during the initial campaign: 1) the first OSHA Safety Training under Fed. Regulation 1910.120 for hazardous waste operations was completed in Poland, 2) the first Treatability Study in IETU dealing solely with the isolation of petroleum degrading bacteria, yeasts and filamentous fungi capable of degrading large quantities of hydrocarbons at very low pH, 3) the first use of epifluorescent techniques to analyze and classify microbiological samples, and 4) the first introduction, training and operation of state-of-the-art instrumentation for the real-time monitoring and analysis of hazardous waste sites. The year ended with a highly successful symposium in Warsaw, Poland that attracted over 600 participants. The IETU's year ended with the opening of RACE, the Risk Abatement Center for Eastern Europe. RACE was supported under this DOE Initiative and has generated several new opportunities for additional research and development in the area of environmental restoration and technology transfer.

Interceptor Well Pump Test -
M. A. Phifer, F. C. Sappington,
B. E. Pemberton

A demonstration of the EnviroWall Barrier System was conducted adjacent to the D-Area Coal Pile Runoff Basin (CPRB). The EnviroWall Barrier System utilizes trench and guidebox construction techniques to install high density polyethylene (HDPE) vertical barriers and other materials below grade. It is an extremely versatile installation system. In its application at the CPRB, the EnviroWall vertical HDPE barrier has been installed and combined with a groundwater recovery system in the same trench to produce an interceptor well. The Interceptor Well has an innovative design, designed to maximize the collection of upgradient contaminated groundwater while minimizing the collection of downgradient groundwater. It was also designed to provide a more even distribution of groundwater collection across the entire width of the contaminant plume. The Interceptor Well (DIW-1) was installed at the northwest corner of the CPRB.

Characterization of the water table aquifer hydrogeology and pump tests of the D-Area Interceptor Well (DIW-1) were conducted in order to evaluate the performance of DIW-1 and its impact upon groundwater flow patterns. The results of the characterization and tests has been reported in the D-Area Interceptor Well, DIW-1, Interim Report issued September 30, 1996. The Interceptor Well performed essentially as designed. It reduced the collection of downgradient groundwater and allowed only some minimal downgradient groundwater flow under the HDPE barrier to the upgradient side. It provided a more even distribution of groundwater collection across its length as evidenced by the relatively flat drawdowns across the entire length of DIW-1 at lower pump rates. Its performance relative to these two criteria could have been improved by the following:

- Design based upon the actual contaminant profile and more full characterization of the hydrogeology prior to its design and installation
- Design based upon 3-D modeling

- Use of slotted laterals across its entire length rather than just in the wing walls

Additionally the following was noted during the pump tests:

- The integrity of the installed HDPE barrier was demonstrated by the significant head differentials noted across the barrier.
- The lateral lines when open transport approximately 90% of the extracted groundwater, and they increase the DIW-1 capacity to extract water by greater than 150 percent, relative to the use of gravel pack alone

TNX Permeable Wall Laboratory Study and Demonstration - M. A. Phifer, F. C. Sappington, J. E. Cardoso-Neto

Zero valence iron enhanced abiotic degradation of chlorinated volatile organic compounds (CVOCs) is essentially a reductive dechlorination process, which uses the iron as the reducing agent. This treatment technology may be applied in situ through the use of a funnel and gate system, a continuous permeable wall, or a passively induced flow treatment system. As applied to the TNX flood plain, such a system would be installed at the small levee which divides the flood plain. A laboratory study and SEM analysis have been performed and a cost estimate for a full scale system has been prepared to address the applicability of zero valent iron treatment to the TNX flood plain contamination. This information has been documented in the Permeable Wall Laboratory Study Final Report issued to the Environmental Restoration Department (ERD) on August 6, 1996.

The laboratory study demonstrates that zero valent iron can treat the CVOC contaminated groundwater in the TNX flood plain to below the Primary Drinking Water Standards (PDWS), while producing less toxic final degradation products such as ethane, ethene, and methane. Additionally the process reduces the nitrates to below the PDWS. Neither chemical precipitation nor biofouling appear to be significant problems relative to plugging the pore space, based upon this study and existing field applications and demonstrations. The

long term continued activity of the iron to perform treatment is currently unknown; however an in situ demonstration conducted by the University of Waterloo has been in operation for five years with no observed reduction in degradation rates. All potential application methods are in situ passive methods with assumed low operating and maintenance costs. The most cost effective method to apply the zero valent iron treatment in the TNX flood plain appears to be the Passively Induced Flow Treatment System at an estimated full scale installation cost of approximately half a million dollars. The iron costs are a significant part of the overall cost of a treatment system. The iron costs and associated construction costs might be reduced with better definition of the anticipated CVOC concentrations (primarily trichloroethylene), plume dimensions, aquifer characteristics (pore velocity), and CVOC half-lives.

ERD has accepted the recommendation that a field scale demonstration of zero valent iron treatment of the TNX flood plain CVOC contaminated groundwater should be conducted utilizing the Passively Induced Flow Treatment System. This demonstration would be directed at verifying that this application method will function as anticipated, providing additional aquifer characteristics, determining field specific CVOC half-lives, and performing the modeling necessary to determine treatment cell spacing (i.e., radius of influence).

Stabilization/Containment Systems

Task A, Demonstrate Surface Containment Systems Repair - D. M. Tuck and M. A. Phifer

Laboratory bench-scale testing of four clay cap repair technologies is being conducted by Lawrence Berkley Laboratory (LBL) under the direction of the Environmental Sciences Section (ESS) using lysimeters designed by ESS. The four technologies being tested include use of geosynthetic clay liners (GCL), colloidal silica, polysiloxane, and removal and recompaction. Testing of three of the technologies has been completed and a draft report outlining the work accomplished in FY96 has been prepared. Additionally a draft paper for presentation at the 1997 International

Containment Technology Conference by both LBL and ESS personnel has been prepared.

Additionally, characterization of the existing SRS desiccation kaolin test cap has been performed. A map, utilizing photographic techniques, is under preparation of the persistent cracks in the exposed portion of the test cap. Percolation tests of the kaolin and its subgrade have also been conducted. Additionally shelly tube samples of the kaolin and its subgrade have been obtained.

Preliminary Testing of the Airlift Recirculation Well at TNX -

R. L. Nichols, R. M. White, C. R. Betivas

A 14-day test of the Airlift Recirculation Well (ARW) technology has been completed using well TVR1 (previously identified as VRW1) in the TNX Area. Air was injected into well TVR1 at a rate of 25 scfm producing an air lift pumping rate of ~ 2-3 gpm. Changes in water levels and dissolved oxygen concentration in nearby monitoring wells show that treated water is being injected back into the subsurface at the water table.

Results from the 14-day test are very encouraging and show that mass removal of CVOCs can be achieved using TVR1 as an airlift recirculation well and is an effective method of introducing dissolved oxygen and other nutrient for bioremediation into the contaminated aquifer. However, due to the short duration of the test we are not able to make a recommendation regarding operation of the ARW system. In order to make a recommendation on operation of the ARW system we recommend conducting a 2 - 3 month test at a higher flowrate to more completely evaluate the effectiveness of the ARW technology. A longer term test will allow us to:

1. determine if a recirculation cell can be established with the current well installation
2. evaluate any bioremediation that may result from operation of the ARW
3. evaluate mass removal of CVOCs using TVR1
4. study groundwater flow resulting from operation of the TVR1

5. determine the area of influence of TVR1

Application of Six-Phase Heating at the 321-M Solvent Storage Tanks - T. R. Jarosch, T. F. Kmetz

A contract was awarded to Terra Vac, Inc. to provide a detailed cost and design analysis of a potential application of the six-phase in-situ soil heating (SPSH) technology at the solvent storage tanks near 321-M. Terra Vac has developed a teaming relationship with Battelle, Pacific Northwest National Laboratories, the technology developers, to commercially market the technology. This work parallels the recent and on-going vadose zone characterization near the tanks and solvent transfer areas. The SPSH technology was successfully tested at the Integrated Demonstration Site near the M-Area Basin in the fall of 1993. This technology is being investigated as a means of accelerating the current vadose zone clean-up program and as a means of more efficiently removing residual chlorinated solvents from shallow clays that have too low of a permeability for conventional vapor extraction operations.

Field Testing of MAG*SEP and Empore Technology - D. M. Beals and W. B. Matthews

Studies were performed to determine the utility of the commercial MAG*SEP and Empore technologies for the quantification of radionuclides in aqueous systems. Samples were collected starting in the Gulf Stream, up through the Savannah River Estuary, and into the freshwater of the Savannah River, to determine the effect of salinity on the uptake of radionuclides by the two technologies.

Field Deployable Tritium Analysis System - P. R. Cable, K. J. Hofstetter, D. M. Beals, J. Noakes

Final laboratory testing of the autosampler for the Field Deployable Tritium Analysis System (FDTAS) was completed by Sampling Systems, Inc., and the unit was delivered to SRS on September 17. The prototype device contains a pneumatically actuated column carousel, program-mable logic control, remote operation capabilities, and is housed in a field portable case. The system was transported to

Center for Applied Isotope Studies (CAIS) at the University of Georgia to be demonstrated during a meeting of representatives of Packard Instruments, Canberra Industries, EICRoM, Inc., Sampling Systems, SRTC, WSRC, and CAIS. The purpose of the meeting was to familiarize all parties with the technology and to discuss commercialization prospects for the autosampler and the prototype detection system. Sampling Systems and CAIS researchers began interfacing the systems after the meeting. The devices were operating in tandem the following day with full compatibility between the respective control systems. A device, which will allow for real-time statusing of the autosampler complete with software tailored for the FDTAS, is being developed. The basic control software for the detector is also being reformatted to better accommodate the analysis sequence of the system.

An invention disclosure for the FDTAS is currently being considered by the SRS patent committee.

Three Dimensional Pump Testing of a Fractured Rock Aquifer in the Western Siberian Basin, Russia - R. L. Nichols, B.B. Looney, C.A. Eddy-Dilek

A group of scientists from the Savannah River Technology Center and Russia successfully completed a 17-day field investigation of a fractured rock aquifer at the MAYAK PA nuclear production facility in Russia. The test site is located in the western Siberian Basin near the floodplain of the Mishelyak river. The fractured rock aquifer is composed of porphyrites, tuff, tuffbreccia and lava and is overlain by 0.5 - 12 meters of elluvail and alluvial sediments. The Joint Coordinating Committee for Environmental Remediation and Waste Management (JCCEM) sponsored the field research and is composed of the United States Department of Energy (USDOE) and the Russian Ministry of Atomic Energy (MINATOM)

A network of 3 uncased wells (176, 1/96, and 2/96) was used to conduct the tests. Wells 176 and 2/96 were used as observation wells and the centrally located well 1/96 was used as the pumping well. Six packers were installed and

inflated in each of the observation wells at a depth of up to 85 meters. The use of 6 packers in each well resulted in isolating 7 zones for monitoring. The packers were inflated to different pressures to accommodate the increasing hydrostatic pressure. A straddle packer assembly was installed in the pumping well to allow testing of each of the individual zones isolated in the observation wells. A constant rate pumping test was run on each of the 7 zones.

The test provided new information about the nature of the fractured rock aquifers in the vicinity of the Mishelyak river and will be key information in understanding the behavior of contaminants originating from process wastes discharged to Lake Karachay. Results from the tests will be analyzed to determine the hydraulic properties of different zones within the fractured rock aquifer and to determine the most cost effective clean-up approach for the site.

DNAPL Characterization at Kennedy Space Center - R. L. Nichols, K. M. Jerome, T. R. Jarosch, C. R. Betivas, S. Burdick, R. D. Raymond, B. D. Riha, J. E. Wedekind

Operations at the Kennedy Space Center, Wilson Corners Site, have resulted in local contamination of shallow groundwater with Freon-113, trichloroethylene, and their associated anaerobic breakdown products. Depth discrete core sampling was conducted at Kennedy Space Center to determine residual solvent concentrations and to map hydrogeologic strata including the primary aquifer confining unit. A total of 15 boreholes were drilled to a typical depth of 50 feet with a hollow stem auger and continuous cores were taken with a 3 inch split spoon sampler. Duplicate or triplicate sediment plug samples were taken from each two foot core depth to be analyzed with headspace methods using gas chromatography. The drilling was conducted by Geotek (Oak Ridge, TN) and geologic oversight was provided by CDM. Analysis of the results from headspace sampling is currently on-going. In addition, field boring logs and core analysis are being used to produce site cross sections and a contour map of the confining unit. Future site work is planned for late fall to conduct additional

ground water analysis for pH, dissolved oxygen, conductivity, and concentrations of metals and anions.

DataDelve - J. A. Bowers

Following ESS's participation at EnviroSoft96, sponsored by the Wessex Institute of Technology, Southampton, GB and funded by HOPS International, Inc., the Italian state oil company, AGIP (Environmental Geochemistry Group, Milan) is continuing their interest in SRTC's DataDelve/HOPS as an environmental warehouse application for their waste sites monitored in Europe. Additional interest has been shown by the French Atomic Energy Commission (Emergency Response and Health Physics) for DataDelve supporting georegistered contaminant plume models of the atmospheres. Discussions have been renewed with Harvard University for the potential application of DataDelve as a global warehouse of botanical diversity funded by a grant to Harvard from the World Bank.

Southeastern Technology Center Bioremediation Demonstration with Biotech Group at Jimbo's Gas Station in Downtown Aiken - T. C. Hazen

Using PHOSter, a SRTC Group Patented Technology, the STC subcontracted Freeman and Vaughn Inc. to demonstrate the technology at Jimbo's a local abandoned gas station site. The results were so good that the demonstration cleaned up the site nearly 3 months ahead of the scheduled completion time of the demo. The City of Aiken has now sold the property to the Aiken Chamber of Commerce who plans to develop it. A great success for SRTC, DOE, a local company and our local community.

Southeastern Technology Center Bioremediation Demonstration with Biotech Group at Columbia County Landfill - T.C. Hazen

American Technologies Inc. completed an air injection in the new Subtitle D section of the Columbia County Landfill under the technical direction of the Biotech Group. The results showed that with relatively simple compressors the leachate collection system could be used as

an air injection system for the entire cell. This air injection was shown to increase biodegradation rates and decrease methane production. The 3 small pumps used were able to push air through the entire 8 acre facility. This demonstration has tremendous implications for municipal landfills in terms their useful life and there long term liability to the community. American Technologies is currently installing a leachate recirculation system in part of the landfill to further enhance the aerobic biodegradation technology patented by SRTC.

Fiber Optic Wind Vane CRADA with Met One Instruments - M. J. Parker

A side-by-side field test of the fiber optic wind vane CRADA prototype and a commercial wind vane indicate good performance characteristics for the measurement of atmospheric turbulence and in low wind-speed conditions.

The prototype fiber optic vane was field tested with a Met One 020C wind vane. Both instruments were mounted on an ETS portable tower at the Central Climatology Facility in N Area. Wind speed data were collected at the 4-meter level of the Climatology tower for comparison. Preliminary analyses indicate an excellent correspondence for calculated values of the standard deviation of wind direction at speeds well above the starting threshold of the 020C sensor. However, the fiber optic vane performed better under low wind speed conditions when the vane remained responsive. Final analysis will be incorporated into the final CRADA report.

ETEX - D. P. Griggs

The official ETEX meteorological database was received from the European Centre for Medium-Range Weather Forecasts (ECMWF). This database includes used analyses, forecasts, and surface geopotentials for Europe during the October 1994 and November 1994 ETEX campaigns. These data are to be used in the ATMES-II model evaluation study, in which ETS is participating. Initial attempts to retrieve the data from the 8-mm tape provided by the ECMWF were unsuccessful. Researchers at the Lawrence Livermore National Laboratory

(LLNL) also had difficulties reading their ETEX tape. LLNL has successfully obtained the data files, decoded them from the original GRIB format, and converted them to ordinary ASCII files. In the interest of efficiency, ETS has requested LLNL to provide their ASCII data files via the SRS FTP server.

AOTF Spectrometer Testing
at Savannah River Site - E. Villa, J. C. Piercy, M. J. Parker, D. Suhre

The Acousto-optic tunable filter spectrometer was delivered to Savannah River Site on September 16, 1996, for a series of experiments. During the week of September 16-20, several experiments were conducted to characterize the spectrometer performance.

Support for Spent Nuclear Fuel Project
at Hanford - K. J. Hofstetter

Technical service support was again requested by Westinghouse Hanford on the K-Basins Integrated Water Treatment System (IWTS). Some of the in-basin testing of the PN Services filtration skid was observed, and the field operation and test data were reviewed. Based on my experience at TMI-2 and at Fort St. Vrain, I provided recommendations on the use of the PN filtration system and its implementation into the final design of the IWTS to support the movement of 2300 metric tons of deteriorated spent nuclear fuel to safe interim storage. This work was performed under a memorandum purchase order.

WASTE MANAGEMENT

High Level Waste Tank 20 Closure Program - C. A. Langton, N. Rajendran, T. M. Nixon

At the request of High Level Waste, BSRI and SRTC have completed a bleed water testing program for controlled low strength material that will be used to fill Tank 20 as part of the closure plan. The CLSM mixes tested were: CLSM Mix #1 (containing 150 lb/yd³) and CLSM Mix #2 (containing 50 lb/yd³). SRS Currently uses CLSM Mix #2 for various applications.

Bleed water(excess water that accumulates on top of the mixture after the pour) percentages were measured along with flow and compressive strength. Mix 1 is the recommended mix as it had better flow characteristics, less segregation, a lower percentage of bleed water, and slightly higher strength.

This information will be used to determine engineering requirements, such as lift height, time required between lifts, and quantity of bleed water to be removed during placement. Optimization of the mixes was beyond the scope of this study, but recommendations were given on alternatives that may decrease or eliminate bleed water. This work has been documented (WSRC-RP-96-554, issued 10/22/96) and communicated with High Level Waste.

Change in Performance Assessment Point of Assessment - J. R. Cook

An addendum to the E-Area Vaults Performance Assessment has been written to evaluate the effect of changing the point at which groundwater concentrations and dose are calculated. In the past this point was a hypothetical well 100 meters from the waste. Current thinking at DOE-HQ and SRTC is that in the future these types of calculations should be done at points where actual people might be exposed, factoring in any future land use plans that have been made. SRS has such a plan that precludes any residential use of any land within the current site boundary. This means that the nearest point at which actual people could be

exposed would be the Savannah River just downstream of SRS.

The PA Addendum calculates radionuclide disposal limits for each of the units in E-Area factoring in a point of assessment at Upper Three Runs. The Addendum is currently undergoing WSRC-BNFL review and will be submitted to DOE-SR at the end of November.

Continuous Emissions Monitoring (CEM) Demonstration - D. B. Burns, R. A. Hane

Continuous emissions monitoring of mixed waste thermal processes is desired for both verification of emissions compliance and process control. Species of particular interest include heavy metals, particulates, radionuclides, and organics. Continued advancement and future implementation of these technologies require pilot-scale demonstrations in actual process environments.

The primary task is to conduct long-term performance testing of several mercury and particulate matter continuous emissions monitors. Nine different CEMS will undergo six months of testing at two commercial thermal waste treatment facilities. Three mercury CEMS are being tested at the Holnam Cement Co. Kiln in Holly Hill SC. The six particulate matter CEMS will be tested at the on-site incinerator of the DuPont Experimental Station in Wilmington, DE. The primary purpose of the tests is to determine if these monitors can meet the CEM performance standards in proposed revisions to the Clean Air Act Amendments (CAAA).

In addition to conducting performance testing of mercury and particulate matter CEMS, this activity included developing and validating a method to individually measure both elemental and ionic mercury. A modification to the standard EPA method for measuring mercury was proposed and validated using the EPA Method 301 validation procedure.

Letters of commendation were issued from WSRC and EPA to DuPont and EERC to commend their staff, employees and contractors in succeeding under adverse conditions.

The contract with EERC extends into FY97. TTP SR17C231 has been written for 1997 to complete the Hg and PM tests. An additional \$50K-\$75K is being sought from the CMST focus area to maintain the planned scope.

In a separate activity, the Sky Company was contracted to test, a German-built dioxin CEM at the Research Triangle Park in Raleigh Durham, NC. The instrument was shipped from the DLR laboratory in Stuttgart, Germany to the EPA Combustion Research Laboratory in Research Triangle Park (RTP), North Carolina.

The primary objective of this test is to determine if REMPI is a viable technology for a dioxin CEM. This CEM uses Jet Resonance Enhanced Multiphoton Ionization (Jet REMPI) technology. The EPA-funded Part 2 of this task is currently underway. The primary issue to be investigated was addressing the apparent inability of the system to detect tetrachloro-dibenzo-dioxin congeners. During Phase 1 testing, the instrument was unable to detect these compounds, trichloro compounds were the largest dioxin congeners that could be detected. The greater the number of chlorine atoms, the higher the required ionization energy, and an increase in the difficulty to detect the compound. During the follow-up testing, the existing Jet-REMPI instrument was able to detect 1,4,6,9-TCDD, thus the single-color laser is able to detect tetrachloro-dibenzo-dioxin congeners. Results of these additional tests will be incorporated prior to issuing the final report.

Mercury Disposal via Sulfur Reactions - MWFA Quick Win - L. N. Oji

A technique for converting large volumes of mercury into mercuric sulfide has been developed. The two forms of mercuric sulfide (cinnabar and metacinnabar) were prepared by triturating various stoichiometric ratios of mercury and sulfur under laboratory conditions. With this technique, large volumes of mercury were readily converted to the sulfides. The resulting sulfides have been shown to pass both the TCLP test for mercury and mercury vapor phase requirements for storing mercury related waste streams. Zinc-mercury amalgams were

also prepared and compared with sulfides of mercury in terms of meeting processing and storage requirements for mixed mercury waste streams.

Since the properties of radioactively contaminated mercury, tritium contaminated mercury in particular, are not that different from that of ordinary elemental mercury, the sulfide disposal approach would eventually be applied in the disposal of radioactively contaminated mercury mixed waste at SRS and other DOE sites. This would change the classification of radioactively contaminated mercury waste at SRS from a mixed waste to a Low-Level radioactive waste (LLRW), making it possible then to remove contaminated mercury from SRS mixed waste treatment plan.

Tank 20F Closure Chemistry - M. S. Hay

In support of the closure of Tank 20F, samples of the residual material in Tank 20F were sent to SRTC for analysis. Analysis of the samples indicated a significant quantity of sodium oxalate and sodium sulfate present in the sludge residue. The subcontractor providing the tank backfill material indicated the oxalate and sulfate may have negative impacts on the performance of the backfill material. A pretreatment method was identified that renders the oxalate and sulfate inert with respect to the backfill material. HLW Engineering requested that IWT test the pretreatment method on sludge obtained from the sampling of Tank 20F. A Task and QA plan was written for the pretreatment test (WSRC-RP-96-469). Researchers completed the tests with samples from the test currently undergoing analyses to determine the effectiveness of the pretreatment.

Two samples of the solids from Tank 19F were received at SRTC for analysis. One of the sample cups contained no sample. Sufficient material was contained in the other sample cup to complete the analyses requested. A portion of the solids were dried and dissolved by three different methods. The dissolution samples are currently being analyzed.

Remediation of Mercury Contaminated Moderator Water - J. P. Bibler, J. P. Hage, L. Tovo

The High Activity Moderator (HAM) process feeds deuterated ('heavy') water with low concentrations of mercury through one of two evaporators for the purpose of reducing conductivity and removing ionic impurities. Mercury poses a special concern due to its corrosive properties. If allowed to remain in the water after processing, introduction of mercury into the reactor cooling systems may lead to increased corrosion and possible equipment failure. Heavy water containing mercury in concentrations greater than 0.014 ppm is processed in the Technical Purification Facility (TPF) either before being shipped to HAM or, in the case of high mercury HAM product, before it is processed in the Moderator Processing Facility (MPF).

Currently, HAM and TPF drums are being sampled and tested by Mike Brissons in D Lab. Prior to being tested for mercury, they are filtered using a 0.45-micron filter. If the mercury concentration is greater than 0.014 mg/L, the new allowable limit (1), the drum sample is submitted to SRTC where it is filtered using a 0.1-micron filter and then tested. If the mercury concentration is still greater than 0.014 mg/L, the MAG*SEP resins (cationic/anionic) will be used. Westar ferrate pre-treatment will be used to oxidize any elemental mercury.

Recent results show that filtration (0.45-micron filter) brings high mercury drums back into allowable specifications. Researchers speculate that ionic mercury amalgamates with the stainless steel of the evaporators, the RWCT, or the drums. The particulates, analyzed after filtration by Scanning Electron Microscopy (SEM), contain mercury, iron, chromium, and nickel. This would explain why high mercury samples treated with the MAG*SEP resins (cationic/anionic) do not lower mercury concentrations.

Solubility Measurements for Potassium and Cesium Tetraphenylborate - D. J. McCabe

To reduce the benzene concentration in Tank 48H during the In-Tank Precipitation process, it is necessary to accurately predict the cesium tetraphenylborate (CsTPB) solubility. Predicting the maximum CsTPB solubility during the slurrywashing cycle will minimize

the addition of excess sodium tetraphenylborate (STPB). It is this excess STPB that is soluble in the ITP salt solution and which decomposes to yield benzene. Equations used at SRS have been derived from published literature reports, but experiments at SRS with radioactive waste samples have frequently indicated lower than expected cesium solubility. The objective of this task is to define and quantify the parameters that impact the CsTPB solubility.

Recent testing focused on evaluating the impact of temperature and on varying the ratio of potassium to cesium. Scoping studies on the kinetics of precipitation were also completed. Results indicate that the dependence of solubility of CsTPB and KTPB on temperature corresponds well with literature values. The solubility increases by approximately 3-fold for an increase of 40 °C. The impact of the potassium to cesium ratio was inconclusive, requiring further testing. The kinetics of precipitation were observed highly dependent on temperature, as expected.

Confirmation of Safe Operating Chemistry for the 2H Evaporator System - D. T. Hobbs

Recent processing of dilute solutions through the 2H-Evaporator system caused dissolution of salt in Tank 38H, the concentrate receipt tank. Because of the quantity of salt dissolved, the 2H-Evaporator was shut down pending confirmation of subcritical conditions during salt dissolution. Five samples were recently analyzed to determine concentrations of fissile isotopes and neutron poisons in the insoluble solids, liquid and soluble salt phases. The samples consisted of two variable depth sampler (VDS) samples from Tank 38H (HTF-001 & HTF-004), one saltcake sample from Tank 38H (HTF-003), one VDS sample from Tank 43H (HTF-002) and one saltcake sample from Tank 41H (SC410696). Analytical results demonstrate the presence of significant quantities of neutron poisons in the insoluble species (i.e., sodium, iron, chromium and manganese) that mitigate any concerns of nuclear criticality safety. The analytical results are reported in "Preliminary Analytical Results for Tank Farm Samples in Support of Salt Dissolution Evaluations (U)," WSRC-RP-96-544, revision 0, October 21, 1996. Plans

include analyzing additional VDS samples from Tank 38H to confirm subcritical conditions during operation of the 2H-Evaporator over the next 12-16 months. After this period of time, all of the sample results will be evaluated to determine if continued sampling and analysis is required.

Wick Detector for DWPF Glass Melter - J. L. Steimke

Glass pouring at DWPF is initiated and controlled by a small differential pressure maintained between the melter and the canister which receives the molten glass. Ideally, the pour stream would be uniform and unwavering. Sometimes the video camera on the pour stream shows that the stream is wavering and varying in thickness, termed wicking. There has been a substantial effort to explain the causes of wicking to prevent its occurrence. However, these efforts have been hampered by not knowing what the system control valves, flowrates, pressures, etc. are indicating at the instant of the wick. For example, does a pressure fluctuation occur just before or just after the wick? As an unsolicited initiative the TFL developed an optical device for identifying wicking. V. L. Bush constructed the device.

The wick detector has a simple principle of operation. The output of the video camera is fed to a spare monitor. Two solar cells (light detectors) are positioned on the screen. One cell is over the normal position of the glass stream. The stream appears white because of its temperature. The other cell is positioned to the side of the image to register ambient light level, which is much dimmer than the glass stream. The output of the wick detector is the square of the voltage output of the ambient cell subtracted from the square of the voltage output of the cell over the glass stream. The signals are squared because light intensity is roughly proportional to the diameter of the glass stream and glass flowrate is roughly proportional to diameter squared. During a wick the detector output goes to zero. Variations in stream thickness are also recorded.

The wick detector was first tested in the TFL using video tapes. It reliably identifies wicks

with timing to the nearest second. It also identifies the frequency of glass stream flow variations. The hardware is now being installed at DWPF.

Parallelization of Integrated Flowsheet Model - M. V. Gregory, R. A. Dimenna

We are currently engaged in a project to accelerate the running time of the HLW Integrated Flowsheet Model (IFM - which simulates the coupled, dynamic response of the entire SRS HLW complex) by a factor of 10-50X, thereby making it a much more accessible analytical tool. The approach we have selected is to parallelize the IFM: running the various plant models simultaneously on several CPUs.

The first step in the task has been to develop a version of the In-Tank Precipitation (ITP) process model which will run efficiently in a stand-alone version on its own CPU. The fundamental technical issue here was the selection of the best way to represent and control the discrete batch steps that make up the ITP process. There are two basic ways to do the batch control: within the dynamic SPEEDUP(tm) process model itself, or through external FORTRAN linked to the SPEEDUP model. The latter choice was implemented in the original version of the IFM because at that time we could not see a way to easily do the dynamic control. We have revisited this choice to confirm that it was correct. With some difficulty, dynamic batch control has been successfully implemented within SPEEDUP which exactly mimicked the response provided by the original IFM algorithm. Such an approach was found to double the running time of the model, primarily due to the computational burden of doing the iterative search for the batch step discontinuities within the dynamic model. This confirmed that external FORTRAN was still the most efficient way to carry out batch control.

With the optimal approach selected, we went on to develop improvements to the batch control logic which could take advantage of the fact that the process model would be running independently on its own CPU. As it turned out, the fastest running batch control algorithm

was a minor variation of the new dynamic control algorithm developed in the first phase of this task. When implemented outside of SPEEDUP, this same algorithm was found to accelerate the calculation by 30% rather than doubling the running time. This significant acceleration was due to a reduction in the number of event discontinuities that had to be found dynamically through interval bisection searches. Thus our version of the ITP model for the parallelized application will easily meet its performance requirements.

We now have developed a generalized, efficient batch control algorithm that we can apply to the other batch processes in the IFM (e.g., Extended Sludge Processing, Late Wash, etc.). Our next step, assuming that funding support for task will not be cut in the current round of HLW reductions, will be to apply the new batch control algorithm to the rest of the IFM which will be running on a second CPU. We have developed good confidence that we can meet our minimum performance goal of a 10X acceleration of the IFM by the end of FY97.

High Level Waste - Malcolm Kyle

EES completed the fabrication of the newly designed camera housing for the direct photography camera, including a modification to prevent contamination from getting into the housing.

EES has completed fabrication and testing of the wide angle camera system.

EES has completed fabrication and testing of all components for the ITP jumper cord. The components include two junction boxes, two test cables, five adapters, and a storage cabinet.

EES presented to HLWE work completed in FY96 on the enhanced data storage system. This work included a plan for digitizing and databasing all existing slides from annulus inspections, enhancing the quality control of the inspections, and improving the safeguarding of the images. The presentation included a demonstration of which images from past annular inspections were scanned into a computer database and compared on-screen. This work will continue in FY97.

EES met with Reactor Engineering to discuss equipment development options for the Spent Nuclear Fuel Program. The meeting highlighted several areas in which EES has demonstrated capabilities for meeting the unique needs of the program. Among these are the development of calorimetry and gamma spectroscopy systems for spent fuel characterization; development of a detector array for assaying SNF fissile materials; remote tooling for welding, capping and canning spent fuel containers; and remote methods for detection and decontamination of storage canisters.

Melter Pour Spout Cleaning Tools - Malcolm Kyle

EES completed design and fabrication of the fourth generation of cleaning tools for the melter pour spout. Modifications were made to decrease the weight of the tools and to add relief on the cleaning teeth. EES also fabricated a helical, drill type tool for cleaning the upper 2" section of the pour spout. All of these tools were successfully used in cleaning the pour spout "the best that it's been in a year."

EES designed and built a gear reducer assembly for the PAR arm to slow the cleaning tool speed while increasing the torque to that required for cleaning the pour spout. This gear reducer is designed to be mounted remotely and the change out of the cleaning tools can be remotely installed using the PAR arm. EES solicited assistance from MTS to select a material for future cleaning tool heads. MTS selected and procured Haynes 188, a nickel, cobalt alloy with more desirable mechanical properties at the higher temperatures required of the pour spout. This material is intended to be used after receiving feedback on the multiple generation tools previously fabricated.

EES also solicited assistance from ATS to better define the internal parameters of the heated melter pour spout. This study was completed and the results were used for sizing the cleaning tools.

EES fabricated a ceramic insulated cup with a mounting device for holding various insert materials for non-contact cleaning of the melter

pour spout. EES also delivered boron nitride inserts to be used with the ceramic cup.

Defense Waste Processing Facility - Malcolm Kyle

EES was requested by DWPF to develop a tool for cleaning glass accumulation in the melter pour spout. EES developed several tools to perform the remote cleaning function and has delivered these to DWPF in conventional types of steels. The cleaning tools are inserted into the PAR manipulator. The first tool is for cleaning the entrance to the 4" section of the pour spout. The second tool is for cleaning up to the lower knife edge and the third tool is for cleaning up to the upper knife edge. The tools are rotated against the glass until they scrape a load of glass. The tools are then removed from the pour spout to cool and unload their glass.

Analytical Cells - Malcolm Kyle

EES continued work on DWPF analytical cells enhancements. EES electrically modified two capper/decapper units for DWPF, one for immediate use in the cells and the other for use in the mockup. Bails were also fabricated for the units. EES completed modifications to the spare titrator controller for use in the cells. Design and fabrication of the lifting bail for the new Denver Instruments balance was completed. A replacement timer switch was selected and ordered for the mockup mixer mill. EES met with DWPF to discuss design modifications for the new centrifuge. EES also fabricated "pigtail" cables for use with a new microwave in the cells. DWPF picked up the completed control cabinets from EES and delivered them to the mockup in S-Area.

DWPF Borescope Redesign Effort - Malcolm Kyle

EES completed the DWPF borescope redesign effort. The blueprints redefining this device are complete and have been given to the DWPF technical group.

The original borescope optics were designed in the early 1980's and did not benefit from the recent advances in computerized optics design. Additionally, the field experience of the

DWPF area had identified several deficiencies in the current design.

The new design was conceptualized by the University of Alabama, Huntsville, to improve the image quality, increase light gathering ability, allow the entire capabilities of the zoom lens to be utilized, and allow point focusing beyond the optics. The last item will have a major benefit on the problems of lens fouling that have persisted, due to vaporized salts in the melter vapor space depositing on the optics, and to sludge material impacting on the optics. The new design reduces the diameter of the opening in the inconel 690 shroud to one half its present value. This will allow a considerable improvement in the effectiveness of the lens sweep gases. This is accomplished by focusing the optics through a small point outside of the final lens.

All required components were included in the new prints, including the lens elements, improved internal components, and new Inconel shroud. The changes to the previous components were minimized to all retrofitting of existing units. New lens elements were fabricated, as all are made to order items, and the design was successfully demonstrated in the laboratory.

It was recommended to the DWPF technical group that one or more of the uncontaminated optics trains be converted to the new design, and demonstration in the DWPF melter be conducted. Sufficient quantities of the specialized optics elements were fabricated during the testing development phase such that one or two of the field units can be fabricated without additional long term purchases.

GENERAL

DOE Research and Development Tracking Database System - L. R. Chandler

DOE-HQ has developed an electronic Research and Development (R&D) Tracking Database System for the entire DOE complex. The data in the system is updated annually. The system provides DOE data in reply to periodic scientific R&D information requests from the White House, the Congress and other governmental bodies. This FY96 data is the second set of data for a data bank which is updated annually. The information provided in each set of R&D data was:

- Work title
- Type of research
- Funding mechanism
- Work identification number
- Work description
- Point of contact
- Sponsoring DOE-HQ program
- B&R codes & FY costs
- Information access limitations

Information is limited to unclassified R&D work. Work for others will be input by the organization for which the work is being done. Forty-eight sets of data were provided for SRTC for FY96. DOE-HQ expects to update the database yearly after the completion of the fiscal year.

The R&D Tracking System is used for a variety of needs, thus reducing the number of data calls and the resources currently involved in those calls. Following are some of the relevant external data calls:

- White House Office of Science and Technology Policy (OSTP)
- Office of Management and Budget (OMB)
- National Science and Technology Council (NSTC)
- National Science Foundation (NSF)
- National Technical Information Service (agency compliance to P. L. 102-245)
- Several bilateral agreements
- Other ad hoc requests.

FY97 Annual Operating Plan - L. R. Chandler

In accordance with the DOE SRS Management Plan for Work Authorization and Control, WSRC provided DOE-SR the FY97 AOP Performance Baseline. The FY97 AOP Performance Baseline consists of 119 Summary Task Description Sheets (Yellow TDS), 14 Support and 5 Line Organization Summaries (Yellow SOS/LOS). The FY97 AOP Performance Baseline provides the summary scope of work, milestones, performance measures, budget and direct FTE resource requirements and Staffing Plan jointly approved and signed by WSRC and DOE-SR Managers. Additionally, a milestone and performance measure compliance matrix and summary reports were provided. SRTC will receive \$190.3M funding for supporting 74 of the Level 3 Tasks.

LR-56S Package Onsite Assessment (OSA) Revision 0 Submittal - R. Gromada

P&T was tasked in January of 1996 to evaluate the French LR-56S packaging for the onsite transfer of plutonium solutions at SRS. A draft of the OSA was completed in June of 1996. While the draft document satisfactorily dealt with previously identified requirements, new issues were uncovered that needed to be resolved. These included the plutonium safety requirements compliance of the LR-56S with Hazardous Material Regulations (HMR), and the compatibility of the plutonium contents.

An engineering team comprised of personnel from P&T, SRTC, Safety Analysis, Transportation, Radiological Engineering, F-area, contractors and the French design agency successfully addressed each of the issues. The work resulted in a clear understanding of the onsite safety requirements, significant design upgrades to the packaging, changes in the chemistry of the contents and the implementation of numerous operational controls. These agreements and results were incorporated into the OSA and the final draft was delivered to DOE as scheduled in December.

Current plans are for DOE/SR to complete its review of the document by the middle of January. P&T will incorporate comments by the end of January. The review team will then write the Safety Evaluation Report. Following sign-off the documents will be transmitted to DOE/HQ by the end of February. Final approval for the transfer will reside with either DOE/SR or DOE/HQ.

Full-scale Test of Density and Liquid-level Measurement Probes - M. R. Duignan, G. E. Weeks

Some excellent experience was obtained during the first several weeks of testing with the replacement liquid-level measurement probes. Some delays, which were outside the control of this experiment, were overcome to begin testing in December. After one week of testing in high temperature (101°C) slurry both the large-diameter (2.75" i.d.) probes and the porous-jacketed (0.62" i.d.) probes showed no sign of pluggage, i.e., they still measured the correct liquid levels. However, upon removing the probes for visual inspection (on 12/05/96) all showed significant slurry build-up, which was not impeding proper level measurement. During the second week of the test all of the probes were maintained 3.5 feet higher in the slurry so that the top-most grouping would be held out of the slurry. The intention was to see if the slurry build-up in the upper probes would dry out and cause inaccurate readings when reintroduced into the slurry during the next week of testing. Also, the dried slurry build-up may be more difficult to remove. Removing the probes from the tank on 12/12/96 showed significantly more build-up of slurry. However, the large-diameter probes still functioned satisfactorily but some of the porous-jacketed probes showed an increase in air pressure, which indicate pluggage. For the remaining portion of December the probes were held in the slurry at 50°C due to the lack of personnel to continue high temperature testing and some unrelated problems which prevented the SRAT/SME tank to operate. Testing will continue in January to determine methods to remotely clean the probes for continued operation. Through the end of December the large-diameter probes continued to operate satisfactorily but most of the porous-jacketed probes displayed effects of pluggage.

Reactor Support - Malcolm Kyle

EES continued work on the development of the prototype basin chemistry monitoring system for 105-L. Operator interface software development for the pH and conductivity systems is approximately 90% complete. This software should be available for beta testing around the first week of December. Operator interface software for the cesium monitoring system is underway and is approximately 25% complete. Fabrication of the probe support housing and instrument cabling has been completed.

EES met with Reactor Engineering and Materials Technology groups to discuss requirements for providing two identical instrumented test canisters for the Spent Nuclear Fuel Program. These canisters will be used in the direct disposal test program to measure and quantify the MTR fuel material response to the proposed storage conditions. The environment within the containers will be monitored for temperature, relative humidity, volatile vapors, and fuel condition. EES is preparing preliminary design specifications which will outline the equipment requirements for the instrumented test canister. This document is slated to be issued by the end of November to meet project milestones.

Site Robotics and Remote Systems Support - Ivan Lewis

EES remotely removed a 39 curie source from the calibration well in Building 736-A using a robotic arm and an automated capping station. See cover story for more information.

EES completed design of the revised optics for the DWPF melter interior viewing borescope. The final development prints have been transmitted to DWPF and a summary memorandum issued. This completion was on the critical path of the DWPF melter #3 acquisition.

Office of Science and Technology Robotics for Mixed Waste - Ivan Lewis

EES received funding from OST to aid INEL in the development of the HANDSS-55 (Handling and Segregating System for 55 gallon drums) which prepares mixed waste drums for shipment to WIPP. EES developed waste flow charts for the HANDSS-55 and identified the equipment to perform the tasks outlined on the flow charts. The equipment was placed on a conceptual HANDSS-55 floor plan. EES also developed a drum open and close (DOC) conceptual design. The flow charts, floor plan, and DOC conceptual design were presented at the INEL mixed waste meeting on 11/12.

Office of Science and Technology
Tanks Focus Area - Ivan Lewis

The light duty utility arm (LDUA) was successfully deployed in a radioactive underground storage tank at the Hanford site. The EES supplied remote video end effectors were used to survey the interior of the waste tank and its contents. All LDUA and remote video systems worked without difficulty.

Office of Science and Technology
Robotics for D&D - Ivan Lewis

EES assisted with the first remote system installation for the CP-5 (Chicago Pile 5 at Argonne National Lab) dismantlement project. A remote radio frequency control and a rotating bottom block installed on the CP-5 crane allowed for highly flexible remote operations. In addition, Convolve, Whiting Services and EES completed installation of a swing reducing control system on the CP-5 gantry crane. This is the first implementation of swing reducing technology on an AC crane in an operating facility. The swing reducing system, the rotating hook, and the remote radio control will allow successful deployment of the dual arm work module over the reactor vessel during dismantlement operations. The remote capability will also allow the highly radioactive center plugs to be pulled from the reactor with minimal exposure to workers.

Office of Science and Technology Robotics
for Plutonium Processes - Ivan Lewis

EES is leading the Plutonium Container Unpacking System (PCUS) Team members

(LANL, SNL, INEL) in the development of design concepts to meet the challenges of unpacking and opening the various packages within the DOE Complex. A mechanical design class at North Carolina A&T State University has taken on the challenge of the PCUS as a senior design project. The PCUS team hopes that the class will generate some valuable and creative ideas as they pursue the project. Professor S.L. Wang has worked with EES in the past developing concepts for robotics in the Mixed Waste Operations technical area.

ITEMS OF INTEREST:

EES completed the preliminary program for the ANS 7th Topical Meeting on Robotics and Remote Systems. Once printed, the preliminary program will be mailed to approximately 5000 individuals around the world. 194 technical presentations have been scheduled for the conference. In addition, a memorandum of understanding has been signed with the Utilities/Manufacturers Robot Users Group to co-locate their annual meeting in Augusta with the ANS Topical. A listing of papers to be presented can be found on SHRINE at <http://teleman.srs.gov> or on the web external to the site at http://www.srs.gov/ans_robotics_topical.

EES published WSRC-RP-96-536 "Robotics and Remote Systems Developments and Applications, FY96" which summarized SRTC's contributions in the Robotics and Remote Systems Technology arena for the previous fiscal year.

EES currently holds two seats on the ANS Robotics and Remote Systems Division Executive Committee. EES representatives attended the semiannual executive committee meeting held in Washington, DC during the ANS Winter Meeting. EES presented on the status of plans to host the 7th Topical Meeting on Robotics and Remote Systems in Augusta in April of 1997. In addition, the executive committee entertained proposals from ANS chapters to host the 8th Topical Meeting in 1999. The Pittsburgh Section was selected as the host organization.

Doncella Alexander attended the Board on Minorities and Women and Public Affairs Committee meetings and was requested to be an adjunct member of the Government Relations Committee. This committee sets up science and technology partnerships, follows legislation, keeps abreast of funding sources for certain technical areas, etc.

Ken Lombard, Terry Hazen and Brian Looney of SRTC/ESS along with Susan Pfiffner and Tommy Phelps of ORNL, were recently recognized as a 1996 R&D 100 Award winner for their work on PHOSter®, a bioremediation

process which provides a safe form of gaseous organic phosphorus as a nutrient source for the stimulation of microorganisms. The process received a patent in 1995 and is currently being used by several companies to assist with the clean-up of hazardous waste sites throughout the United States. The award was presented in a ceremony in Philadelphia, Pennsylvania on October 14, 1996.

Publications

W. H. Carlton—ETS and C. E. Murphy, Jr.—ESS co-authored an article, "Plutonium in the Savannah River Site Environment", in Health Physics Journal, WSRC-MS-95-0367.

B. A. Harmon, W. G. Winn—ETS, and et al., "Induced Radioactivity of LDEF Materials and Structural Components", NASA Report, Marshall Space Flight Center (September 1996).

D. L. Dunn—ESS "Mapping Radionuclide Distribution in Surface Sediments Using GIS and an Underwater HPGe Detector", WSRC-MS-96-0321, accepted for presentation and proceedings publication 1996 ANS National Meeting.

H.E. Mackey—ESS, co-authored a paper entitled "Remote Sensing Image Browse and Archival Systems." Geocarto International, A Multidisciplinary Journal of Remote Sensing & GIS. 11(2):33-42. June, 1996.

T.C. Hazen—ESS, 1996. Photograph: Core Sediment Exam. In: Lakes and Ponds by Sayre, Henry Holt Publishers.

T. C. Hazen—ESS, 1996. Sanitary Landfill in situ bioremediation optimization test final report. WSRC-TR-96-0065. Westinghouse Savannah River Company, Aiken, SC DOE - NITS.

S. M. Pfiffner, , A. V. Palumbo, J. J. Beauchamp, T. J. Phelps—ORNL and T. C. Hazen—ESS In Press. The effects of nutrient dosing of subsurface methanotrophic populations and TCE degradation. J. Ind. Microbiol.

C. B. Fliermans, M. M. Franck, T. C. Hazen—ESS R. W. Gorden— In press. Ecofunctional

enzymes of microbial communities in groundwater. Microb. Ecol, WSRC-RP-97-31.

K. Ulfig, G. Plaza, —IETU, T. C. Hazen, C. B. Fliermans, M. M. Franck, and K. H. Lombard. In Press. Bioremediation treatability and feasibility studies at a Polish petroleum refinery. Proceedings Warsaw96, WSRC-MS-96-0387X (abstract only).

F. J. Brockman, W. Sun—PNL, T. C. Hazen—ESS, Submitted. Monitoring of culturable Methanotroph Numbers, Soluble Methane Monooxygenase Gene Densities, and Trichloroethylene Biodegradative Potential During In Situ Bioremediation of a Deep Trichloroethylene Plume. AEM.

S. M. Pfiffner, A. V. Palumbo, T. J. Phelps, J. J. Beauchamp, D. B. Ringelberg, H. C. Pinkart, and D.C. White—ORNL, T. C. Hazen—ESS, Submitted Microbial monitoring as a measure of success for in situ TCE bioremediation. ES&T.

T. C. Hazen—ESS, In Press. Bioremediation. In: Microbiology of the Terrestrial Subsurface (eds) P. Amy and D. Haldeman. CRC Press, Boca Raton, WSRC-TR-96-0040.

T. C. Hazen—ESS, In Press. Case Study: Full scale in situ bioremediation demonstration (methane biostimulation) of the Savannah River Site Integrated Demonstration Project. In: Bioremediation of Contaminated Soils (eds) D. C. Adriano and J. M. Bollag. Monograph of the Soil Science Society of America/American Society of Agronomy, WSRC-TR-96-0044.

Presentations

J. A. Bowers—ESS, gave a talk titled "DataDelve and EcoTrack Server: A Spatial Data System for Environmental Warehousing" at EnviroSoft96, an international symposium sponsored by Wessex Institute of Technology held in Como, Italy, September 1996.

J. R. Kastner, J. Radway, T. C. Hazen, K. H. Lombard, G. Burbage, D. J. Altman, M. M. Franck, F. A. Washburn, C. J. Berry, and R. L. Brigmon—ESS, WSRC-MS-96-0386X (abstract only) Bioventing vs. prepared beds for remediation of petroleum contaminated

sites. September, 1996, Warsaw, Poland. Third International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe.

K. Ulfig, G. Plaza—IETU, T. C. Hazen, C. B. Fliermans, M. M. Franck, and K. H. Lombard—ESS, Bioremediation Treatability and Feasibility Studies At A Polish Petroleum Refinery. September, 1996, Warsaw, Poland. Third International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe.

P. R. Cable—ETS, presented "Field Deployable Tritium Analysis System", to all contributing partners (Sampling Systems Inc., C.A.I.S., EICrom, Inc. and SRTC) on commercialization of the technology, WSRC-MS-96-0459S (slides).

P. R. Cable—ETS, attended the "Asilomar Conference on Elemental Mass Spectrometry," Pacific Grove, California.

K. J. Hofstetter—ETS, presented "Field Deployable Tritium Analysis System", to all contributing partners (Sampling Systems Inc., C.A.I.S., Eichrom, Inc. and SRTC) on commercialization of technology, WSRC-MS-96-0384.

K. J. Hofstetter and M. M. Pendergast—ETS, presented "Application of UAV's at the Savannah River Site", as invited paper at UAVSI'96 in Orlando, Florida, WSRC-MS-96-0319.

K. J. Hofstetter and P. R. Cable—ETS, co-authored "A Remotely Operated, Field-Deployable Tritium Analysis System for Surface and Groundwater Measurements", an invited paper for DOE-NV Field Sampling Workshop in Las Vegas, Nevada. The co-authors were J. E. Noakes, J. D. Spaulding, and M. P. Neary of the Center for Applied Isotope Studies at the University of Georgia and M. Wasyl of Packard Instruments, WSRC-MS-96-0384.

R. Buckle—ETS, prepared and presented a poster entitled "Mesoscale Modeling of the Inland Nocturnal Sea Breeze" at Bell Auditorium in Augusta, Georgia, on as part of

the 1996 Research Intern Exhibit sponsored by the Education Outreach Programs Department, WSRC-MS-96-0432.

C. H. Hunter—ETS, presented an overview of ETS meteorological capabilities and plans for meteorological collaboration with local counties. Representatives of the Richmond County Emergency Management Agency, Georgia Environmental Protection Division, and local industry were in attendance. Following the presentation, M. J. Parker, R. F. Holland, J. T. Hamilton, and F. A. Cheek conducted a demonstration of the bivanes and anemometers that will be used in Richmond County's meteorological monitoring network.

Poster Presentations by Summer Interns

A Heuristic DNAPL Model for Estimating the Extent and Thickness of DNAPL on the Green Clay Confining Zone, WSRC-MS-96-0479, Tamra Payne, Clemson University, Mentor: D.G. Jackson—ESS.

Characterization of Chlorinated Solvents in the Crouch Branch Aquifer, WSRC-MS-96-0458, Harvey Campbell, North Carolina A&T, Mentor: D.G. Jackson—ESS.

Development of Numerical Algorithms for the Analysis of Groundwater Flow using Advective Three-Dimensional Particle Tracking, WSRC-MS-96-0478, Kelle Langham, Clemson University, Mentor: D.G. Jackson—ESS.

An Investigation of Phytotoxicity in a Contaminated Sandhill Seep Wetland. WSRC-MS-96-0484 H.M. Westbury Jr. University of South Carolina, Mentor: E.A. Nelson—ESS

A Small Mammal Survey of Pen Branch, Lost Lake, and an Isolated Wood Lot. WSRC-MS-96-0491, E. Stieve, Purdue; T. Parker, Warren Wilson College; and J. Gass. Un. of South Carolina, Aiken, Mentor: L.D. Wike—ESS
Lost Lake Biological Restoration WSRC-MS-96-0447, K.M. Hiers Un. of South Carolina, Mentor: F.D. Martin—ESS

Methods Used to Assess the Risk of the Savannah River Integrator Operable Unit (IOU), WSRC-MS-96-0449, K. Mayernick,

Un. of South Carolina, Mentor: C.E. Murphy—ESS

Closure Cap Repair. WSRC-MS-96-0463, T. Richardson, South Carolina State Un., Mentor: M.A. Phifer—ESS

Evaluation of a Direct Ion Trap Mass Spectrometry Method for the Analysis of Volatile Organic Compounds, WSRC-MS-96-0464, B.A. Balogun, Clemson University, Mentor: T.R. Jarosch—ESS

Application of Minipermeameter Technology to SRS Sediments, WSRC-MS-96-0465, J. Celeste, Un. of South Carolina, Wilmington, Mentor: M.K. Harris—ESS

Biodegradation of Automobile Tires by *Sulfolobus* sp., WSRC-MS-96-0466, G.M. McKinney, Un. of South Carolina, Aiken, Mentor: C.B. Fliermans—ESS

Determination of Aquifer Characteristics from Air Pressurized Slug Test Data, WSRC-MS-96-0483, T. Lovekamp, Un. of Georgia, Mentor: K.L. Dixon—ESS

Flourescent Antibody Application in the Bioremediation of TCE at the Sanitary Lanfill of SRS, WSRC-MS-96-0485, B.S. Richardson, Un. of South Carolina, Aiken, Mentor: R. Brigmon—ESS

Microbial Characterization of Trichloroethylene Contaminated Groundwater Using Substrate Utilization Patterns and Fatty Acid Methyl Ester Profiles, WSRC-MS-96-0486, A.L. Gluxman, Clemson University, Mentor: R.L. Brigmon—ESS

Degradation of Benzene by Microbial Communities Inhabiting the Organic Removal Facility, WSRC-MS-96-0488, B. Bumgarner, Clemson University, Mentor: T.C. Hazen—ESS

Evaluating DNA Based Methods to Determine N2 Fixers in Compost, WSRC-MS-96-0489, L.D. Ives, Un. of South Carolina, Aiken, Mentor: T.C. Hazen—ESS

Bromide Tracer Testing for DNAPL Characterization, WSRC-MS-96-0490, M.L.

Rhoden, Un. of South Carolina, Mentor: K.M.
Jerome—ESS

Development of Terrestrial Rapid
Bioassessment Protocols, WSRC-MS-96-0497,
J.T. Hayes, Paine College, Mentor: L.D.
Wike—ESS

Enzyme-Linked Immunosorbent Assay
(ELISA) for TCE and PAH Degrading acteria
Isolated from the SLF at SRS, , D. Jones, Un.
of South Carolina, Aiken, Mentor: T. C.
Hazen—ESS, WSRC-MS-96-0493.