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TRITIUM

- The technical requirements for the design of the W-76 loading line have been issued. The requirements have been reviewed with the Design Agencies to provide concurrence that the design is sufficient to meet all current and future missions.

- In preparation for a full-scale, cold Terrazzo reclamation test, additional test and equipment changes were successfully completed to improve the cap seal weld for the Terrazzo reservoir. The reclamation resistance welding station was modified to provide a helium atmosphere during welding and a series of Terrazzo test welds was successfully completed in helium. X-ray radiography was shown to be a viable inspection method to evaluate the quality of the cap weld.

- A full-scale, deuterium-loaded Terrazzo reservoir was successfully reclaimed following as closely as possible the laser drilling and laser rewelding process steps proposed for production reclamation of these reservoirs.

- The Equipment Engineering Section has completed the Mini-Manifold design drawings, and the drawings are being reviewed by Bechtel Design Engineering. Currently, the scheduled completion date for installation of the Mini-Manifold and modifications to the loading line is September 1995.

- Six 993 type pinch welds were evaluated in the MTF with the bonds rated as Class I. Internal stem surfaces were examined and concluded to be typical of other WR stems.

- An initial proposal for tritium charging to achieve accelerated aging of burst disk assemblies for SNL/CA has been developed and presented to involved parties.

- A flow through cleaning station has been assembled and located adjacent to the existing development Acorn cleaning station. This will be used to evaluate a flow through cleaning method for potential benefits over the existing method.

- A new specimen preparation technique has been developed to produce TEM thin-foils from solid-state weld specimens. This new technique provides a method to more precisely locate the electron transparent region in TEM samples near a weld interface, thus facilitating finer scale analyses of solid-state weld microstructures.
- Delta-ferrite stringers were discovered in the grain structure of a 1M burst reservoir from the Life Storage Program. Upon visiting SRS to discuss this issue, LANL personnel requested additional metallurgical examinations.

- SRS personnel visited LANL to discuss their inventory in the Life Storage Program as well as a five year plan for work.

- A titanium hydride storage bed was recently recommended for the long-term storage of tritium. The material of construction of the bed container vessel must be chosen with care, since the tritium bed requires an unloading temperature of 600°C. Two specific types of stainless steel Types 347H and 316, are candidates for material of construction for the vessel. With either stainless steel, the bed should be used only once and discarded after the first unloading. In addition, the materials compatibility of titanium and the stainless steel at 600°C should be evaluated.

- On an expedited basis, EES was requested to design a new insert for unloading 681 units.

- SRS has received the first shipment of development units from Mound.

- EES was requested to test a new oil-free transfer pump from Normetex for use in the FTF. EG&G Mound used a custom oil pump to perform this function. Due to FTF limitations, an oil-free pump must be used.

- Technical presentations were given by SRS personnel January 12, 1995 to review the current as well as future capabilities SRS has in support of the Acorn technology. Design Agency, Mound, and DOE-SR personnel attended.

- Personnel from SRS visited Mound January 17-18, 1995 to conduct a safe and file walk-through for Reservoir Surveillance Operations. Design Agency personnel also assisted.

- A new method to produce silica embedded metal hydride in granular form was demonstrated in the laboratory.

- EES and SPS assisted the Chemical and Hydrogen Technology Section (CHTS) in successfully demonstrating the ability to laser drill and re-weld a 3T reservoir.

### SEPARATIONS

- An interim report WSRC-TR-95-0028 was prepared and reviewed by the Chemical Technology Group. The results show that dispersion of organic phase in an immiscible aqueous phase involves a number of distinctly different stages, each of which can be reasonably well defined.

- A series of mixing studies was begun to identify the range of levels in a canyon tank where the agitation is sufficient to disperse quantities of organic
greater than 8 vol.%. The intent of the studies is to provide an envelope for the operation of an evaporator feed tank for the fault tree being prepared for the H-Canyon BIO.

- Support was provided to the restart activities for the second plutonium cycle in F-Canyon in verification of solvent quality. Solvent quality parameters measured include dibutyl phosphate (DBP) concentration, ability to strip extracted plutonium (pickup test), and interfacial tension (IT). Results after cold stream and initial plutonium operations indicated passage through the second plutonium cycle did not degrade solvent quality.

- An alternate flow sheet 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 flow sheet development, studies are being conducted with acid-soluble plastic bag materials which might replace insoluble PVC and polyethylene. Two potential bag materials were tested with promising results. Work will continue in March.

- The air exhausted from potentially radioactive areas of the F-Canyon facility is passed through a sand filter before expulsion to the atmosphere. As a part of the annual inspection of the filter medium, sinkholes which form in the sand are filled with fresh sand. Due to the critical nature of the filter, the sand which it contains has been classified a Nuclear Safety (NS) Class item and must meet certain criteria. CHTS performed air permeability tests on a proposed vendor's sand to be added to the filter, and found it to be acceptable.

- Among the materials stored in the FB-Line vault are mixed UO2-PuO2 powders, probably shipped from Hanford. A possible method for long-term storage for this material is a calcination treatment to drive off absorbed H2O and/or CO2 and packaging in all-metal containers.

- Storage of plutonium in a glass is a potential answer to the problem of long-term plutonium storage as a stable, non-dispersible solid phase. The study of Pu glass to define the Pu loading, the durability of the glass, and the optimum frit mixture has begun to determine the parameters for a satisfactory glass. Three PuO2-frit mixtures were fired to produce glasses at 6, 17, and 30% Pu. All three glasses appeared homogenous and remained intact after cooling.

- H-Canyon proposed a Test Authorization (TA) to detail the method and limits for the processing of Pu-242 through Frame Waste Recovery (FWR) for transfer to HB-Line. After review by CTS, a change in minimum acid concentration was made to prevent polymer formation.

- The Safety Analysis Report - Packages (SARP) for the 5320 radioactive material package, used by several sites within the DOE complex for transport of heat source material over public highways has been issued and is awaiting DOE response.

- EES has successfully completed initial testing of the Haskel 100,000 psi compressor cart, the burst test cell, and the Lepel induction power supply for the Hydraulic Burst Test Facility.
ENVIROMENTAL

- The capabilities of the Environmental Data Atlas were presented to representatives of Information Resource Management and the Site Geotechnical Services. The ability to handle any variety of remote sensing and Geographic Information System data, as well as bibliographic information, and development of a user-friendly site selection module were presented.

- Samples were collected from 30 locations in Par Pond to determine contaminant levels in surface soils, in small mammals, and in vegetation from areas exposed when the reservoir was drawn down. The data will be used to determine the ecological risks posed by radionuclides and other contaminants in the sediments.

- Fisheries, water quality, and submerged sediment samples were collected from Par Pond to establish baseline conditions prior to refilling the reservoir.

- The VENTSAR computer code has been verified and a report was issued (WSRC-RP-95-89). VENTSAR is used for release safety analysis calculations involving building wake effects.

- The Radiological Assessment Program (RAP) document, Assessment of Mercury in the Savannah River Site Environment, was published.

- An aquifer vulnerability assessment is being performed for SRS. This assessment will identify areas that are more susceptible to groundwater contamination based upon hydrogeologic environment. The analysis is based upon EPA’s DRASTIC method.

- A Safety Analysis Report (SAR) is being prepared for the Liquid Radioactive Waste Handling Facility (LRWHF) in F and H Areas. Conservative groundwater travel times and transport parameters were used to generate attenuation factors for use in LRWHF SAR analyses.

- The Environmental Sciences Section Biotechnology Group has been working with Interim Waste Technology and local industry to determine if irradiation could possibly be used to sterilize clay shipments that tend to “spoil” after extended shipment and storage times. The problem was originally thought to be due to the sulfate-reducing bacteria causing discoloration. Tests by the Biotechnology Group have shown that the contamination was actually caused by a fungus.

- Burlington Environmental, Inc. has been successfully applying the SRTC-patented technology for in situ bioremediation of chlorinated solvents using methane and air biostimulation. Their pilot tests over the past five months demonstrated that the methane and air injection for in situ bioremediation can...
greatly enhance site remediation by decreasing time and achieving lower cleanup levels.

- E. W. Wilde (Biotechnology Group) and J. Koch (Ecology Group) accompanied R. Goetzman (Economic Development Division) to a Spartan Mills textile plant near Spartanburg, SC on January 31, 1995. The purpose of the trip was to assist Spartan Mills personnel in developing process changes designed to reduce odors in their water treatment process for dye bath waste waters.

- The ESS-Biotechnology Group was asked to be a co-participant on a Bioremediation Education Science and Technology (BEST) Center. SRTC’s role will consist of being the primary field demonstration and field training site for the proposed BEST Center. In addition, a licensee of SRTC Bioremediation technology, is also submitting a proposal for a bioventing demonstration at an US Air Force base in Frankfurt, Germany. The focus of the proposal will be the use of gaseous nutrient injection of phosphate and nitrous oxide at a diesel fuel contaminated site. SRTC will provide technical assistance in applying the technology.

- Bradtec-US, Inc. issued the first chemistry report on the work done using amino iminodiacetate (IDA) resin on magnetic particles. The report pointed out the need for further testing with magnetite cores that would not leach contaminants into the treated water.

- The draft of the Treatability Study Workplan for the MAG*SEP Demonstration was presented to EPA and SCDHEC. Waste generation and handling may be issues of concern for the regulators. Construction of the barrier wall by BMC Corporation is continuing. The pass-thru was installed. Failure of one of the joints of the pass-thru after installation caused a delay of the construction of the barrier wall by two to three weeks. The pass-thru box was excavated and repairs are underway.

- The purpose of the Field Test Platform is to evaluate characterization and monitoring technologies under real-world conditions to determine their operating parameters and to facilitate technology transfer. The technologies focused on are field-deployable instruments for measuring volatile organic compounds. Long term evaluations of five instruments are underway at the Integrated Demonstration Site under a variety of operating scenarios.

- SRS is the host site for the field portion of the Phase II and III work to be completed through the METC/PRDA geophysical data fusion program. The purpose of the study is to use innovative geophysical methods to collect high-quality data from multiple geophysical sensors that will be input into the Coleman data fusion workstation. The collection and preliminary interpretation of the Phase II and III geophysical data is complete. A critical EM-40 need provided the focus for the work—determination of the competence of the layer separating the two major regional aquifer systems.

- As part of the DOE-SR Special Consolidated Solicitation, a demonstration is being conducted to test a regenerative adsorption system for recovering chlorinated organic solvents for reuse. The project is being managed by Tetra Tech, Inc. (Pasadena, CA) and uses the PADRESTM (Purus Adsorb-Desorb Remediation Equipment) system developed by Purus, Inc. (San Jose, CA).
Executive Summary

SRTC is operating the vacuum extraction system and providing logistical and analytical support. Results on solvent acceptance testing were received in late January 1995 from the recycling firm. The vendor believes the recovered solvent can be reused as is without blending with existing stock piles or modified with the addition of stabilizers. The presence of trichloroethane, however, will require designation of the solvent as an ozone depleter.

- Isotron cylinders could not withstand the high voltage tests and voltage on the TNX array was lowered to 40V. Isotron will remove their cylinders on February 1, 1995.

- A rapid and relatively inexpensive technique for defining the extent of groundwater contamination by tritium was investigated. Trees can be used to sample groundwater where the groundwater is not too deep or below a soil strata difficult for roots to penetrate (approximately 20 feet below the surface).

- SRS and ESS were requested by HAZWRAP (Martin Marietta Energy Systems) of Oak Ridge, TN to provide our site, services, and expertise in conducting a demonstration of an emerging technology for treating air streams containing chlorinated VOCs (CVOCs). The technology demonstration being proposed involves a flameless thermal oxidation (FTO) technique developed and patented by Thermatrix Inc. Work is in progress at the test site on well sampling and pump tests and on installation of electrical power and gravel pads. Preliminary analysis of samples collected during a pump test at AMH-4 show a total chlorinated organic concentration of approximately 1000 ppmv which is sufficient for determining destruction efficiencies >99.9%.

- ESS is responsible for the installation and start-up-testing of a vertical recirculation well (VRW) at TNX. A VRW is an innovative groundwater remediation method that uses in-well vapor stripping of chlorinated volatile organic compounds (CVOC). The VRW is being installed as part of the TNX Groundwater Interim Record of Decision. A conceptual design of the TNX recirculation well was prepared and a design review was scheduled. A revised map of trichloroethylene (TCE) concentration in groundwater was prepared and submitted to ERD.

- Field testing of the two-inch monitor wells installed in the Southern Sector of the A/M Area is complete. This testing involved pumping one well and monitoring for hydraulic response in another well. These tests were conducted to obtain the data needed to calculate aquifer hydraulic parameters, transmissivity, storativity, and leakance is complete.

- The technical task plan to evaluate the use of an in situ soil-stabilization technique was reviewed and comments are being incorporated for issue by February 10, 1995. Preliminary physical and chemical characterizations for the depth-specific soil composite borings from the Old F-Area Seepage Basin are complete. Tasks remaining to complete the soil characterization include analysis of acid-digested solutions by ICP-MS and TCLP tests (and ICP-MS-analyze the extracts) on each soil sample (12 total) and the four composite samples.

- The reverse osmosis (RO) test report (WSRC-RP-95-0143, Rev. 0 - January 25, 1995) from the Environmental Restoration-sponsored Barnwell-McBean aquifer study was issued. The membrane remediated all non-tritium species
that exceeded the primary drinking water standards (PDWS) (e.g., cadmium, non-volatile beta, and total radium) to levels well below the PDWS. Many other species were removed to below their analytical detection limits. Treated water flow rate losses of 55–90% were observed with the pilot unit and were primarily attributed to the inadequate pumping capacity (~2/3 vendor-recommended flows) of the available RO test unit.

- Environmental Restoration (ER) conducted an aquifer extraction test using water from the Barnwell-McBean aquifer down gradient of the F-Area seepage basins. This water is contaminated with various salts, metals, and radionuclides. IWTS used the aquifer test as an opportunity to evaluate reverse osmosis (RO) on actual contaminated groundwater.

- To assist the Environmental Restoration Division (ERD) with wetlands mapping and delineation and to document the history of changes at the R-Area seepage basins, the Environmental Sciences Section’s reference collection of 80,000 frames of vertical photography of SRS was searched. Over fifty frames of photography that cover the period from 1958, during early construction and use of the seepage basin, until the present were found. Representative photographic materials were selected for producing scaled enlargements to assist ERD in developing work and characterization plans for these basins.

WASTE MANAGEMENT

- A report discusses hydrogen gas release rates from salt dissolution operations in Tank 41H. The analysis demonstrates an adequate safety margin for planned operations.

- SRTC is investigating whether leaks in waste transfer lines during In-Tank Precipitation (ITP) processing will flow to leak detection boxes. The investigation showed concentrated precipitate (>5%) will not flow to the leak detection boxes, dilute precipitate (1-2%) could have a yield stress which is too large to enable it to flow to the leak detection boxes, and salt solution could crystallize in the transfer lines and not flow to the leak detection boxes.

- As part of the OTD Economic Development Plan, IWT is coordinating a treatment demonstration with RUST Engineering on Rad Polychorinated Biphenyl(PCB) waste. The objectives are to demonstrate a low temperature extraction and destruction process as an alternative to incineration, demonstrate the RUST process that could lead to more business for the Anderson, S.C. located company, and treat and dispose of 9 drums of SRS Rad PCB waste. The 9 drums were sent to RUST in February and characterization is underway.

- The OCTF is a 1/10 scale pilot facility at TNX which will evaluate the operating performance of the CIF off-gas system. The OCTF underwent hardware modifications to address two problems uncovered during the initial stage of the five week production and simulation run. With these modifications, the burner chamber pressure fluctuations have been eliminated, the burner ignites easier and comes on line sooner, and the
scrubber operates per vendor specifications. Similar modifications will be made to the CIF.

- Enertech, based in Atlanta, is developing a slurry carbonization process to convert sanitary waste to energy. SRTC (IWT, DWPT, and Materials Technology) recently provided a work plan to Enertech describing what would be needed to further develop this process. Enertech included this work plan in a NIST proposal.

- During a recent aquifer test down gradient of the F-Area Seepage Basins, IWT evaluated Reverse Osmosis (RO) on the contaminated groundwater as a potential treatment technology. The membrane remediates all non-tritium species which exceed the primary drinking water standards (cadmium, non-volatile beta, and total radium) to levels well below the standards.

- English China Clay (ECC) is launching an effort to control biological growth in their kaolin product while minimizing chemical biocides. Under the Industrial Assistance program, SRTC has performed preliminary testing of irradiation (from electron beam or cobalt source) for biological control. ECC has expressed willingness to fund about $10K for a second set of irradiation tests.

- EES was requested by ITP to perform tests on the Tank 49 benzene analyzer to determine the cause of spurious analyzer readings.

- EES has delivered equipment mockups for the Analytical Cell mockup at DWPF.

- EES completed final development drawings in the effort to repair, re-engineer, and document the DWPF Melter Borescope Assembly.

- EES completed design of the equipment frame for SWAMI II (Stored Waste Autonomous Mobile Inspector).

- EES completed the design of the Video Camera Deployment Stand for use in underground storage tanks at Hanford.

- During December and January, the HLWIFM was upgraded to include a generic wash water supply and to allow salt dissolution operations in Tank 41 to transfer product to and from Tank 40 without mass balance errors. This removes the last major barrier to HLWIFM use for limited year simulations.

- Computational fluid dynamics (CFD) methods are being developed to better understand and guide the processes by which the contents of the high level waste processing and storage tanks are mixed. Turbulent free jet calculations with FLUENT and CFDS-FLOW3D have been analyzed in detail to ensure that jet spreading and liquid entrainment rates agree with the open literature. Further analysis is being completed to ensure that the physical models which give good agreement with data for water jets will be applicable to analyses of high level waste tank materials.

- The ProdMod development effort to create a fast running linear programming model of the SRS high level waste complex met both of its
January 1995 milestones: completion of a "skeleton" version model, and a successful proof-of-principle demonstration. Current effort is focused on verification of the model and expansion of the existing unit operation models.

- The customer was concerned by an unexpectedly high pressure drop across the scrubber-inlet damper valve in the Off-Gas Components Test Facility (OCTF) at TNX. The OCTF can not be operated at maximum design flow rate because of this unexpected pressure drop. Three recommendations have been made that would increase the void fraction in the vertical duct and reduce the pressure drop. The customer has already started to implement one of the recommendations by increasing the scrubber-inlet damper valve from a 6” to a 12” butterfly valve.

**GENERAL**

- EES and SSQ completed an inspection of underwater fuel assemblies in the RBOF basin.

- EES shipped MACS (Mobile Autonomous Characterization System) to Oak Ridge National Laboratory (ORNL) to achieve a major milestone in the Office of Technology Development Robotics Technology Development Program for D&D.

- SRTC has prepared a total of 21 Baseline Change Control Packages during FY-95 and 14 of the packages have been approved by DOE.

- DOE Orders 1540.2 and 1540.3 remain among those of special interest to the Defense Nuclear Facilities Safety Board (DNFSB). Recent revisions to the associated Directive Implementation Instructions (DIIs) from DOE-SR have been reviewed for applicability to WSRC, and both were found to contain pertinent requirements. Respectively, the directives address administrative controls to be used in packaging hazardous materials for transport and the technology used in packaging radioactive material for transport.
Progress and Accomplishments

TRITIUM

A document (WSRC-RP-94-947) has been issued summarizing the technical requirements to which two production loading lines must be designed in order to meet current and future requirements for tritium loading of gas transfer bottles. These include system pressures, volume requirements, purity limits, proposed valving requirements and other pertinent information. The information in this document was reviewed for concurrence with representatives of both the design agencies (LANL and SNL/CA) after the Process Realization Team (PRT) meeting in January. The information in this document was also used as the basis for the Functional Performance Requirements developed for this project. SRTC involvement will be required for several phases of the project including: materials selection and design of the hydride beds, development of fixtures, and capabilities for leak checking valve integrity. The primary design requirement information in this document was also summarized in a letter to R. D. Buley (WSRC-RP-95-205) which will be forwarded on to DOE for concurrence that we are designing to meet currently foreseen complex needs.

The PRT underwent a 2-day Teaming Training at their last meeting. This involved representatives from LANL, SNL/CA, DOE-AL, AS-KCD, SNL/AL and SRS. Three SRS personnel were involved. This training is one of the training segments required for all operating PRT's as specified in the DOE-AL Engineering Procedures (EP's). Since the Acorn PRT is the first operating PRT and courses have not been designed specifically for the PRT, the training was provided by a Kansas City trainer.

Upset Welded Cap Closure

W. R. Kanne, J. A. Morin

In preparation for a full-scale cold Terrazzo reclamation test, additional test and equipment changes were successfully completed to improve the welded cap seal for the Terrazzo reservoir. The reclamation resistance welding station was modified to provide a helium atmosphere during welding and a series of Terrazzo test welds was made in helium. Three of these welds were helium leak tested in the laser unloading chamber to demonstrate that this method can be used to evaluate the equipment in the full scale test. The process of welding in helium followed by the leak test worked well and no leaks were detected in the three welds. Two welds made in helium were pressure tested to failure. One held the pressure limit without failing. The other, welded at a low current, failed in the weld, but at a pressure more than an order of magnitude greater than the maximum that the cap could see at end-of-life.

The Special Processes Section is investigating radiography and ultrasonic testing for evaluating the quality of the cap weld. Radiographs showed the internal configuration of the weld, thus demonstrating that x-ray radiography can be used as an indication of weld quality in production. These radiographs are being digitized to further enhance and enlarge the weld area.

A modified joint design on the cap, to put more weld metal in the joint area, was tried, but no obvious improvement from the previous design was apparent. No interactions with the ring representing the pinch weld on the test base were observed with either joint design. The cap weld for the full scale test will be
made in helium using a cap of the original joint design.
In support of the deuterium reclamation demonstration, the tube bore of the WR reservoir was inspected and found to be satisfactory.


A full-scale, deuterium-loaded Terrazzo reservoir was successfully reclaimed following as closely as possible the laser drilling and laser rewelding process steps proposed for production reclamation of these reservoirs. All of the process steps, unit loading, laser drilling, gas change-out, laser welding, and upset welding of the cap, were accomplished within expectations, demonstrating the proposed reclamation process is a workable one.

A new Terrazzo reservoir was first loaded to simulate an aged reservoir returning from stockpile for reclamation. To begin the reclamation process, a weld filler metal sleeve was clipped over the fill stem, the reservoir was sealed in a gas/vacuum tight laser fixture, and the old fill stem was laser drilled to remove the old gas. This gas was collected and measured using a gas manifold connected to the laser fixture. New D₂ gas was loaded into the unit through the laser drilled hole to a specified target pressure. The laser with a different set of power/pulse parameters was then used to weld shut the hole in the fill stem, sealing the new gas fill in the reservoir. The welded region incorporated metal from the fill stem wall and from the filler metal sleeve, producing a weld that is expected to be resistant to weld cracking that could occur if the weld had been made on the 316 SS stem alone. Initial visual inspection and pressure and vacuum leak testing indicated that a good weld had been made.

After the laser reclamation steps were completed, a cap covering the fill stem was successfully welded to the top of the threaded boss below the fill stem using a solid-state upset welding technique (resistance forge welding). This cap weld provides an assured seal for the reservoir gas in the event that the laser weld leaks or otherwise fails during its lifetime. After welding, the cap was inspected visually and gauged to verify that the dimensional changes in the cap region were within the expected range for a good weld. The cap weld was made in an atmosphere of ⁴He, trapping this gas under the cap, which permitted the use of a standard mass 4 leak detector to be used to verify that this weld was leak tight. After leak checking, the cap weld was radiographed to further qualify the weld and to assure that it contained no major flaws.

Plans for this unit next include function testing the unit to verify that it delivers as expected, and that no major damage was caused by any steps of the reclamation process. When all process information has been obtained from this unit, the laser and cap weld regions will be destructively examined to provide additional data to assure these reclamation steps had achieved the required quality.

Acorn - Status of "Mini-Manifold"
Additions to the RTF - W. N. Posey, D. L. Fish, D. D. Alexander, T. J. Warren, J. V. Cordaro

The Mini-Manifold Project Status is as follows:

- EES has completed the Mini-Manifold Design Drawings, and the drawings are being reviewed by Bechtel Design Engineering.
- The two Whitey gas cylinders and Nupro Metering valve for use on the Mini-Manifold has been received and submitted to EES, who will fabricate, assemble, and He proof/leak test the Mini-Manifold.
- The two Parascientific Pressure Transducers ordered by EES for the Mini-Manifold are scheduled for receipt during March 1995.
- DOE-SR has agreed to release two reclaimed 2A reservoirs for use as calibrated volumes on this project.
Progress and Accomplishments

- Installation of the Mini-Manifold on the loading line, and the necessary modifications to the line are scheduled for completion during September 1995.

**Type 993 Pinch Weld Evaluations**

C. S. Kestin, S. B. Rhodes

The Tritium Facility received six return 993 type reservoirs with a request to evaluate them for possible leak paths. As part of the investigation, the pinch welds were sent to the Materials Test Facility (MTF) for metallography to rate the weld bonds, and to examine the internal stem surfaces.

The welds were metallographically prepared in the longitudinal direction. All six bonds were acceptable and rated as Class 1. Four of the six welds exhibited intergranular melting, while the other two welds appeared to be solid state bonds. No evidence of any leak paths were discovered.

Visual examination was conducted using a stereoscope at magnifications of 6X to 50X. There was very little surface area above the weld to examine, and the laser unloading compromised the interior surfaces of the stems below the weld. Some machining marks were noticed on the internal stem surfaces, but they appeared typical of other stems which produced WR quality bonds.

It was concluded that the welds and the stems were of WR quality. No evidence of potential leak paths were discovered.

**Burst Disk Charging**

D. L. Fish, J. Morin, J. Wermer

A proposal was generated in support of the charging of burst disk assemblies with tritium using elevated temperatures and pressures to achieve accelerated aging data. The proposed test plan would be to load the burst disks in a commercially available high pressure container capable of 10 ksi at 600°C. Two-inch diameter vessels with an internal length of 7" would enable 50-pound load limitations to be met. Free volumes in the unit would need to be minimized with inserts/filler to minimize the free tritium at risk during the loading. After inspection of samples and bakeout, the charging container would be connected to an existing RTF loading line manifold. The units would be heated to the exposure temperature and then charged while remaining on the manifold for the 48-hour charging time. After charging, the container would be cooled to room temperature and the tritium discharged. A time limitation of 24-48 hours would be necessary upon discharging to ensure that the disks did not lose significant amounts of tritium by diffusion. Approximately 10% of the tritium would be lost out of the unit within 48 hours at room temperature without any tritium overpressure. The samples would be stored at -40°C for 18 months in MTF facilities. During the storage time EES would design burst testing fixtures for testing the charged units. This work could potentially be performed in an existing test facility in MTF.

**Flow Through Cleaning Method Evaluation**

T.F. Walburg, D. Fish W. Rogier

An in depth cleaning study of Acorn series units was completed at SRTC in 1994. The current cleaning technique is done at 150°C and uses a H2 medium to effect the cleaning process. The H2 is introduced into the unit, subsequently removed and the unit then evacuated to less than 20 µm. This H2 fill/removal followed by evacuation is repeated 3 or more times, with a final pull down for several hours with a turbo pump. SRTC has been asked to evaluate a dynamic flow through cleaning technique to see if it offers any benefit over the current method. A flow through cleaning station was assembled and physically located adjacent to the existing station. In this manner it can utilize the same gas supply, evacuation system, and Residual Gas Analyzer. These will give a preliminary indication whether more thorough cleaning is being accomplished with the flow through method. However, an improvement (or lack thereof) in functional parameters during a simulated usage test will more definitively indicate if the flow through method offers any additional cleaning benefits.

**TEM Specimen Preparation Technique For Solid-State Weld Test Samples**
M. H. Tosten, C. N. Foreman

A new transmission electron microscopy (TEM) specimen preparation technique appears to provide a reproducible method to more precisely locate thin regions in or near the weld interface, thus facilitating fine-scale analysis of solid-state weld microstructures. The major challenges in preparing these samples are 1) the specimen must contain a region of the weld interface and 2) the electron transparent region must be in the near-weld region. Traditional specimen preparation techniques allow little control over where the electron transparent region will be located in the final, polished TEM sample.

Using the new technique, disks for TEM analysis are sectioned from an orientation perpendicular to the weld interface. Specimens are punched so that each 3 mm disk contains a segment of the weld interface. (The interface is located by electrolytically etching the bulk sample prior to punching.) A precision dimple grinding unit is used to preferentially grind the samples along the weld interface so that this region is much thinner than the surrounding area. Electrolytic polishing is then used to produce electron transparent regions in the mechanically thinned region.

Recently, eight TEM samples were prepared using this new technique from weld test samples previously prepared by S. L. West using the Gleeble 1500 thermo-mechanical simulation device. Thin areas suitable for TEM observation were produced within 100 µm of the weld zones on all specimens. Most thin regions were located within 50 µm of the weld interface and in one sample the weld interface was located within the electron transparent area. Future work will include the evaluation of the microstructure(s) present in these samples as well as the continued fine-tuning of specimen preparation procedure.

1M Burst Reservoir Examinations

While performing routine metallurgical examinations on a burst 1M reservoir from the Life Storage Program, it was noticed that the grain structure contained stringers. Bob Gates and Leo Michels from Los Alamos National Laboratories (LANL) visited SRS to discuss this potential material issue.

Burst reservoir 1M 220162 was lightly etched (electrolytically) with 10% oxalic acid. This etch revealed the stringers without dissolving them. Thus, using scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDS), the elemental composition of the inclusions were identified. Results showed a higher concentration of chromium present in the inclusion versus the matrix metal. LANL personnel stated that this was consistent with ferrite, another metallurgical phase of steel. It was concluded that these inclusions were indeed delta-ferrite stringers that apparently originated during the metal fabrication process.

LANL has requested additional metallography to determine the orientation of the stringers throughout the wall of the reservoir, as well as further elemental analyses of the stringers.

Inventory And Scheduling Meeting With LANL - K. A. Dunn, W. W. Yau, C. S. Kestin

SRS personnel visited LANL to discuss their inventory in the Life Storage Program as well as a five year plan for work. The inventory was reviewed with no comments, however, LANL provided input to the five year plan for work.

A schedule showing the work in support of qualifying a 304L LF-7 for use in the stockpile was reviewed. In addition, the plan for completing metallurgical examinations of selected 1M reservoirs in support of the 1M-97 reclamation was presented. LANL personnel were in agreement with the information presented.

Work in the Life Storage Program completed for LANL throughout 1994 was discussed. This work included unloading 16 units (LF-10, 2M, 1K), burst 5 units (1M, 2M, 1K) and metallurgical examinations of 4 units (1K, 6I/2I). The progress made on examinations of non-acid cleaned reservoirs was of interest to
LANL since there is a great emphasis being placed on sending non-acid cleaned reservoirs to the stockpile. SRS personnel expect to provide LANL with data from non-acid cleaned 1K reservoirs within approximately two months.

Previously, SRS provided LANL with a great deal of information related to the examination of 1K reservoirs reclaimed with the 03 insert. At this Life Storage meeting SRS personnel requested LANL to address whether or not the 1K reservoir with the 03 insert can be loaded with tritium for use in the stockpile. LANL personnel agreed to provide SRS with a decision within approximately 1 month.

Finally, as a result of the meeting with LANL personnel, SRTC has requested Tritium Operations to save the pinch welds from all Life Storage reservoirs for further examinations.

**Hydride Storage Vessel Materials Issues** - E. A. Clark

A hydride storage bed is being designed to store tritium in the SRS Tritium Facilities. The Hydride Storage Vessel (HSV) will consist of titanium powder contained in an austenitic stainless steel vessel. The titanium absorbs gaseous tritium when exposed at ambient temperature and forms a titanium hydride compound. The tritium is recovered from the bed by heating the bed to about 600°C and pumping the gas away. Storing tritium as a metal hydride is safer than storing it as a gas, and also the facility volume required to store a given quantity of tritium is much smaller than storing tritium gas. Titanium is chosen for this application because of its low cost compared to other hydride compounds, and because the vapor pressure of tritium over titanium hydride is very small. Austenitic stainless steels are preferred materials of construction for tritium systems.

This bed is similar to the recently designed Hydride Transport Vessel (HTV), which uses uranium hydride to store and transport tritium. Design considerations for the HTV led to choosing Type 347H stainless steel for the container. This material contains niobium and tantalum that combines with carbon, preventing sensitization during welding. Because Type 347H is immune to sensitization, it is not required to be post-weld heat treated, if the storage vessel is being designed to ASME Section VIII. If the HSV is designed to ASME Section VIII, the same materials selection should be made, for the same reasons. In addition, the mechanical properties of Type 347H near 600°C make it preferable to other type of austenitic stainless steels. If the HSV is not designed to Section VIII, an alternative material of construction can be Type 316 stainless steel, having a minimum of 0.04% carbon. This material also has adequate mechanical properties up to 600°C. Whatever material is chosen, the bed should only be used once. The unloading at 600°C will allow large amounts of tritium to permeate the vessel wall, resulting in significant tritium contamination on the vessel exterior. Also, a large concentration of helium will eventually form in the wall by tritium decay thereby decreasing the ductility of the wall with time. In addition, the materials compatibility of titanium and the chosen stainless steel should be evaluated at 600°C, to assure no detrimental reaction occurs during unloading. Wall stresses formed when the hydride is formed and expands should also be considered in design.

**681 Unloading Insert** - C. E. Sweeney

EES was requested, on an expedited basis, to design a new unloading insert for 681 units. Several 681's had reached their end of life pressure, and needed to be unloaded. The existing insert did not seal properly, and as a result, could not be used to unload the units.

To solve the problem, an adapter was designed to be used in conjunction with an existing 1C insert. By only having to fabricate an adapter, instead of a whole new insert, both time and money were saved. A prototype was fabricated and was delivered on 1/19 to RTF for testing purposes. RTF completed a successful test of the new insert assembly and requested seven more of the adapters. The seven additional adapters were delivered to RTF on 2/9.

**Transfer Of GTS Units From Mound To SRS** - K. A. Dunn, J. S. Hölter, H. D. Brown
SRS received the first shipment of development units from Mound on January 27. Five UC-609 shipping containers with two secondary containers per UC-609 arrived at 234-H receiving. Personnel in Receiving unloaded the UC-609 shipping containers without incident and returned the empty UC-609. All of the secondary containers were smeared by Radiological Control Operations (RCO) and eight of the ten were clean. The remaining two had low levels of tritium beta contamination.

All ten secondaries have been transferred from 234-H to 232-H where they will be opened and the inside of the secondary containers as well as the units will be surveyed for alpha contamination. If alpha contamination is detected the units and secondary containers will be transferred to 232-H for decontamination. Regardless of contamination level measured at SRS, all units and secondary containers will be tagged to alert personnel to the possibility of alpha contamination on unsmearable surfaces. A procedure, prepared by MTF personnel, will be used to complete the transfer of the units into storage in 232-H.

Normetex Pump Tests - C. E. Sweeney

A key aspect of function testing that is performed as part of Reservoir Surveillance Operations (RSO) requires the taking of accurate low-pressure PVT measurements. The accuracy of these measurements is dependent upon the ability of a transfer pump to pump high pressure gas to a large volume tank during the function testing. EG&G Mound used a custom oil transfer pump to accomplish this. The new SRS Function Test Facility to be installed in 233-H however, cannot use oil pumps. As a result, EES was requested to evaluate a new model, tritium-compatible, oil-free Normetex pump. Normetex agreed to loan SRS a pump for testing purposes.

Tests were conducted using a 1 liter volume and a 15 liter volume. Test gases included nitrogen, helium, hydrogen, and deuterium. The tests were completed in early February, and the test results are now being analyzed. The results of these tests will be used to determine whether or not the Normetex pump can be used in the FTF.

Technical Review of SRS Acorn Related Capabilities Meeting
K. A. Dunn, A. F. Riechman

Technical presentations were given by SRS personnel January 12, 1995 to review the current as well as future capabilities SRS has in support of the Acorn technology. LANL and SNL/CA personnel, representing the Design Agencies interest, attended the meeting as well as Mound personnel and DOE-SR.

In November, 1994 LANL expressed concern that communication between Design Agency and SRS personnel needed to be improved. Therefore, LANL personnel requested that SRS present technical reviews of the Acorn capabilities at SRS. The topics covered included receipt and storage of the development units from Mound, and testing of the units including gas assay, mass spectrometry, calorimetry, function testing, and environmental conditioning. In addition, an overview of SRS non-destructive as well as destructive examinations of the units was discussed.

Each speaker outlined the lead technical person, task description, schedule, equipment to be used, steps of a test, capacity, estimated accuracy of results as well as concerns and costs to DA.

Safe Walk Through At Mound - K. A. Dunn

Personnel from SRS visited Mound January 17-18, 1995 to conduct a safe and file walk-through for Reservoir Surveillance Operations (RSO). The purpose of the walk-through was to identify records to be transferred to either SRS or one of the Design Agencies (LANL or SNL) in support of RSO.
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Those individuals participating in the walk-through from SRS included Juli Hearn (Records Management for NNR), Joel Casey (Design Authority), and Kerry Dunn (SRTC). In addition, Bob Balthaser (SNWNM), Gerald Schotik and Jack Newmeyr (LANL), and Al Reichmuth and Carl Pretzel (SNL/CA) attended from the Design Agencies.

Safes and files in seven rooms, as well as the flow test lab and Dean Jones' office were reviewed for pertinent RSO records. The group identified 272 records to be sent to SRS and 137 records to be sent to the Design Agencies. SRS personnel will prioritize the list of records for disposition at Mound.

**Exxon CRADA - L. K. Heung**

The goal of the CRADA with Exxon is to develop a sol-gel metal hydride composite that will separate hydrogen from a gas mixture containing reaction poisons such as H2S. The metal hydride composite must have two basic properties: (1) not break down to fines after repeated hydrogen absorption/desorption cycles; (2) resist the poison effect of CO and H2S. The approach to produce these composites is to embed (encapsulate) the metal hydride particles in a porous matrix of silica. The matrix can accommodate the expansion of the hydride particles during hydrogen absorption so that the composite will not break down to fines. The pores and channels in the matrix can be made to be small so that CO and H2S which have larger molecule size than H2 can be blocked from entering the metal hydride particles.

It has been reported previously that two methods, one beginning with a silicate sol and the other with fumed silica, were tested and showed positive results on producing composites that did not break down to fines. An additional method which produces a composite in granular form has also been demonstrated. This new method involves the use of metal hydride powder, fumed silica powder, water and a light oil. The final product is porous granules. Each granule is comprised of a porous matrix of silica and uniformly distributed metal hydride powders. The granules can be made to different sizes well suited for packing columns for hydrogen separation or isotopes separation. Tests have shown that the granules do not generate fines after 7 cycles of hydrogen absorption and desorption. A pure metal hydride would have broken down to fines after the same number of cycles.

**Tritium Capital Projects - J. W. Wong**

The calibration of the data acquisition system for Project 4173 (Function Test Facility) has been completed. In a meeting with LANL, positive feedback about the system was received, as well as some suggestions for minor improvements. EES is presently assisting CHTS with troubleshooting of the system loops.

**Non-Nuclear Reconfiguration - J. W. Wong**

EES has successfully completed initial testing of the Haskel 100,000 psi compressor cart, the burst test cell, and the Lepel induction power supply for the Hydraulic Burst Test Facility. Burst tests were conducted to verify the burst test cell design and to check out the compressor cart. Test brazes were made with the induction power supply and pressurized to 120,000 psi without failure.

The burst test cell, compressor cart, and induction power supply were delivered to Building 238-H and are currently being installed by Bechtel Construction. EES is authoring the necessary field procedures for equipment check out and testing, and Construction is on schedule for a March 21 turnover of the hydraulic burst test equipment to EES.
SEPARATIONS

Mixing in Canyon Tanks
(N. M. Hassan T. S Rudisill and Y. J. Simpkins)

Separations Engineering requested Chemical Technology (CT) to develop the documentation necessary to quantify the mixing quality in Separations process tanks. Some of these tanks contain an aqueous (continuous) phase and an organic (dispersed) phase, and these two-phases are well mixed before they are introduced into the process evaporators. Other process tanks contain solid fissile materials whose mass determination relies heavily on the degree of dispersion of the solids in the bulk solution. To assure proper control and safety of the process vessels, a mixing quality characterization study on a laboratory scale unit with geometrically similar scale of operation with plant size units was performed.

An interim report WSRC-TR-95-0028 was prepared and reviewed by the Chemical Technology Group. The results show that dispersion of organic phase in an immiscible aqueous phase involves a number of distinctly different stages, each of which can be reasonably well defined. Four stages of dispersion were identified with increasing rotational speed of the impeller of the lab scale unit, and were characterized in terms of the mixing quality. In stage 1 of the dispersion process, the organic layer on the top of the agitated aqueous vessel was undisturbed due to shearing influence of the low-speed impeller being insufficient to induce any dispersion. As the impeller speed was increased, the fraction of organic phase dispersed increased in stage 2 until the organic layer disappeared and complete but non-uniform dispersion state was reached, as described by Skelland and Seksaria (Ind. Eng. Chem. Process Des. Dev., 17, 56, 1978). In stage 3 of the dispersion process, the non-uniformity of the completely dispersed mixture decreased with increasing rotational speed of the impeller. A grossly uniform dispersion was attained in stage 4 where the local volume fraction of dispersed phase was the same in samples taken throughout the vessel.

The results also show that the lowest rotational speed of the impeller at which operation in dispersion stage 3 was always achieved was 528 rpm for acceptable total liquid levels. Scale-up relationship based on equal power per unit volume on the two scales of operation was found to be the proper criteria. This provided an impeller speed on the plant scale of 173 rpm. Since current plant impeller speed is only 68 rpm, operation of the plant scale vessel falls in the lower end of dispersion stage 2 or even in stage 1 in some cases. Thus the current plant impeller speed is insufficient to completely disperse the organic layer. The scale-up criterion employed suggested that the speed should be increased roughly by 2.5-fold, to at least 173 rpm.

Restart of the Second Plutonium Cycle
(J. H. Gray, K. J. Kalbaugh, Y. J. Simpkins, and ADS)

Part of the support provided to the restart activities for the second plutonium cycle in F-Canyon involves verification of solvent quality. Solvent quality parameters measured include dibutyl phosphate (DBP) concentration, ability to strip extracted plutonium (pickup test), and interfacial tension (IT). These measurements are made following internal circulation of feed tank solvent through carbonate and acid wash tanks, for tank 10.5 2BW solvent after cold stream operations in the second plutonium cycle, and for both 906 and 10.5 solvent within two weeks before actual hot operations begin.

Results after two recent cold stream operations indicated passage through the second plutonium cycle did not degrade solvent quality. Essentially all plutonium extracted in the 2A bank stripped in the 2B bank. The DBP concentration actually was lowered from 24-25 ppm in 906 to 10-12 ppm in the exiting 10.5 solvent. Interfacial tension values indicated phase disengaging should not be a problem (refer to SRTC-CTS-95-0020).

Hot Operations of the Second Plutonium Cycle
(J. H. Gray, K. J Kalbaugh, K. N. Forrest, Y. J. Simpkins, and ADS)
Progress and Accomplishments

Support provided for hot operation of the F-Canyon second plutonium cycle has expanded to include characterization of aqueous plutonium feed solutions as well as the solvent. Solvent pickup tests using samples of plutonium feed from various storage tanks are run to verify that plutonium in these solutions will extract, then strip, and impurities present will not degrade the behavior of solvent in the extraction and strip banks.

Following two successful hot operations of the second plutonium cycle using plutonium feed solutions from Tanks 11.8 and 12.5, the next solution scheduled to be processed is from Tank 9.6. Since this is one of the F-Area tanks which has a history of high phosphorus content, extraction and strip pickup tests were conducted with 9.6 plutonium feed samples and with feed solvent from Tank 906. The final alpha activity of 1.4x10^4 dpm/ml in the 906 solvent after 11 strip stages indicates a slight increase in "stripping difficulty" probably due to dibutyl phosphate content. However, since there are 12 strip stages in the 2B bank and an alpha value of 1.4x10^4 dpm/ml is still acceptable and no difficulties in operation of the 2A and 2B banks and minimal amounts of plutonium collected in the carbonate washer are expected.

Oxalate Precipitation in F-Canyon
(R. A. Pierce, J. D. Clark, and R. M. Younkins, AS&ET)

SRTC briefly studied a flow sheet for recovering Pu-239 in F-Canyon as an oxide via oxalate precipitation and calcination. A simple process was formulated which incorporates "in-line" precipitation, filtration, and in-situ calcination. The process can run remotely and semi-continuously with very few crane operations.

Initial tests studied the approximate time required to precipitate cerium oxalate from solution; cerium is used as a surrogate for plutonium. Using 10 mL of 1M oxalic acid and 10 mL of 1.5 g/L Ce in 2M HNO3, it was found that precipitation begins in 10-15 seconds, and is essentially complete in 3-5 minutes or less.

Next, the flow sheet was tested in the lab using a simple mock-up which simulated in-line precipitation and filtration. The demonstration unit allowed approximately five minutes of residence time for the oxalic acid and cerium solution to be in contact prior to filtration. The test unit was operated using 1M oxalic acid and 1.5 g/L Ce in 3M HNO3. The test unit operated as expected with little or no cerium oxalate precipitate observed downstream of the filter.

Based on the preliminary tests conducted, in-line precipitation has a high probability of operating successfully in F-Canyon. The process is simple to operate and is based on well-characterized chemistry. A report discussing the tests is being written.

Dissolution of Plastic Bags for SS&C Processing
(R. A. Pierce and J. D. Clark)

An alternate flow sheet 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 flow sheet development, studies are being conducted with acid-soluble plastic bag materials which might replace insoluble PVC and polyethylene.

Two new plastic samples were received and tested this month; one sample is a thick nylon while the other is a nylon-EVOH coextruded film. The vendor is waiting for a polyimide sample. Tests have been conducted to determine the solubility in boiling 50% nitric acid. In each test, about 0.14 grams of plastic was added to 40 mL of boiling nitric acid. As in previous tests, the nylon dissolved immediately. The coextruded film also dissolved immediately leaving a milky residue. This residue dissolved upon heating, and generated a significant amount of NOx gas suggesting that oxidation is also occurring, probably of the EVOH.

The vendor has said that he is able to seal both films by a conventional method with good seal strength and impact qualities. The polyimide sample is expected to dissolve in nitric acid and be sealable.
Sand Permeability Testing  
(W. S. Cavin and T. B. Garbutt)

The air exhausted from potentially radioactive areas of the F-Canyon facility is passed through a sand filter before expulsion to the atmosphere. As a part of the annual inspection of the filter medium, sinkholes which form in the sand are filled with fresh sand. Due to the critical nature of the filter, the sand which it contains has been classified a Nuclear Safety (NS) Class item and must meet certain criteria. A sand filter inspection/repair is scheduled soon, so Type G sand is being procured which will meet the existing performance criteria.

One of the criterion which any sand added to the filter must meet is air permeability. This criterion states that a two foot column of Type G sand must have a pressure drop of 2.6 to 4.0 inches of water while air with a superficial velocity of 5 ft./min. is being passed through it. An apparatus to test the pressure drop across a two foot column of sand has been constructed. A preliminary sample of sand from Badger Mining Corporation (BMC) has been tested for air permeability and was found to have an average pressure drop of 3.803 inches of water (average of 10 runs). Based on satisfactory results from this and several other tests, the required amount of sand is being purchased from BMC. When the sand arrives (about one month), 15 random samples will be analyzed to ensure compliance with the criteria.

Organic Material in the 1AP Decanter  
(M. L. Hyder)

On the shutdown of F-Area Canyon operations, 1AP solvent was left in the 1AP decanter, along with some amount of 3M nitric acid from the IAS. This material has remained in place for about seven years, and concern had arisen regarding its disposition. Separations personnel asked for advice on this problem.

Calculations based on literature data indicated that the TBP present will be partially hydrolyzed to dibutyl phosphate (DBP) and butanol or butyl nitrate. The extent of hydrolysis could be as much as 40%. Butyl nitrate is expected to be present in much greater quantities than butanol. The DBP should be soluble in the organic phase and will make it difficult to strip U or Pu from that phase. The butyl nitrate will also remain in the organic phase; it is not expected to interfere with solvent extraction, but its reactivity with nitric acid at higher temperatures makes it a potential hazard, should it ever be inadvertantly heated.

It was recommended that the solvent be removed from the decanter, and the actinides present stripped as much as possible; then the solvent should be discarded.

PuO₂ Storage Testing  
(D. G. Karraker, J. H. Gray, and J. Middleton)

Among the materials stored in the FB-Line vault are mixed UO₂-PuO₂ powders, probably shipped from Hanford. A possible method for long-term storage for this material is a calcination treatment to drive off absorbed H₂O and/or CO₂ and packaging in all-metal containers. The storage specification for PuO₂ requires weight loss-on-ignition (LOI) of 0.5 wt.% after one hour at 900°C. UO₂-PuO₂ material is presumed to meet the same requirement. Tests also measure the absorption of H₂O/CO₂ after calcination.

A sample of UO₂-PuO₂ calcined for three hours at 750°C met the storage and absorption requirements for long-term storage. Calcination of the 35%PuO₂-65%UO₂ material showed a slight weight gain, identified by x-ray diffraction as the result on some UO₂ conversion to U₃O₈ as,

\[
3\text{UO}_2 + \text{O}_2 \longrightarrow \text{U}_3\text{O}_8
\]

The conversion to U₃O₈ is incomplete at 750°C; LOI test of the calcined mixture at 900°C found no weight change. Since x-ray diffraction showed an increased intensity for the U₃O₈ pattern, apparently volatiles driven off by the LOI test were equal to the slight weight gain produced by conversion of UO₂ to U₃O₈. However, x-ray diffraction indicated that the bulk of the material was not converted.

A 24 g sample was exposed to glove box air for 9 days, during which there was a 0.1%
weight gain. The sample gained weight for four days, then lost weight. It is concluded that the humidity of the air was also involved in the weight gain.

Glass Storage of Plutonium
(D. G. Karraker and W. G. Ramsey, DWT)

Storage of plutonium in a glass is a potential answer to the problem of long-term plutonium storage as a stable, non-dispersible solid phase. The study of Pu glass to define the Pu loading, the durability of the glass, and the optimum frit mixture has begun to determine the parameters for a satisfactory glass.

Three PuO₂-frit mixtures have been fired to produce Pu containing glasses; the first, a 6 wt.% PuO₂ was fabricated by the addition of the standard DWPF borosilicate frit (P202), the second, a 17 wt.% PuO₂ was made with an iron phosphate frit, and the third, a 30 wt.% PuO₂ was made with the same frit. All three firings were at 1100° C for five hours; all three glasses appeared homogenous and remained intact after cooling. The DWPF frit sample is intended to serve as a baseline for durability studies to be performed later. Glasses produced from CeO₂-iron phosphate frit were found to be superior to DWPF glass in an earlier study, so the PuO₂-iron phosphate glass was chosen for initial PuO₂ glass investigations.

Hydrogen Generation in FB-Line Tanks Containing HSA and HAN
(J. R. Smith and J. B. Schaade)

Alpha particle emitting radioactive materials produce hydrogen, oxygen, and traces of other gases in nitric acid solutions through radiolysis. The production rate of these gases depends on the dose rate from the emitted alpha particles and the nitric acid concentration of the solution. Calculations show radiolysis can potentially cause hydrogen build-up in unvented tanks.

Modeling calculations of earlier experimental data has been successful in simulating much of the data observed experimentally. In a high nitrate and acid environment the aqueous electrons generated from radiolysis rapidly react (<5x10⁻¹¹ seconds) to produce NO₂⁻ and H⁺ radicals. Recombination of the H⁺ radicals to produce hydrogen gas (H₂) competes with oxidation of H⁺ by oxidants such as NO₃⁻, O₂, ·OH, and NO₂⁻. The model predicts a slight [H⁺] effect for constant [NO₃⁻].

An important product of the model is the ability to predict the effect of additives to solutions to reduce the production of hydrogen. Two promising candidates for nitric acid solutions (>0.1M NO₃⁻) are Mn⁺² and ascorbic acid. Addition of Mn⁺² to 0.05M concentration should reduce the G(H₂) value (the molecules of H₂ produced per 100eV of absorbed alpha dose) by about a factor of five. The reaction is

\[ \text{Mn}^{+2} + \text{H}^+ \rightarrow \text{Mn}^{+} + \text{H}^2 \]

and has a rate constant of 6.6E8 moles⁻¹ liter⁻¹ sec⁻¹. The Mn⁺ should then be reoxidized to Mn⁺² by the nitric acid. Future work will test the model predictions for these additives and the effects of HAN (versus [NO₃⁻]) and urea in solution.

Flow Interruption for Pu239 Loaded Anion Column in FB-Line
(E. A. Kyser and K. J. Kalbaugh)

Pu processing with nitrate to form anion resin is a standard technique for purification of Pu nitric acid solutions. After a series of world wide incidents involving nitrated resins, a number of safety limitations and controls were placed on operations. The primary controls had to do with venting of columns, keeping the resin wet, the temperature below 60 C, and limiting the resin’s exposure to high acid and cumulative radiation dose. Leaving Pu loaded onto organic resin in 8 M nitric acid for an extended time is recognized as an undesirable practice. During normal processing, the solution flowing through the resin bed removes both heat and degradation products. Historically FB-Line has had operating limits for flow interruptions on the order of 48 to 72
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hours. The basis for these limits was operating experience, but it is not well documented. CHTS has been requested to provide assistance with a technical basis to justify a reasonable operating limit for flow interruption.

A 4 day long exposure test is being performed with a very small, well vented column of Dowex 21K (FB-Line anion resin) that has been loaded with weapons grade Pu. Observations are being taken of the condition of the resin over 3 days exposure time. After 36 hours no obvious evidence of gassing or NOx formation has been observed (one indication of oxidation of resin). Testing is continuing, to be completed in March.

Mixing in Canyon Tanks
(N. M. Hassan T. S Rudisill and Y. J. Simpkins)

Safety Analysis and NMPD Regulatory Programs personnel have requested a series of mixing studies to identify the range of levels in a canyon tank where the agitation is sufficient to disperse quantities of organic greater than 8 vol%. The intent of the studies was to provide an envelope for the operation of an evaporator feed tank where an organic phase could not be present on the surface. Safety Analysis personnel want to take credit for dispersing large quantities of organic in the "red oil" fault tree being prepared for the H-Canyon Basis for Interim Operation (BIO).

The initial mixing experiment was performed using an organic concentration of 8 vol% with the organic/aqueous interface just above the top agitator (i.e. the best mixing conditions). Using an agitator speed representative of plant operations, the organic phase was only partially dispersed; however, no organic layer was present on the surface. Additional experiments, with tank levels two inches above and below this point, failed to disperse the organic phase. In two separate experiments, the organic concentration was increased to 14 and 19 vol% (holding the aqueous content constant). At 14 vol%, the organic was uniformly dispersed at all levels below 16 inches which corresponds to a level of approximately 7 feet in a canyon tank. At 17 vol% organic, a uniform dispersion was obtained; however, there was a thin (about 1/2 inch) organic layer floating on the surface of the tank contents. Tests are continuing to provide needed data to the Safety Analysis Group.

Pu242 Processing
(E. A. Kyser)

H-Canyon proposed a Test Authorization (TA) to detail the method and limits for the processing of Pu-242 through Frame Waste Recovery (FWR) for transfer to HB-Line. This processing differs from traditional processing in FWR in that more total Pu is proposed to be loaded on the column. This will increase the peak Pu concentration in the column during elution significantly.

The original version of the TA contained the traditional H-Canyon acid limits of between 0.2 M to 9 M nitric acid. The minimum acid concentration differs from the limits as applied to FB-Line because FB-Line has historically run a flowsheet that results in peak Pu concentrations that are higher than those historically produced in FWR. In both cases the minimum acid concentration was to avoid the formation of Pu(IV) polymer. Pu(IV) polymer formation is a function of nitric acid concentration, Pu concentration and solution temperature. Once formed, Pu(IV) polymer would be difficult to redissolve and also would cause significant accountability problems due to both the difficulty of sampling solids and the unpredictable behavior of polymer in the process. In the case of Pu-242, the safety issues this would cause are not as serious as when processing Pu-239 or Pu-238. However, the existing Technical Standards for FWR state a lower acid limit to avoid polymer formation of 0.2, which is not sufficient with the increased loading proposed for Pu-242.

CHTS personnel recommended that a minimum elution acid concentration of 0.30M nitric acid be used for Pu-242 processing and the TA was modified, approved and sent for DOE-SR approval. The change from 0.2 M nitric acid to 0.3 will not have a significant impact on either the elution process nor further
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processing of the product solution and will ensure that polymer formation will not occur.

5320 Recertification Activities
(A. C. Smith)

The 5320 radioactive material package is used by several sites within the DOE complex for transport of heat source material over public highways. The 5320 package is currently undergoing mandatory periodic re-evaluation to support renewal of its Certificate of Compliance, which permits its use for transporting radioactive materials.

DOE has reviewed the Safety Analysis Report - Packages (SARP) for the 5320 and issued Q1-series questions. Responding to these questions will require revision to the SARP. A schedule for completing these responses has been developed, based on estimates of the effort required to answer the questions from the individuals who will be performing the work. An estimate of the cost for the task has been developed from these estimates of the scope of work. The cost and schedule projections have been discussed with the customer.

Separations Support - Ivan Lewis

EES provided several design alternatives to Separations Engineering for a device to penetrate stainless steel Primary Shipping Containers to relieve pressure in the containers prior to opening. Equipment has been procured and delivered to HB-Line.

EES issued Document # SRT-EES-95-0302 on environmental testing of an HB-Line Pu Filter boat furnace heater assembly. The testing was performed to analyze the effects of humidity on the furnace resistance levels and provide storage and operating parameters to improve furnace life. EES is also working with HB-Line to determine the cause of recent failures on these furnace assemblies. Equipment has been set up to monitor power levels supplied to the furnaces to see if power spikes could be a contributing factor.

EES issued Document # SRT-EES-95006 on abnormal count rates in the Effluent Water Alpha Monitor System when pressure changes occur. A mock-up alpha water monitor system was fabricated and used for testing in Building 723-A. Testing confirmed that the high readings were caused by vibration in the photomultiplier tube during rapid changes in pressure. The report documents the testing and provides recommendations for eliminating the problem. EES is currently assisting Separations Maintenance with making recommended temporary modifications.

EES fabricated and delivered to HB-Line personnel a simple filtering system for aqueous oxalate solution vacuum transfers. Job closure will follow HB-Line usage to ensure support during processing.

EES demonstrated the Elbow Cutting Pipe Crawler for Separations and DOE-SR personnel in building 246-F. The crawler successfully negotiated a piping mock-up including several elbows and vertical sections of pipe. The crawler then articulated a plasma torch to cut and remove a section of the pipe. The crawler is scheduled to perform actual elbow removal in the FB-Line ventilation duct in April.
ENVIRONMENTAL

Environmental Data Atlas Demonstration - H. Mackey

The capabilities of the Environmental Data Atlas were presented to representatives of Information Resource Management and the Site Geotechnical Services. The ability to handle any variety of remote sensing and Geographic Information System data, as well as bibliographic information, and development of a user-friendly site selection module were presented. Discussions occurred with SGS on providing certain prepared site-wide data layers to save time and costs in setting up their program and SCUREF tasks.

February 1995 Meeting of the Environmental Advisory Committee
C.E. Murphy, Jr.

The WSRC Environmental Advisory Committee met at SRS from February 1–3, 1995; Drs. E. Berkey (University of Pittsburgh), K. Cartwright (Illinois Geologic Survey), B. Kahn (Georgia Institute of Technology), and M. Russell (University of Tennessee) attended. They participated in discussions with SRS management and staff on a variety of environmental topics including the review of the following: the 1995 SRS Environmental Report by EAC, the land-use recommendation of the SRS Citizens Advisory Committee, technology transfer at SRS, the ecological risk assessment, PAR Pond, the Radionuclides and Elements in the SRS Environment series of volumes, and the bioremediation program. Subcommittees of one or more members are active in reviewing the Site Solid Waste Management Plan, the Site Treatment Plan, and the Review of Human Experimentation. The committee agreed to review the questionnaire that will be used in public involvement with SRS land use.

Pen Branch Mitigation Action Plan
E. Nelson and K. F. Chen

A grid model for the Savannah River Swamp was obtained from the Corporation of Engineers Waterways Experiment Station in Vicksburgh, MS. This grid model will allow ESS to better understand the flooding and drying patterns of the swamp and of the Pen Branch Delta region, in particular. This will help guide ESS scientists in reforestation planting, which has begun in the Delta and in the Upper Corridor of Pen Branch. This model will also be used to assess changes in swamp hydrology resulting from changes in tributary stream flows.

Par Pond Ecological Risk Assessment
M. Paller, L. Wike, and C. Cummins

Samples were collected from 30 locations in Par Pond to determine contaminant levels in surface soils, in small mammals, and in vegetation from areas exposed when the reservoir was drawn down. The data will be used to determine the ecological risks posed by radionuclides and other contaminants in the sediments that were exposed by the drawdown. The sampling program was also designed to provide data for assessing ecological and human health risks posed by future operational scenarios in which Par Pond is refilled and water levels are permitted to fluctuate naturally by several feet in response to rainfall patterns.

Par Pond Refill Sampling
M. Paller, J. Chappell, and C. Cummins

Fisheries, water quality, and submerged sediment samples were collected from Par Pond to establish baseline conditions prior to refilling the reservoir. Sampling will also be conducted during and after refilling to document recovery of the aquatic communities and to assess changes in the movement of contaminants through the aquatic food chain that may occur as a result of the refilling. SRTC is working in cooperation with the Environmental Protection Department and the Savannah River Ecology Laboratory to conduct this work.

VENTSAR Computer Code Verified
A. A. Simpkins

The VENTSAR computer code has been verified and a report was issued (WSRC-RP-95-89). VENTSAR is used for release safety analysis calculations involving building wake effects. The verification report demonstrates that VENTSAR properly executes all algorithms and transfers data correctly. Hand calculations were...
performed to ensure proper application of methodologies.


The Radiological Assessment Program (RAP) document, Assessment of Mercury in the Savannah River Site Environment, was published. This is the ninth in a series of documents on radionuclides and heavy metals released from SRS. Documents on tritium, cesium, iodine, uranium, carbon, strontium, plutonium, and technetium were issued and a document on noble gases is being drafted.

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

Technical support of EDG's dosimetry function for this month includes the following:

- performed LADTAP XL calculations for potential H-canyon releases
- performed LADTAP XL calculations for liquid radioactive waste handling facility Safety Analysis Report
- determined minimum distance to the site boundary for various potential release locations
- rewrote Section 7.7 of the draft SRS Generic SAR to include a description of the SRS Radiological Environmental Monitoring Program (at the request of the Safety Services Section)
- prepared the liquid and air effluent monitoring chapters of the preoperational assessment document for the new HP and EMS B-Area laboratories

**Assessment of Aquifer Vulnerability**
C. Eddy-Dilek, G. Flach, D. Jackson, B. B. Looney, and R. Nichols

An aquifer vulnerability assessment is being performed for SRS. This assessment will identify areas that are more susceptible to groundwater contamination based upon the hydrogeologic environment. The analysis is based upon EPA's DRASTIC method. This methodology quantifies several parameters that contribute to the spread of contamination within an aquifer. The parameters used include: the depth to groundwater, recharge to groundwater, aquifer media, soil media, topography (slope), impact of the vadose zone, and the conductivity of the aquifer. These parameters were combined to determine the distribution of the "DRASTIC INDEX" for the water-table aquifer across the site. The pollution potential for the first confined aquifer is being determined by modifying the "DRASTIC INDEX" of the water table aquifer by the magnitude and direction of the local vertical hydraulic gradient.

**Safety Analysis Report Support**
G. Flach

A Safety Analysis Report (SAR) is being prepared for the Liquid Radioactive Waste Handling Facility (LRWHF) located in F and H Areas. To determine the consequences of postulated subsurface waste releases, attenuation factors accounting for radioactive decay for the time between release and discharge to surface water are needed. Conservative groundwater travel times and transport parameters were used to generate attenuation factors for use in LRWHF SAR analyses.

**Interactive Data Language Initial Evaluation Completed WBS WAP**
L. C. Heavner

The initial evaluation of Interactive Data Language (IDL) from Research Systems, Inc. is complete. A prototype program using pull-down menus to graphically display weather data was demonstrated and given to G. Snyder (ETG). This program plots a separate graph of each instrument installed on the TV Tower, Area Towers, CL Towers, and Bush Field data. The program runs on the SLWND1 node of the WINDS VAX cluster. Data is retrieved from an Rdb database on the WINDS VAX cluster and displayed on a VAX station 3100 in the Weather Center. This program uses the 'SPAWN' command to run one of the 29 FORTRAN programs generated by C. P. Tatum (ETG). These FORTRAN programs extract the data from the Rdb database and write it to a flat file. Research Systems, Inc. promised an SQL interface to the IDL within six months. This SQL interface fold eliminates the 5000 plus
lines of the prototype program to be reduced to approximately 1000 lines.

**In-Tank Precipitation Air Permit Modifications** - J. Stewart

Air dispersion modeling was performed in support of proposed modifications to the South Carolina Department of Health and Environmental Control (SCDHEC) Air Quality Control Permit for six sources in the in-tank precipitation (ITP) facility. Two emission scenarios were modeled for benzene. These were annualized average hourly emissions and maximum operating emissions (one hour peak) of benzene. Since air quality control considerations emissions of benzene from the ITP should not be considered in isolation from all other sources of benzene, the maximum operating emissions from all SRS sources, including the ITP, were also modeled (a total of 71 sources).

The SCDHEC ambient air quality standard for benzene is 150 micrograms/cu. m., using 24-hour averaging. The recommended air dispersion model is the Environmental Protection Agency’s Industrial Source Complex Short-Term model, Release 2 (IS CST2). The estimated maximum site boundary concentrations of benzene calculated using the ISCST2 model were found to be less than 12 percent of the SCDHEC standard for SRS emissions as a whole, and less than 5 percent for the ITP emissions in the absolute worst case scenarios. Concentrations of benzene at the site boundary calculated using averaged emissions from the ITP were less than 1 percent of the standard.

**In-Tank Precipitation Facility**

R. J. Kurzeja

Two reports on daily maximum and minimum temperatures and pressures for 1994 were prepared for the in-tank precipitation facility. These data will be used to calculate diurnal venting from waste tanks due to natural causes.

**Clean Air Act Amendments—1990**

J. Stewart

Provisions of Title III (Air Toxics) and Title V (Permits) of the federal Clean Air Act, as amended, may have significant impacts on source permitting at SRS when implemented through the South Carolina State Implementation Plan. A detailed review has been made of pertinent aspects of the Clean Air Act Amendments to identify issues to be pursued, including modeling requirements.

**Swamp Hydrologic Modeling**

K. Chen

A set of files that model the SRS swamp area hydrology was obtained from the Waterway Experiment Station of the US Army Corps of Engineers (USACE). These files will be used as input to FASTTABS, a finite element code from USACE that models the surface water hydraulics. A Silicon Graphics workstation at SRTC will perform the FASTTABS calculations. Results of these calculations will be compared with results obtained by USACE to ensure that FASTTABS is installed correctly at SRTC.

**Modification of Stream Code for Emergency Responses** - K. Chen

Replacement of the pollutant transport calculation procedure in the STREAM code with the EPA WASP5 model is nearly complete. STREAM is an emergency response code that calculates aqueous pollutant concentrations downstream from accidental spills. A test case was run successfully.

**Economic Development Clay Industry Assistance** -

C. B. Fliermans, L. Oji and S. Wach, C. Beam

The Environmental Sciences Section Biotechnology Group has been working with Interim Waste Technology and local industry to determine if irradiation could possibly be used to sterilize clay shipments that tend to “spoil” after extended shipment and storage times. The problem was originally thought to be due to the sulfate-reducing bacteria causing discoloration. Tests by the Biotechnology Group have shown that the contamination was actually caused by a fungus, Aspergillus niger. The irradiation experiments with cobalt-60 showed that doses higher than 2,000,000 RADs would be required to reduce microbial activity; a biocide tested was
also ineffective. Alternative biocides will be required to control this problem. Further discussions are occurring.

**Licensee of SRTC Patents Successfully Applying Technology to a Private Industry Site in Missouri**

T. C. Hazen and B. B. Looney

With the support of the Economic Development Division, T. C. Hazen and B. B. Looney visited a private industry site in Missouri that is contaminated with chlorinated solvents. Burlington Environmental, Inc. has been successfully applying the SRTC-patented technology for in situ bioremediation of chlorinated solvents using methane and air biostimulation. They successfully bid for the remediation of the site using the technology as their centerpiece. Their pilot tests over the past five months demonstrated that the methane and air injection for in situ bioremediation can greatly enhance site remediation by decreasing time and achieving lower cleanup levels. Burlington Environmental, Inc. is so pleased with the results that they are already bidding on several other projects using this technology as the centerpiece. They have found our technical guidance and Integrated Demonstration reports and videos extremely helpful and important in making their application of this technology a success.

**Presentation to Public Relations for use by EDD**

C. J. Berry and R. Brigmon

A presentation illustrating many of the pictures taken with the laser confocal microscope (LCM) was forwarded to K. McCarthy from the Economic Development Division. The LCM can take three-dimensional pictures of biofilms and other microscopic assemblages at resolutions of 0.01 microns. He saw pictures of biofilm formation from the mobile methanotrophic bioreactor, algae used to remove heavy metals from water, and bacteria and protozoa from other samples. McCarthy will use the pictures for publicity and conferences on SRS technologies.

**SRTC Assists Local Textile Plant With Odor Problem** - E. W. Wilde, J. Koch, R. Goetzman

E. W. Wilde (Biotechnology Group) and J. Koch (Ecology Group) accompanied R. Goetzman (Economic Development Division) to a Spartan Mills textile plant near Spartanburg, SC on January 31, 1995. The purpose of the trip was to assist Spartan Mills personnel in developing process changes designed to reduce odors in their water treatment process for dye bath waste waters. It was mutually agreed that enhanced mixing and aeration by the use of blowers in the chemical treatment basins and rerouting sanitary waste water to the biological treatment basin (rather than to the chemical treatment basins where it presently goes) should greatly reduce the odors believed to be primarily caused by anaerobic bacteria.

**Department of Defense Proposals**

T. Hazen

The ESS Biotechnology Group was asked to be a co-participant on a Bioremediation Education Science and Technology (BEST) Center. The other participants are Howard University, Michigan State University and University of Michigan (linked through the Great Lakes and Mid-Atlantic Environmental Protection Agency Hazardous Substance Research Center), and Oak Ridge National Laboratory. They will work together to provide a complete range of research (basic and applied), education (courses) and field demonstrations for faculty and students in the area of bioremediation. SRTC’s role will consist of being the primary field demonstration and field training site for the proposed BEST Center. In addition, a licensee of SRTC Bioremediation technology, is also submitting a proposal for a bioventing demonstration at an U.S. Air Force base in Frankfurt, Germany. The focus of the proposal will be the use of gaseous nutrient injection of phosphate and nitrous oxide at a diesel fuel contaminated site. SRTC will provide technical assistance in applying the technology.

**Technology Development MAG*SEP Demonstration**

K. Jerome, R. Nichols, M. Phifer, F. Sappington, C. Betivas, J. Bibler

The MAG*SEP Demonstration will provide for the development, design and first field tests of two new technologies: the Magnetic Separation
System, referred to as the MAG*SEP system, and the EnviroWall Barrier. This demonstration brings DOE, national laboratories, operating facilities, and private vendors together to develop and test new technologies targeted for environmental restoration needs. SRS is hosting the demonstration and providing process chemistry support, all site support, and site characterization.

Several key tasks were completed this month. The draft of the Treatability Study Workplan for the MAG*SEP Demonstration was presented to EPA and SCDHEC during the January 25 FFA scoping meeting. The regulators showed interest in the project. Waste generation and handling may be issues of concern for the regulators and may lead to not approving the workplan. A team meeting was held on January 19, 1995 at SRS. All team members were present. Key issues discussed were the process chemistry status, design of the MAG*SEP system and the viability of meeting the June 1, 1995 start date for the field demonstration of the MAG*SEP system. The process chemistry report was issued by Bradtec on January 26, 1995.

Ongoing activities of significance are provided below.

- construction of the barrier wall by BMC Corporation is continuing
- the pass-thru was installed
- failure of one of the joints of the pass-thru after installation caused a delay of the construction of the barrier wall by two to three weeks
- the pass-thru box was excavated and repairs are underway
- BMC personnel rapidly assessed the situation and took corrective actions in a timely manner
- WSRC staff is providing oversight of the construction activities
- the Process Hazards Review of the MAG*SEP treatment system is on hold pending completion of the process chemistry and redesign of the regeneration system

In addition, several tasks were initiated this month:

- additional process chemistry tasks were started January 24, 1995
- a Sampling and Analytical Group was formed based on needs identified during the January 19, 1995 team meeting.

This group will put together the sampling and analysis plan for the MAG*SEP system demonstration. WSRC participation is limited to Jane Bibler consulting if need be. There are no active WSRC participants because the scope of this new group is outside the scope of the WSRC personnel.

**Mag*Sep Decontamination of D-Area Groundwater - J. P. Bibler**

Bradtec-US, Inc. issued the first chemistry report on the work done using amino iminodiacetate (IDA) resin on magnetic particles. The report pointed out the need for further testing with magnetite cores that would not leach contaminants into the treated water. Also, studies to test possible replacement of ammonium ion with the more environmentally desirable sodium ion as a conditioning ion and to reduce or mask the large quantities of iron in D-Area groundwater are being performed at Bradtec’s United Kingdom laboratory. That is part of an extension of their contract through Argonne National Laboratory. SRTC and Bradtec are formulating a new test plan to improve the process so that secondary waste can be minimized. Ideas under consideration are a pretreatment for iron reduction, either by adding a reducing agent or by contact of groundwater with an immobilized reducing agent, and using hydroxyl ammonium nitrate or sulfate to condition the magnetic particles instead of ammonium hydroxide. The latter concept has the attraction of possibly reducing iron at the particle surface with secondary waste products of nitrogen gas and water.

**SRS Environmental Technology Development Field Test Platform - J. Rossabi, B. D. Riha, and B. Good**

The purpose of the Field Test Platform is to evaluate characterization and monitoring technologies under real-world conditions to determine their operating parameters and to facilitate technology transfer. The technologies focused on are field-deployable instruments for
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measuring volatile organic compounds. Long-term evaluations of five instruments are underway at the Integrated Demonstration Site under a variety of operating scenarios. The technology demonstration and training activities are scheduled for March 20–24, 1995. Invitations for the demonstration were made through a Commerce Business Daily announcement and mailings. Respondents to the invitation include local and federal regulatory personnel, environmental consultants, and technology developers. Four additional technology developers have contacted SRS about demonstrating their instruments during the field activity. A presentation was made at the Third International Conference of Onsite Analysis about the preliminary results from the Field Test Platform.

Special Consolidated Solicitation (SCS-Vendor Forum)/Technology Development: Offgas Treatment - T. R. Jarosch, J. S. Haselow, J. L. Steele

As part of the DOE-SR Special Consolidated Solicitation, a demonstration is being conducted to test a regenerative adsorption system for recovering chlorinated organic solvents for reuse. The project is being managed by Tetra Tech, Inc. (Pasadena, CA) and uses the PADRET (Purus Adsorb-Desorb Remediation Equipment) system developed by Purus, Inc. (San Jose, CA). SRTC is operating the vacuum extraction system and providing logistical and analytical support. Results on solvent acceptance testing were received in late January from the recycling firm. The collected solvent has low water content (0.1%) and is very stable. The vendor believes the recovered solvent (63% v/v perchloroethylene, 23% v/v trichloroethylene, and 14% v/v 1,1,1-trichloroethane) can be reused as is without blending with existing stock piles or modified with the addition of stabilizers. The presence of trichloroethane, however, will require designation of the solvent as an ozone depleter. Based on these findings, efforts are in place to resume the demonstration in late February or early March 1995. Tetra-Tech completed a change in scope that will reduce the demonstration time to six weeks and is working on design modifications to the solvent separation and filtering equipment. A revised health and safety plan is being completed. It will include hazard controls and monitoring related to the concentration of naturally occurring radon in the recovery process.

Support for Coleman Research Corporation Data Fusion Workstation C. A. Eddy-Dilek, J. S. Haselow, B. Pemberton

SRS is the host site for the field portion of the Phase II and III work to be completed through the METC/PRDA geophysical data fusion program. The purpose of the study is to use innovative geophysical methods to collect high-quality data from multiple geophysical sensors that will be input into the Coleman data fusion workstation. The collection and preliminary interpretation of the Phase II and III geophysical data is complete. A critical EM-40 need provided the focus for the work—determination of the competence of the layer separating the two major regional aquifer systems. Baseline approaches applied previously did not provide the necessary information to characterize this important layer, leading to the potential for expensive clean up requirements. Definition of areas where the “aquitard” is competent versus areas where it is leaky would allow DOE to pursue a strategy of a “surgical,” or limited, pump and treat system to protect the deep aquifer, rather than installing a large area wide system in this zone. The geophysical results from TDEM and high-resolution seismic studies clearly demonstrate that the combination of these two geophysical techniques provides important information. Typically, surface TDEM studies are used to delineate areas where an aquitard is thin or absent. Along the M-Area traverse where the TDEM shows an increase in resistivity of the aquitard leading to questions about the competence of the unit, the seismic results clearly demonstrate that the top of aquitard is an irregular undulating surface that varies in elevation but that the unit is continuous across the traverse. The results show that these techniques have the potential to collect critical information about the subsurface hydrological regime that can be used to optimize remedial system designs resulting in significant cost savings. Preliminary discussions are scheduled to pursue EM-40 to continue this work.
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Electrolytic Migration Demonstration at Old TNX Basin - J. P. Bibler

Isotron cylinders could not withstand the high voltage tests and voltage on the TNX array was lowered to 40V. Isotron will remove their cylinders on February 1, 1995. The site will be sampled and closed. Analytical results from soil samples, dissolved electrode polymers, buffer solutions, and electrode leachates will provide data for a report on the success of the demonstration in the Old Seepage Basin at TNX.

ERDA Contract Involving Fungal-Based Bioremediation - E. W. Wilde

Georgia State University (GSU) researchers are evaluating fungal strains for use in the bioremediation of chlorinated hydrocarbons at SRS. The work is being conducted under an ERDA contract with E. Wilde. Thus far, the project has resulted in the identification of fungi isolated from a variety of trichloroethylene (TCE)-contaminated sources at SRS and the characterization of TCE toxicity to these fungal strains as well as strains from GSU stock cultures. Nine fungi representing the genera Aspergillus, Aureobasidium, Candida, Cladosporium, Phoma, Rhizopus, and Rhodotorula were isolated from samples of TCE-contaminated soil collected from well TRW-1. Isolates from biowell samples from a mobile bioreactor at TNX included fungi from the genera Cryptococcus, Geotrichum, Mucor, and Rhodotorula. In addition, scanning electron microscopy analysis of biowell samples revealed the presence of fungi, bacteria, algae, and protists. TCE toxicity studies using a modified antibiotic assay sensitivity test showed that five of six fungal isolates from well TRW-1 and three of four isolates from GSU cultures showed no growth inhibition when exposed to TCE concentrations up to 100 ppm. Finally, ethanol was demonstrated as a usable primary carbon source in six of seven fungal isolates.

Bioremoval of Metals
E. W. Wilde and J. Radway

E. Wilde met with K. Gerdes and B. Schreiber (Office of Technology Development-Headquarters) and others on January 24, 1995 to discuss financial and technical aspects of TTP SR-141019. Gerdes and Schreiber indicated they were pleased with the status of the project, projected future plans, and the way the PTS reports were written. M. Bryant and M. Whitaker of the Analytical Development Section met with Biotechnology Group researchers on January 9, 1995 to discuss current data and future plans. Bryant and Whitaker are overseeing chemical analysis of water samples for metal detection and they are also involved in experimental work associated with the chemical and physical integrity of the algal/foam filter media being developed.

Final Report on OTD Rapid Bioassessment Using Trees to Sample Groundwater Tritium - C.E. Murphy, Jr.

Contamination of groundwater is one of the most expensive and difficult aspects of remediating the waste burial sites and other instances of surface soil contamination reaching the groundwater. Sampling groundwater to determine the extent of contamination requires drilling to the contaminated groundwater and pumping samples to the surface.

A rapid and relatively inexpensive technique for defining the extent of groundwater contamination by tritium was investigated. The technique uses existing vegetation to sample the groundwater. Water taken up by deep rooted trees is collected by enclosing tree branches in clear plastic bags. Water evaporated from the leaves condenses on the inner surface of the bag. The water is removed from the bag with a syringe (the bags can be sampled many times). Tritium in the water is detected by liquid scintillation counting. The water collected in the bags has no color and counts as well as distilled water reference samples.

An area near the SRS Solid Waste Disposal Facility (SWDF) was chosen for the study. The extent of groundwater contamination was measured and documented to provide an opportunity to evaluate the methods onsite with supporting data. Tritiated water was collected along five transects across and perpendicular to the small branch of Fourmile Creek, which drains the SWDF. The collection was repeated along the original five transects and an additional six transects closer to the source of the tritium.
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This study indicates that trees can be used to sample groundwater where the groundwater is not too deep or below a soil strata difficult for roots to penetrate (approximately 20 feet below the surface). The trees clearly showed the pattern of tritium in the groundwater on the flood plain at the south end of the drainage, where the extent of the spread near the confluence of the two branches draining the area was not anticipated.

**Supercritical Fluid Extraction System**
D. M. Beals

Supercritical Fluid Extraction (SFE) system was installed in the ETS labs. ISCO was awarded the contract to purchase an SFE unit. The unit was delivered in December 1994; the vendor completed the installation and trained two ETS personnel in January 1995. The system uses supercritical carbon dioxide to mimic organic solvent extractions of organic compounds from solid matrices. ETS will test the concept of binding trace metals in a solid substrate with an organic ligand, and then use the SFE to extract the metal-ligand complex.

**RADMAPS Radiation/Position Detection Unit** - R. F. Eakle and D. W. Hayes

Field testing of the Phase I prototype portable radiation detector and spectral data acquisition system continued in January 1995 by recording spectra in the B-Area. Gamma-ray spectra were recorded and stored on the removable flash memory card using the pre-programmed data acquisition protocol. Position coordinates were stored independently via an independent GPS unit. The DOLCH data acquisition system was used to develop programs for the RADMAPS system and for the custom TRACKER GPS unit through the PCM-CIA interface to flash memory cards. A TOSHIBA laptop computer was received and modified to analyze the scintillation spectra taken with the field RADMAPS unit. The laptop has a PCM-CIA interface permitting the direct input of the spectra through the flash memory cards used for data storage in the RADMAPS unit. Automated spectral data analysis software and correlation with GPS coordinates is being developed for use in the field.

**Aerial Monitoring System**
R. F. Eakle, G. E. Reeves

The AMS remains the premier field testing system for radiation detection coupled with real-time GPS coordinates. The ETS Suburban vehicle was outfitted with a data acquisition station that includes a DC/AC inverter, noise filter, and NIM bin and power supply mounted in a removable rack and table. The table will accommodate the DOLCH data acquisition system computer in a variety of configurations. One of the 4" x 4" x 16" NaI(Tl) AMS detectors was mounted under the vehicle for survey work and testing. A 5" diameter FIDLER detector was mounted on the front bumper for ground survey measurements. To test the capabilities, several NaI(Tl) spectra were taken near the building in B Area where 2070 drums of depleted uranium are temporarily stored. Shielded and unshielded spectra were recorded to determine the amount of atmospheric scattering present. A HPGe detector was also used to record high resolution gamma-ray spectra near the storage building as a comparison to the scintillation spectra.

**Environmental Restoration**

**TNX Groundwater Remediation**

The TNX groundwater is contaminated with chlorinated volatile organic compounds (CVOC). The Record of Decision (ROD) to address this contamination states that the 500 ppb trichloroethylene (TCE) plume will be hydraulically contained and treated. Recovery wells at the edge of the 500 ppb TCE contaminant plume and an associated air stripper will be installed to accomplish this. ER requested that ESS install a test recovery well and perform a pump test on the test well to obtain design parameters for a full scale recovery well system. The following occurred in association with the TNX Test Recovery Well and Pump Test:

- Preliminary aquifer parameter data was transmitted to SGS and ER to expedite
modelling of the planned recovery well system.
- A preliminary recommendation for the TNX recovery well locations and flow rates were made to ERE to allow initiation of design.
- Analysis of the pump test and recovery data using the computer program, Aqtesolv, is complete. Results are under evaluation.
- Samples of the activated carbon used to remove the CVOCs from the groundwater were taken on January 31, 1995. The samples will be used to determine if the carbon is classified as a hazardous waste or not.
- Contingency plans were made for proper disposition of the carbon based upon its classification as hazardous or not.
- Work was stopped on February 10, 1995, pending written guidance from ER concerning an additional funding request made on January 10, 1995.


Zero valance iron-enhanced abiotic degradation of chlorinated volatile organic compounds (CVOC) is essentially a reductive dechlorination process that produces end products such as ethane and methane. This process has the potential for application as a passive in situ treatment system in a permeable barrier or funnel and gate configuration. Use of such a system may be applicable to the CVOC-contaminated groundwater at TNX due to the relatively shallow nature of the contamination within the TNX flood plain. Laboratory benchscale tests will be performed by EnviroMetal Technologies Inc./University of Waterloo under the direction of ESS to evaluate the potential use of this technology at TNX. The following occurred in association with this study:

- A meeting was held on January 11, 1995 at the University of Waterloo to discuss WSRC comments on the test plan and for the WSRC STR to tour the test facilities.
- The final test plan was received from Envirometal Technologies and approved on January 31, 1995.

- Groundwater samples from wells TNX-3D and TNX-10D were collected and shipped to the University of Waterloo.
- ER issued a stop work order due to funding constraints.


ESS is responsible for the installation and start-up-testing of a vertical recirculation well (VRW) at TNX. A VRW is an innovative groundwater remediation method that uses in-well vapor stripping of chlorinated volatile organic compounds (CVOC). The VRW is being installed as part of the TNX Groundwater Interim Record of Decision. A conceptual design of the TNX recirculation well was prepared and a design review was scheduled. Preparation of an Underground Injection Control (UIC) permit application was initiated. The permit is required by the South Carolina Department of Health and Environmental Control for the injection of any fluids into a well.

The TNX Groundwater Record of Decision also requires the installation of a pump and treat groundwater remediation system to supplement the VRW. In January 1995, a revised map of trichloroethylene (TCE) concentration in groundwater was prepared and submitted to ERD. The TCE map will be used to design the pump and treat system.

**Southern Sector—A/M Area Aquifer Tests** - R. Hiergesell, R. White, C. May, B. Pemberton, R. Van Pelt

Field testing of the two-inch monitor wells installed in the Southern Sector of the A/M Area is complete. This testing involved pumping one well and monitoring for hydraulic response in another well finished in the same horizon and located close enough to detect a response. These tests were conducted to obtain the data needed to calculate aquifer hydraulic parameters, transmissivity, storativity, and leakance is complete.

Originally, testing was planned for wells MSB-32CP, -32BP, -88CP, -89BP, and -89CP. However, due to the implementation of
new and more restrictive containerization requirements, testing could not proceed in MSB-88CP and -89BP. The new requirements are dictated by the Investigation-Derived Waste (IDW) Management Plan (WSRC-RP-94-1227, Rev. 2) and generally require that pumped groundwater with contaminant concentrations in excess of the primary drinking water standard (PDWS) be containerized and disposed of at an appropriate disposal facility. Southern Sector wells contain low concentrations of tri- and tetrachloroethylene, however wells MSB-88CP and -89BP have concentrations in excess of the PDWS. ER does not have the funds necessary to containerize and transport the large volume of water produced during an aquifer test to meet these new requirements.

Wells MSB-32CP, -32BP, and -89CP were pumped for periods ranging from approximately 18 to 60 hours. Recovery of water levels to pre-test levels were then monitored at each well site. Water levels were measured with pressure transducers and recorded on electronic data loggers. Atmospheric pressure was also monitored during the tests so that the effect that changes in this pressure have on water levels could be compensated for. Pumping rates ranged from 2.5 gallons per minute to 6.5 gallons per minute and were measured by filling a container of known volume and recording how long this took. Samples of groundwater were also collected from each pumping well twice a day during the time each of the three wells were pumped. Water level responses to pumping will eventually be used to calculate the hydraulic parameters mentioned above.

**Environmental Restoration Support for Vadose Zone Remediation**


SRTC is assisting Environmental Restoration Engineering in the vendor and site acceptance testing on four commercial soil vapor extraction (SVE) - thermal catalytic offgas treatment units to be used as part of the A- and M-Area vadose zone remediation project. After inspections of the catalysts, repairs of heat exchanger leaks, and recalibration of instruments, acceptance testing resumed. Testing of all four units is expected to be completed by the end of February 1995.

**Old F-Area Seepage Basin Soil Remediation** - V. H. Dukes, S. M. Serkiz, J. L. Siler

The Old F-Area Seepage Basin (OFASB) is an inactive, unlined basin located north of Building 221-F. During its operating life, it received an estimated 35 to 52 million liters of waste water, including evaporator overheads, contaminated cooling water, laundry wastewater, spent etching solution (6M HNO3), and unknown amounts of chemicals. Currently, the basin is dry, but based on weather conditions, it can have a varying amount of accumulated rainwater. Thus, the basin can be described as a wet-weather pond.

The Interim Waste Technology Section (IWTS) drafted a technical task plan for Environmental Restoration to evaluate the use of an in situ soil-stabilization technique involving injecting a binder mixture (e.g., grout and various binding agents) to immobilize the soil contaminants. This work will evaluate the physical properties of the raw soils themselves. Additionally, the project will evaluate the leaching characteristics of the binder and soil matrices. The task plan was reviewed and comments are being incorporated. The plan should be issued by February 10, 1995.

The Interim Waste Technology Section and the Analytical Development Section completed preliminary physical and chemical characterization of the depth-specific soil composite borings collected from three locations within the OFASB. The acid-digested solutions must be analyzed by ICP-MS. The next order of business will be to perform a TCLP test on each soil sample (12 total) and the four composite samples.

**Reverse Osmosis Field Testing on F-Area Groundwater**

S. M. Serkiz, J. L. Siler

Environmental Restoration (ER) conducted an aquifer extraction test (the test ran from September 22, 1994 to September 28, 1994) using water from the Barnwell-McBean aquifer down gradient of the F-Area seepage basins.
This water is contaminated with various salts, metals, and radionuclides. The Interim Waste Technology Section (IWTS) used the aquifer test as an opportunity to evaluate reverse osmosis (RO) on actual contaminated groundwater. The testing program was designed to evaluate different RO technologies, run conditions, and run types (i.e., single-pass versus recycle operation). The final report (WSRC-RP-95-0143, Rev. 0) was issued on January 25, 1995.

Cadmium, gross beta, total radium, and tritium were present in concentrations in excess of the primary drinking water standards (PDWS) in this groundwater. The membrane removed all species, except tritium, to levels well below the PDWS. A number of species were removed to below their analytical detection limits. Most of the radionuclides analyzed were below detection limit in the feed stream.

Substantial permeate (treated water) flow losses, ranging from 55–90% were observed with the pilot unit. The primary reason for the magnitude of the losses was attributed to using a test unit that contained a pump that could only produce approximately two-thirds of the vendor-recommended feed flow (~2.2 GPM vs. >3.5 GPM). This unit was the only portable RO equipment that could be implemented by IWTS to meet the schedule requirements for ER’s field test. Before the test, it was recognized that using this pump might result in performance degradation because of the low flow rate.

IWTS decided to proceed following a preliminary baseline run using a standard salt solution. Results of the salt test indicated normal membrane performance for the test unit setup. Furthermore, there is no way to determine whether membrane fouling will be a problem unless testing is performed.

In summary, IWTS stresses that RO can remediate groundwater to meet and exceed the drinking water standards (except for tritium). The portable unit must be upgraded in pumping capacity prior to future testing.

**Detailed Three-dimensional Flow and Contaminant Transport Modeling of the Old Burial Ground**

M. Harris, J. Haselow, G. Flach, and W. Jones, L. Hamm

Development of a detailed, three-dimensional contaminant transport model of the Old Burial Ground continues. An ongoing literature search and interviews with SRTC/Interim Waste Technology, Solid Waste Engineering and Environmental Restoration personnel over the past month have produced additional relevant information, including electronic databases, historical information, lysimeter data, drawings, diffusivity data, and grid well monitoring reports.


Since the initial operation of the production reactors cooling water has been discharged from the reactors through unlined cooling ponds and lakes. These unlined canals and ponds are most apparent at P-, R-, and C-Reactors. The discharges of 45°C, established unique microbial habitats within the canal system. Previous investigations demonstrated that the microbial communities sequestered isotopes and metals at concentrations of several orders of magnitude above the concentrations found in the effluent discharges. Previous studies have not, however, investigated the fate of tritium of the groundwater. In an effort to determine the impact of the reactor effluent on the groundwater, well points will be installed and groundwater samples will be collected and analyzed. Preliminary documentation, such as NEPA and Site Use/Site Clearance, have either been approved or are routing for approval. Drilling activities are scheduled to begin in April 1995.

**Detritiation Technologies Review**
B. Looney, K. Jerome

A program to evaluate the status of current and emerging aqueous detritiation methods and develop a practical assessment of potential viability will be conducted to support the Environmental Restoration efforts in remediating F- and H-Area Groundwater Plume. The statement of scope for the SCUREF contract was submitted to procurement and the
request for proposal was forwarded to the universities. The project is on schedule for completion on May 26, 1994 with the submittal of the final report to ER.

ER stopped placement of the contract until a decision can be made as to whether to continue funding this study.

Small Mammal Trapping Along Fourmile Creek - L. D. Wike

Sampling of small mammals was completed at eight grid locations adjacent to the Fourmile Creek seepline and in two control areas. Biomass was collected from this sampling to analyze for the presence of contaminants of concern for the southwest plume from the Mixed Waste Management Facility.

Photographic Assistance to ERD - H. Mackey

To assist the Environmental Restoration Division (ERD) with wetlands mapping and delineation and to document the history of changes at the R-Area seepage basins, the Environmental Sciences Section's reference collection of 80,000 frames of vertical photography of SRS was searched. The search covered the time period from 1938 to 1994. Over fifty frames of photography that cover the period from 1958, during early construction and use of the seepage basin, until the present were found. Representative photographic materials were selected for producing scaled enlargements to assist ERD in developing work and characterization plans for these basins. Likewise, representative photography was selected, especially recent false color infrared photography, to assist with mapping and verification of wetlands and potential groundwater outcrop zones near the streams draining R Area. Photography representative of thermal surface water discharges to the reaches of the upper portions of Lower Three Runs Creek was included to provide guidance to potentially contaminated wetlands near R Area. Final products should be available by the end of March 1995.

Assay of Burial Ground Wells with HPGe and NaI Detectors - W. G. Winn

The preliminary report (SRTC-ETS-94-513) was examined by ETS and ER personnel and an edited report (WSRC-TR-95-0502) was completed by the end of the month. Copies were hand-delivered to T. Gaughan of ER on January 30, 1995 at which time the highlights of the report were reviewed. The Publications Department will reissue the report in final format at a later date.

Offgas Treatment Technology Testing of Flameless Thermal Oxidation (FTO) T. R. Jarosch, J. S. Haselow

The Savannah River Site (SRS) and the Savannah River Technology Center's Environmental Sciences Section have been requested by HAZWRAP (Martin Marietta Energy Systems) of Oak Ridge, TN to provide our site, services, and expertise in conducting a demonstration of an emerging technology for treating air streams containing chlorinated VOCs (CVOCs). The technology demonstration being proposed involves a flameless thermal oxidation (FTO) technique developed and patented by Thermatrix Inc. (San Jose, CA). The design employs a controlled, high-temperature (800 - 1000 °C) inert-ceramic packed-bed reactor to thermally oxidize the organics. Thermatrix is currently working on modifications to the health and safety plan and has submitted a sampling plan which SRTC has reviewed and commented on. The 5 scfm test unit is currently being fabricated and will be ready for shipment by the end of February. Work is in progress at the test site on well sampling and pump tests and on installation of electrical power and gravel pads. Preliminary analysis of samples collected during a pump test at AMH-4 show a total chlorinated organic concentration of approximately 1000 ppmv (approximately 75% perchloroethylene), which is sufficient for determining destruction efficiencies > 99.9%.

Bivane Development CRADA with Met One Instruments—Wind Tunnel Flow Modifications - M. J. Parker

Phase II of the bivane development CRADA with Met One Instruments involves the development of a single-axis vane prototype by Met One. In the interim, in anticipation of the need for low response threshold testing of new
prototypes, a method of lowering the minimum air flow in the 735-7A wind tunnel has been established. A baffle that reduces the amount of air exhausted from the tunnel by one-half was designed and built. The baffle uses a grid of 56 four-inch diameter holes to allow limited air flow over the unobstructed portion of the exhaust area. Another baffle, which fits over the first baffle, was designed to reduce air flow by another one-third. Preliminary tests indicate that the minimum tunnel flow can be reduced from about 0.53 m/s with no baffle to about 0.26 m/s with one baffle and to about 0.16 m/s with the second baffle. These low flow rates should provide the conditions necessary to test for a 0.25 m/s starting threshold for any wind measuring instrument. Minor adjustments of the baffle system may be required during the testing process, but the general design is expected to remain intact since initial testing was successful.

The American Society for Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE) will sponsor a Seminar in February 1996 at the annual winter meeting in Atlanta (chaired by Dr. C. B. Fliermans of the Biotechnology Group). The Seminar entitled, “Federal” 'Freebies for ASHRAE Customers,” will highlight technology transfer in federal laboratories with emphasis on DOE facilities. It will also include NASA, OSHA, EPA, CDC, and NIH. J. Corey (SRS) and L. McKinley (ORNL) will participate in the seminar. B. Riha of ESS presented a paper on the Field Test Platform in Houston Texas at the Third International Conference for Onsite Analysis. He co-authored the paper with J. Rossabi, T. Jarosch, C. May and B. Pemberton.
WASTE MANAGEMENT

Trapped Gas Release During Tank 41H Salt Dissolution - D. D. Walker

Hydrogen gas is generated by radiolytic decomposition of water in the solutions stored in the Savannah River Site waste tanks. Under most operating conditions, the hydrogen gas is released slowly and is purged at low concentrations by the tank ventilation systems. However, it has been postulated that during waste removal operations (e.g., salt cake dissolution), an additional mechanism for hydrogen release may result in hydrogen concentrations higher than found under normal operations. Small-scale experimental work indicates that radiolytically generated gases may accumulate in damp salt cake. When the salt cake is dissolved, such as would occur during waste removal operations in the tank farm, the trapped gas is released. The gas released by this mechanism would be in addition to the normal, continuous radiolytic gas generation. The impact of this additional hydrogen release has been calculated based on experimental work and the proposed salt removal operations. It is estimated that the hydrogen concentration due to trapped gas release will not exceed 0.06 vol % (1.5% of the lower flammable limit, LFL) during Tank 41H salt dissolution operations when the ventilation system is running. Under accident conditions in which the ventilation system stops, it is estimated that the hydrogen concentration in the tank vapor space could reach 2 vol % (50% of the lower flammability limit). If this occurs, the time required to reach the hydrogen LFL in the Tank 41H vapor space would be reduced to 8 weeks. Since the time required to reach the LFL is still long compared to the nine days required by the safety envelope, this release mechanism does not impact the proposed Tank 41H salt removal plan.

Evaluating Leak Probability in Tank 48 Transfer Lines Flowing to Leak Detection Boxes - M. R. Poirier

During In-Tank Precipitation (ITP) processing, salt solution and precipitate slurries will be transported between Tank 48 and the Mott filters, and between Tank 48 and Tank 49. Waste transfer lines are designed so any leakage into the secondary containment flows to leak detection boxes.

Momentum balances determined the shear stress generated by the transfer line slope. The results were used to determine the maximum yield stress of a precipitate slurry which will flow to the leak detection boxes. These results showed that concentrated precipitate (>5 wt % insoluble solids) will not flow to the leak detection boxes and that dilute precipitate (1-2 wt % insoluble solids) could have a yield stress too large to enable flow to the leak detection boxes. It is also likely that salt solution could crystallize in the pipe jacket and not flow to the leak detection boxes. Hence, improvements in leak detection is recommended for these applications.

Rad PCB Treatment Demonstration - D. B. Burns, A. Wong, R. K. Roberts

As part of the OTD Economic Development Plan, IWT is coordinating a treatment demonstration with RUST Engineering on Rad Polychlorinated Biphenyl (PCB) waste. The objectives are to demonstrate a low temperature extraction and destruction process as an alternative to incineration, demonstrate the RUST process that could lead to more business for the Anderson, S.C. located company, and treat and dispose of 9 drums of SRS Rad PCB waste. The 9 drums were sent to RUST in February and characterization is underway. Once the treatability study request is approved by the EPA, treatment can begin. The resulting stream will be disposed at SRS as a low level waste in 1996, assuming EPA approval for the demo is granted.

Off-gas Components Test Facility (OCTF) Update - D. B. Burns, A. Wong, R. K. Roberts

The OCTF is a 1/10 scale pilot facility at TNX which will evaluate the operating performance of the CIF off-gas system. The OCTF underwent hardware modifications to address two problems uncovered during the initial stage of the five week production and simulation run. The first problem was inadequate steam quality at the scrubber. A
steam separator was installed to increase the steam quality. The second problem was an accumulation of scrubber water downstream of the scrubber inlet damper causing pressure fluctuations in the burner chamber. The 6 inch damper was replaced with a 12 inch damper and the fiberglass reinforced piping was modified for the new damper. Operation was resumed the week of 2/13. The burner chamber pressure fluctuations have been eliminated, the burner ignites easier and comes on line sooner, and the scrubber operates per vendor specifications. The production and simulation run is now underway.


Enertech, based in Atlanta, is developing a slurry carbonization process to convert sanitary waste to energy. SRTC(IWT, DWPT, and Materials Technology) recently provided a work plan to Enertech describing what would be needed to further develop this process. It included reaction studies, treatability testing, process modeling and optimization, and materials of construction studies. Enertech plans to include this work plan in a NIST proposal. Also included in the NIST proposal will be a 10 ton/day pilot scale test to be performed at SRS. DOE-SR has also indicated strong support for this work and would like to include as part of the Three Rivers Land Fill and Solid Waste Technology Center work.

**Reverse Osmosis (RO) Testing on F-Area Groundwater**

J. L. Siler, S. M. Serkiz

During a recent aquifer test down gradient of the F-Area Seepage Basins, IWT evaluated RO on the contaminated groundwater as a potential treatment technology. The membrane remediated all non-tritium species which exceeded the primary drinking water standards (cadmium, non-volatile beta, and total radium) to levels well below the standards. Many other species were removed to below their analytical detection limits. Treated water flowrate losses were observed, but were attributed to inadequate pumping capacity of the available RO test unit.

**Work for English China Clay (ECC)**

L. N. Oji, C. B. Fliermans, D. C. Beam

ECC International is pursuing SRTC help to control biological growth in their kaolin product. Work for others and/or a CRADA may result.

ECC is launching an effort to control biological growth while minimizing chemical biocides. Biological growth limits shelf life of kaolin slurries. Traditional biocides are causing quality problems for paper makers. Under the Industrial Assistance program, SRTC has performed preliminary testing of irradiation (from electron beam or cobalt source) for biological control.

On 2/17/95, Carl Fliermans (ESS) presented the results of our kaolin irradiation tests and led a discussion of ECC's bacterial/fungal problems. The testing also involved Larry Oji (IWT) and Chris Beam (DWPT). The test results were encouraging to ECC and it was very clear that SRTC involvement would greatly enhance ECC's overall biological control efforts.

ECC expressed willingness to fund about $10K for a second set of irradiation tests. In addition, ECC wants to pursue continued support in developing their overall biological control strategy. ECC would like to discuss a CRADA; they are willing to share royalties from sale of the technology. SRS position and path forward are being assessed.

**Waste Management and Environmental Restoration** - Alex Henderson

EES has been issued a WAD for $336,000 to develop instrumentation for Tank 48. This WAD is for the ITP Hot Functional Phase 2 Testing and covers the development of two in-tank instrument poles, a gas sampling system, and temperature monitoring systems for the walls and ceiling.

EES was requested by ITP perform tests on the Tank 49 benzene analyzer to determine the cause of spurious analyzer readings. Testing and a review of the sampling system has
shown that significant backpressure exists as well as possible leaks (these could cause siphoning of atmospheric air, diluting the sample). Both of these problems could adversely affect the analyzer reading, and ITP is currently working to fix these analyzer sampling problems.

EES and HLWE held an informal review on the mechanical design of the Annulus Camera Housing. The design has been changed from previous systems which used a tilting mirror to obtain a range of vertical views within the waste tanks. The new design protects the camera in a spherical housing which pivots vertically. Electrical design is complete for the system. Rotation, tilt, and tank level position feedback, in actual units, are additions to former designs.

EES completed the redesign and fabrication of the Direct Photography Rig Control Box for HLWE. The Direct Photography Rig was developed by EES and has been in service for approximately 13 years. The redesign was necessary to make the equipment easier to use and more portable. The equipment was delivered to H-area, and testing has been successfully completed.

EES is working to correct a design flaw encountered in the cable reel that deploys/retrieves the Waste Tank Camera into/from the annulus. The axle of the reel is held in place by set screws which came loose allowing the reel drum to freewheel. The camera housing dropped approximately 20 feet before hitting the floor. EES is correcting the design flaw and repairing minor damage to the camera housing. The cable reel was purchased from a vendor, who also supplied the cable reels for the two ITP Camera Systems currently in use. The design flaw will be corrected on these reels as well.

Inspections of Tank 48 and Tank 49 have been completed using the ASET Wall Crawler. Routine maintenance will be performed for approximately a week, and tank inspections will resume.

EES has been requested by the Late Wash Project Control & Production Systems group to design and fabricate two field termination cabinets (FTC) and one process control module cabinet (PCM). The FTCs will terminate over 750 I/O lines from the Late Wash Facility Project. Fabrication of the cabinets is tied closely to the Late Wash Facility startup schedule, and the cabinets are scheduled to be completed by June. Estimates for this work have been submitted to Late Wash Engineering.

EES has begun a project for the Late Wash Facility to install a benzene analyzer in one glovebox and a nitrite analyzer in another glovebox. This equipment will be used in the process of sampling waste for benzene and nitrites in the transfer from ITP to DWPF. Red-lined Piping and Instrumentation diagrams were delivered on schedule, and the creation of software documentation has begun.

**Defense Waste Processing Facility**

EES has delivered equipment mockups for the Analytical Cell mockup at DWPF. Preliminary equipment arrangements for Cell 3 have begun. The installation of equipment in the towers is continuing on schedule. A management review of the mockup installation was completed. The new cell penetration seal prototype design was completed, and fabrication has begun. A 3-D conceptual layout of the cell services routing was completed and is being reviewed by the customer. Further development is underway.

EES has delivered the bailed vortex mixer and is in the process of bailing the capper/decapper, four furnaces, and two stirrers.

EES is assisting on the Canister Level Detection system for DWPF. The system was originally designed to consist of two parts: an array of thermocouples along the height of the canister to determine the liquid level based on temperature and an infrared camera, housed in a lead-lined box, which provides a real-time picture of the temperature gradients from the molten glass in the canisters. The infrared camera system has been tested and will be used in the vitrification facility at the DOE West Valley Demonstration Project Site. Based on the success of the infrared camera at West Valley, DWPF has decided to duplicate the
system, tie the output to the Distributed
Control System, and forgo using the
thermocouple array. EES has written a
purchase requisition and sole source
specification to acquire an infrared system for
DWPF.

Site Robotics Support

EES completed final development drawings in
the effort to repair, re-engineer, and document
the DWPF Melter Borescope Assembly.
These drawings have been submitted to DWPF
for final approval, and site record drawings
have been prepared. The optical designs are
being worked through the University of
Alabama, Huntsville (UAH) for evaluation.
The goal is improved image quality and light
sensitivity. UAH has extensive facilities and
experience in optics research and will be able
to rapidly evaluate the DWPF system.

Robotics for Mixed Waste Operations

EES completed design of the equipment frame
for SWAMI II (Stored Waste Autonomous
Mobile Inspector). SWAMI II will be
delivered to Fernald this summer to perform
autonomous inspections of stored waste
drums. SWAMI II will scan the floor for
contamination, analyze each waste drum for
dents, bulges, and rust spots, read the barcode
of each drum, and interact with the Fernald
Sitewish Waste Information Forecasting and
Tracking System to update the inventory. EES
coordinates efforts by Lawrence Livermore
National Laboratory, the University of
Michigan, and Transitions Research
Corporation on this program.

Underground Storage Tank -
Integrated
Demonstration

EES completed the design of the Video Camera
Deployment Stand for use in underground
storage tanks at Hanford. Requisitions for
Item parts for the stand are in purchasing.
Designs for the Overview Video Camera
Housing, the Overview Stereo Video Camera
Housing and the Video Camera Deployment
Stand have all been completed and submitted
for machining. Electrical schematics for these
systems are complete and are being reviewed.

These three systems are to be delivered to
Hanford by April 30.

High Level Waste Integrated
Flowsheet Model (HLWIFM) Upgrades
- Kirk L. Shanahan

The tentative HLWIFM project schedule
proposes a simulation of the next two years as
a milestone in FY95. In order to accomplish
that milestone, several upgrades to the model
had to be implemented. The primary cause
requiring them was the salt dissolution
operation in Tank 41. Dissolved salt was to be
prepared in a series of small batches and the
salt solution accumulated in Tank 40 before
being transferred in 600 kilogallon batches to
Tank 48. Insufficient low specific gravity tank
supernate solution was available to accomplish
the complete dissolution sequence. A generic
wash water source had to be added so that the
full dissolution sequence could be carried out
with water as the dissolving medium. In
addition, the transfer pathway of Tanks 41 to
40 to 48 was new and had not been configured
in the model in such a fashion as to guarantee
mass balance was maintained.

The model was upgraded by installing
SPEEDUP FEED streams on the three
'universal couplers'. This allows any tank in
the model to receive wash water from those
defeds. In addition, switches were installed
(but not implemented) that will allow those
defeds to supply sodium hydroxide or nitrite
inhibitors as well. Mass balance was
guaranteed by adding new input streams to the
ESP tanks (40, 42, and 51) and Tank 48 (ITP)
and appropriately connecting those streams to
couplers. Concomitant modification and
upgrade of the external EDI FORTRAN was
done to take advantage of the upgrades. These
modifications make it possible to use the
HLWIFM for the proposed two-year run, and
remove some exceptions taken from the
Software Requirement Specification.

In the upcoming weeks, some minor upgrades
will be accomplished by other team members.
Those upgrades will be incorporated into the
HLWIFM, and a new version issued and
entered into the SCMS.
Tank Mixing - R. A. Dimenna and S. Y. Lee

FLUENT and CFDS-FLOW3D were used to compute the spreading of a turbulent free jet in water. The results were compared to commonly accepted behavior as published in the open literature and textbooks. FLUENT showed a spreading angle of about 14° using its turbulence model. This was considered a reasonable result, but it raised the question of how to identify the edge of the jet. Such a determination is not well documented, but applying a condition of constant momentum flux proved to be useful for analyzing the computational results. Using this same criterion, the entrained volume flux within the jet was shown to increase linearly with distance along the jet axis in agreement with theoretical behavior. Axial velocity profiles in planes perpendicular to the jet axis were shown to be similar when nondimensionalized by the axial velocity in the plane of interest and by the half-height location perpendicular to the jet axis. This, too, showed good agreement with theory.

In an attempt to better characterize the edge of the jet, velocity profiles in planes perpendicular to the jet axis were plotted. The profiles showed the jet expanding in the internal regions, i.e., the velocity vectors pointed away from the jet axis. Outside the jet region, the velocity vectors pointed toward the jet axis, indicating an entrainment flow. The null position where the two regions met corresponded closely to the jet boundary as determined by the constant momentum flux condition. Further work on this aspect of the jet behavior is continuing to ensure that the physical models causing liquid entrainment within the computational codes are applicable to both the water calculations currently being performed and the non Newtonian materials to be addressed when we progress to high level waste tank materials.

HLW Production Plan Model (ProdMod) - M. V. Gregory and P. K. Paul

Development is continuing on the Production Planning Model (ProdMod), a fast running linear programming model of the entire SRS high level waste complex being created in the SPEEDUP(tm) modeling environment. The bases of ProdMod were described in some detail in the November 1994 Monthly Report. The team had two significant goals to be achieved in January 1995: the completion of an initial, "skeletal" version of the model (i.e., a fully coupled flowsheet of all SRS HLW processes, each represented in at least minimal input/output detail) and a proof-of-principle demonstration of a running ProdMod session to our principal customers (i.e., HLWE and DOE personnel). Both goals were met.

The completed, initial version of ProdMod contains all the desired connectivity (i.e., every HLW tank) and all the major systems of interest (i.e., 2F, 2H, and RHLWE Evaporator Systems; F and H Waste Removal Tanks; Defense Waste Processing Facility, Extended Sludge Processing, Effluent Treatment Facility, In-Tank Precipitation, Late Wash, and Saltstone Systems). All processes are represented in at least skeletal detail, with some like ITP represented in full detail almost comparable to that in the full High Level Waste Integrated Flowsheet Model (HLWIFM - the dynamic model developed during the previous FY). The current version of ProdMod simulates three years of HLW complex operation and consists of more than 7,000 algebraic equations. Solution time on the RS 6000/560 workstation requires from 5 to 90 * CPU sec, depending on the goodness of the initial guess being provided by the user (from the right answer to no initial guess at all, respectively).

Actual ProdMod runs have been demonstrated to HLWE and DOE personnel using the facilities of the Visualization Laboratory in 773-42A. This constituted a successful proof-of-principle demonstration that the SPEEDUP(tm) implementation is indeed capable of meeting the needs and specifications of our customers.

The current effort is focused on two areas: verifying the existing ProdMod models by comparison of results against both the published HLW System Plan and the output of the detailed ITP Production Plan Spreadsheet provided by HLWE personnel; and filling in
more details in the skeletal models, with the DWPF model being the first target.

**OCTF Scrubber Inlet Damper Pressure Drop** - T. L. Spatz and J.W. Corbett

The Off-Gas Components Test Facility (OCTF) is a 1/10 scale pilot facility at TNX which is evaluating the operating performance of the Consolidated Incineration Facility (CIF) off-gas system. An unacceptable vacuum control at the burner has resulted from a build up of liquid just downstream of the scrubber inlet damper. The scrubber inlet damper is a 6" butterfly valve in the vertical duct upstream of the scrubber. The excess water and steam from the steam atomization scrubber was not flowing down the vertical duct and through the butterfly valve as anticipated. The Experimental Thermal-Fluids (ETF) group was asked to analyze the experimental data and propose solutions to reduce the pressure drop across the scrubber inlet damper valve and it's adjoining ductwork.

A video tape of the inside of the duct section, several feet above the 6" butterfly valve, was made during operation of the off-gas system. The video revealed that under conditions where the steam and scrubber water were turned on the vertical duct filled with two-phase flow. The view resembled that of flying through a dense cloud, where the valve was not visible two feet away. The pressure drop between the pressure taps in the system was calculated from an energy balance and compared to experimental results. Results from the calculation showed that pressure drops equivalent to those experienced experimentally resulted when a void fraction of about 0.85 was present in the vertical duct. Three possible solutions are being proposed, in a technical report, to reduce the amount of excess water and steam in the vertical duct section. The report is in 'draft' form and will be issued soon.
GENERAL

Reactor Support

EES completed activities for the Cadmium Rod Removal Project. EES field activities began after the lid of the cask containing the cadmium rods was welded shut. EES was in charge of leak-testing, draining/drying, and desiccant addition. All three activities were completed smoothly, with the only delay being the need for a few weld repairs on some small leaks found during the leak-test. EES engineers acted as field support during all three procedures.

EES and SSQ completed an inspection of underwater fuel assemblies in the RBOF basin. SSQ used a camera already in their inventory for the inspection. EES supplied modified extension poles and underwater lights. A small CCD type camera was purchased for the project but was received after the completion of the inspection. At the request of the customer, the camera has been waterproofed and will be tested.

EES is investigating possible methods for decontaminating various types of scaffolding and equipment on the Decontamination Facility Support Project. EES is currently looking into the design/fabrication of a saw which will "split" Waco style scaffolding to allow decontamination and monitoring of all potentially contaminated surfaces.

EES has completed the fabrication of all necessary tools for the Purification Deionizer Sampling Project and is prepared to do a test run on the remote installation of a sample port plug in the 723-A shop. The test run is awaiting a decision from the customer on the use of a silicone seal on the plug.

EES is currently fabricating piping and some small components for the Disassembly Basin Saw Chip Strainer Project. A demonstration of the equipment to Components Handling personnel is scheduled for early March.

EES was requested by Reactor Engineering to investigate the possibility of designing and fabricating a system which will "wash" radioactive contaminants from soil. Several chemical processes are being reviewed by Interim Waste Technology (IWT), and equipment requirements will be based on IWT findings.

Robotics for D&D

EES shipped MACS (Mobile Autonomous Characterization System) to Oak Ridge National Laboratory (ORNL) to achieve a major milestone in the Office of Technology Development Robotics Technology Development Program for D&D. MACS is a current state-of-the-art version of the SRTC SIMON (Semi-Intelligent Mobile Observing Navigator) vehicle. MACS can autonomously scan facility floors for contamination and map the facility for transition and decommissioning activities. Plans are to use MACS at the Oak Ridge K25 site and at Reactive Metals Incorporated. EES will be at ORNL the week of February 27 to assist with startup.

Change Control Status - L. R. Chandler

The current status of the Baseline Change Proposal (BCP) packages developed by SRTC for the FY95 Annual Operating Plan is: twenty-one have been prepared; one is routing in SRTC for approval; six are awaiting DOE approval; fourteen have been approved by DOE; and six have been entered into the FY95 AOP electronic data base.

Assessment of DII 1540.2A and DII 1540.3A for Applicability to WSRC - T. K. Houghtaling

Procedures governing hazardous materials packaging for transport are required and guided by DOE Order 1540.2. The technology of packaging radioactive material for transport is controlled by DOE Order 1540.3. Requirements for managing and operating (M&O) contractors are identified in both the orders and in the Directive Implementation Instructions (DII) associated with the orders. Contractor (WSRC) compliance with these
orders and with the associated DIIs from DOE-SR is of special interest to the DNFSB, along with other environmental health and safety related orders related to facility startup.

The current state of WSRC compliance with these directives is documented in a Compliance Assessment and Implementation Report (CAIR) issued last year. However, both DIIs from DOE-SR were revised recently, and re-evaluation of the requirements for applicability to WSRC was necessary. Both DIIs were found to contain requirements applicable to WSRC, and a program for assessing compliance is underway. The work will be documented in accordance with the WSRC 8B DOE Directives Administration manual.

**Items of Interest**

EES participated in meetings with representatives of the Bureau of Mines, Oak Ridge, and Hanford underground storage tank remediation groups during their visit to SRS. The Robotics group’s experience and capabilities were reviewed relative to several projects. Of particular interest were the remote viewing technologies that may be applicable to bore hole mining and the Oak Ridge Tanks.


EES Robotics and the ANS Savannah River Section presented a proposal to the ANS Robotics and Remote System Division to host the 7th Topical Meeting on Robotics and Remote System in Augusta in 1997. Competing sections included San Diego, Los Angeles, Idaho, and Pittsburgh. Savannah River was awarded the conference based on the strength and comprehensiveness of the proposal. The conference will include technical sessions, exhibits, student programs, technical tours, and guest programs.

EES presented on the Stored Waste Autonomous Mobile Inspector and on Remote Drum Opening and Handling at WM95.

EES has developed a process for The Standard Products Co. that may overcome the flashing problem on injection molded plastics. This process incorporates the application of heat via convection to molded plastic parts to eliminate flashing without affecting the part’s integrity. The concept was successfully demonstrated to The Standard Products Co. on February 21.

EES conducted tours of the Robotics Laboratory for the SRTC Chairman’s Performance Leadership Committee, for the Idaho Site Chief Engineer, for DOE-HQ Consultant Augie Patrillo, and for the Academy of Lifelong Learning.