**SCIENTIFIC COMPUTATIONS SECTION MONTHLY REPORT
SEPTEMBER 1993 (U)**

by

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Savannah River Site
Aiken, South Carolina 29808

MASTER

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**Westinghouse Savannah River Company
Inter-Office Memorandum**

November 1, 1993

To: Fred Beranek, 773-A

From: M. R. Buckner, 773-42A
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**Scientific Computations Section
Monthly Report
September 1993**

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Abstracts

COMPUTATIONAL MODELING

(J. R. Pelfrey, Manager)

Engineering Modeling

- Thermal Analysis of Glass Waste Storage Canisters - S. J. Hensel7**
 A preliminary thermal analysis of the glass waste storage canisters has been completed and documented in WSRC-TR-93-520.
- Deflagration Analysis of DWPF Tanks - S. J. Hensel7**
 The computer code DPAC, developed to determine the hypothetical pressure transient during an ITP deflagration, will be used to analyze potential DWPF deflagrations.
- Thermal Evaluation of the 9965, 9966, 9967, and 9968 Shipping Packages - J. W. Jerrell, S. J. Hensel7**
 Revisions to the dimensions of the 9965, 9966, 9967, and 9968 shipping packages are being incorporated into the thermal models and the SAR documentation is being completed. Benchmarking of the high temperature celotex thermal model continued.
- Structural Analysis of Closure Cap Barriers - A Pre-test Study for the Bentonite Mat Demonstration Project - C. Gong8**
 The U. S. Environmental Protection Agency (EPA) recommended waste site cover system design capitalizes on the performance characteristics of both natural and man-made materials. The introduction of man-made geosynthetic materials increases performance capabilities of both hydraulic and structural characteristics of the cover system. This provides the cover system strength to maintain its integrity under greater stress than natural soils.
- High Level Waste Simulation Package - M.V. Gregory9**
 The 2H/ESP SPEEDUP model will be expanded to include all significant High level waste complex operations in at least a skeletal fashion. One of the four new elements (the H-Area Waste Removal Tanks) has been completed. In addition, modeling of the ESP slurry pump seal leakage will be attempted.
- Training on F-Canyon Ventilation Model - J. E. Aull9**
 A week-long training session was conducted for personnel in the Separations Engineering Group and the Environmental Air System Group on Bechtel's Dynamic Analysis Program (DAP) and the DAP model of the F-canyon ventilation system.
- High Level Waste Model User Interface - J. E. Aull, K. L. Shanahan10**
 The 2H/ESP SPEEDUP model was modified to read batch sequencing information that controls the simulation as it runs.
- SPEEDUP Installation on VAXstation - J. E. Aull, K. L. Shanahan10**
 SPEEDUP was installed on a VAXstation within the SRTC VAXcluster. Models execute at approximately 60% the speed of the VAX 8810, node SLLAB2.

APPLIED STATISTICS

(R. C. Tuckfield, Manager)

- Environmental Monitoring Section's Data Analysis Program (EMDAP) Delivered - M. D. Wise, R. C. Tuckfield, G. R. Morton, E. W. Jenkins11**
 EMDAP is a menu-based interface to the EMS data bases which allows automated generation of predefined reports. EMDAP was made available to EMS users in early September.

- Aluminum Nitrate Testing at the Effluent Treatment Facility - M. D. Wise11**
Addition of Aluminum Nitrate to the Wastewater Collection Tanks has been shown to improve the performance of the Effluent Treatment Facility(ETF) filters. Testing during FY93 has helped identify a predictive model of filter run capacity and areas of improvement to be investigated in FY94.

APPLIED PHYSICS **(C. E. Apperson, Manager)**

Methods Development- R. E. Pevey

- Programmer's Environment and Configuration Control - P. W. Wyatt12**
SCS has a software product (NPA_E, developed by Tom Arnold in 1990-91) which unites the advantages of the UNIX utility "imake" and a configuration control system. The imake utility is PORTABLE. It allows a user to make Makefiles on a wide variety of platforms without worrying about the machine-dependent idiosyncracies of the UNIX utility "make". Makefiles are a labor-saving device for compiling and linking complicated programs, and imake is a labor-saving device for making Makefiles, as well as other useful software (like a description of a program's internal dependencies on included files). Tom originally wrote his NPA_E for C code to run on Sun-4's and RS6000's. In the past month, the NPA_E has been modified to handle C code on the Cray (using UNICOS) and on an SGI Indigo (using IRIX). It has also been modified to handle FORTRAN on a Sun-4. This means that large FORTRAN programs can be managed in much the same way that UNIX developers managed the development of X – with order and planning in the way the code is controlled, updated, compiled, linked, and installed. It also means that Makefiles can be created and used by people who are not expert UNIX programmers.

Criticality Methods and Analysis - J. F. Mincey

- Experimental Benchmark Descriptions - E.F. Trumble, R.L. Frost, J.B. Justice13**
Work continues on the development of experimental descriptions and benchmark specifications for criticality safety benchmark experiments in support of both on-site validation and a DOE sponsored, complex wide, Criticality Safety Benchmark Evaluation Working Group.
- DOE Order 5480.24 Compliance - R. L. Reed14**
APG has submitted tables detailing SRTC facility level compliance with DOE Order 5480.24 and associated implementation plans for identified non-compliances. ESH&QA has submitted them for WSRC management approval.
- 100 Area Fuel Consolidation Support Activities - R. L. Reed and S. Y. Lee14**
APG has performed calculations to assess the degree of subcriticality maintained in Assembly storage arrays proposed for the unirradiated fuel consolidation in K Area. Calculations for increased storage in Disassembly have been initiated.
- 100 Area Support Activities -Mark 42 Criticality - R. L. Reed15**
Criticality potential of irradiated Mark 42 assemblies in P Area Disassembly Basin has been requested.
- 100 Area Support Activities -PVC Enclosures for K-15 Fuel - R. L. Reed15**
Evaluation of the criticality aspects of enclosing the K-15 Mark 22 fuel assemblies in PVC pipes before placing them in the borated fuel storage racks has been requested.
- Technical Reviews: K Disassembly VTS Cleanup - R. L. Reed15**
The RED evaluation (RRD-RED-930306) of the criticality potential associated with VTS sludge removal was reviewed and approved.

Technical Reviews: TA -93-0003-0001 (Loading of Borated Racks in 321-M with defueling ingots) - R. L. Reed	16
A proposed Test Authorization to approve loading of defueling ingots into borated storage racks in 321-M was reviewed and comments provided to the author.	
Tech. Reviews: Improved Storage of Corroding Mark 31A Slugs in L Area - R. L. Reed	16
The RED evaluation (RRD-RED-930343) of the criticality potential associated with modified storage of corroding Mark 31A slugs in the L Disassembly basin was reviewed and approved.	
Technical Reviews: Disassembly Basin Sludge Cleanup in L Area - R. L. Reed	16
The RED evaluation (RRD-RED-930373) of the criticality potential associated with sludge removal activities in the L Disassembly basin was reviewed.	
USF Waste Handling Facility NIM Studies - J. F. Zino, K. C. Okafor, and R. L. Webb	16
A study to recommend locations for NIMs within the Uranium Solidification Facility (USF) waste handling facility is nearing completion, and preliminary results have been released.	
AMPX-77 Certification - K. A. Niemer	17
Certification of the AMPX-77 modular code system has begun.	
Installation and Testing of SCALE4.1 - ORIGENS - J. H. Hightower	17
The ORIGENS code of the SCALE4.1 modular system of computer codes has been installed on the CRAY machine.	

EXPERIMENTAL THERMAL HYDRAULICS

(D. R. Muhlbaier, Manager)

Enhanced Waste-Tank Level Model - M. R. Duignan	18
Modeling of environmental effects on the waste level in the waste tank located in H-area has been initiated.	
FRR Spent Fuel Dry Storage Development - H. N. Guerrero	18
The Department of Energy has a program to develop dry storage as a means of storing Foreign Research Reactor (FRR) spent fuel in the interim period prior to acceptance of the fuel in a final repository. This is needed in view of the present plans to phase out Separations Area facilities and the continuing delivery of FRR spent fuel over a period of 10 to 15 years. The objective of the ETF portion of the program is to determine how one of the four commercial dry fuel storage canister designs can be adapted to meet thermal storage requirements of the FRR spent fuel.	
Pilot Scale Demonstration of HEME Dissolution Process - Z H. Qureshi	19
The High Efficiency Mist Eliminators (HEME) used in the melter feed preparation process will be dissolved in a caustic solution for their ultimate disposal. A pilot-scale demonstration of this dissolution process will be conducted in the Thermal-Fluids Lab. This task is scheduled to be complete by June 94.	
ITP Filter Replacement Capability - A. C. Smith	19
This task will establish the capability to replace the ITP filters and dispose of the unusable filter.	
Plasma Technology Users Facility - T. L. Spatz	19
A Plasma Technology User Facility has been proposed by Interim Waste Technology (IWT) and Office of Technology Development (OTD) to be set up at TNX. An existing plasma arc furnace has been donated by the South Carolina Research Authority (SCRA) at Charleston. The project is still in its infancy but the ultimate goal is to have a multi-purpose/multi-user plasma furnace.	

Abstracts

E7 Manual Orientation - T. J. Steeper	19
E 7 Manual Orientation has been completed for our section	
Crossflow Filter Test - J. L. Steimke	20
A test loop for a crossflow filter has been designed and built.	
Air Cooling of Glass Canisters - J. L. Steimke	20
A proposal was made to address technical questions for the Glass Waste Storage Building.	
Proposal for Foaming Study - J. L. Steimke	20
A proposal was made to address foaming concerns for the SRAT and SME.	
Rectifier Operating Procedure - J. L. Steimke	20
The rectifier operating procedure is being revised.	
Support to Low Level Mixed Waste Vitrification Program - J. C. Whitehouse	21
Instrumentation and Data Acquisition Systems were installed at the DOE/Industry Waste Vitrification Center at Clemson University.	

Administrative

Scientific Computing Resource Center

Table 1: SCRC Courses

Course	Students	Date
Object Oriented Analysis and Design (LNRVH072)	12	September 27-30

Table 2: Facilities Utilization

Name/Dept.	Room/Application	Students Trained	Date
Maureen Schilb Analytical Lab Sample Management & Analysis	IBM Training on Environmental Database	8	Sept. 2
Morgan Wise, SRTC	VAX Demo Environmental Monitoring SAS Program	2	Sept. 13
Harvey Reif, Contractor-Stone Webster Engineering	MAC/DOE Emergency Pre- paredness Requirements	8 DOE Per- sonnel	Sept. 9 Sept. 28
Terry Williams, FMIS	MAC/CLS Training	6	Sept. 29

Travel

- Aug. 30-Sept. 3 R. W. Rathbun served as Registration Chair for the ANS ETD Topical Meeting in Charleston, SC.
- Sept. 13-14 C. E. Apperson participated in the ANS Technical Program Committee paper review for the 1994 Reactor Physics Topical Meeting held in Knoxville, TN.
- Sept. 18-23 R. L. Frost attended the ANS 1993 Topical Meeting on Physics and Methods in Criticality Safety Workshop in Nashville, TN.
- Sept. 18-23 R. L. Webb attended the ANS 1993 Topical Meeting on Physics and Methods in Criticality Safety Workshop in Nashville, TN.
- Sept. 19-24 C. E. Apperson attended the Westinghouse Employee Development Course #967, Middle Managers Development Program, held in Pittsburgh, PA.
- Sept. 19-23 R. L. Reed attended the ANS 1993 Topical Meeting on Physics and Methods in Criticality Safety Workshop in Nashville, TN.
- Sept. 19-23 E. F. Trumble attended the ANS 1993 Topical Meeting on Physics and Methods in Criticality Safety Workshop in Nashville, TN.

Administrative

- Sept. 19-22 T. G. Williamson participated as a member of the (ABET) engineering accreditation team at Idaho State University in Pocatello, ID.
- Sept. 26-29 R. W. Rathbun participated in the Plutonium Burner Strategy Meeting at WEC in Monroeville, PA.
- Sept. 29-Oct. 1 C. E. Apperson participated in the HE-SNF meeting hosted by B&W Fuels Division in Las Vegas, NV.

Presentations

- Sept. 12-17 M. R. Buckner presented a poster session titled "Strategies For Denaturing The Weapons Grade Plutonium Stockpile (U)" at the GLOBAL'93 International Conference and Technology Exhibition in Seattle, WA.
- Sept. 19-20 J. F. Zino presented a paper titled "The Need For Coupled Differential And Integral Spectral Radiation Measurements (U)" at the ANS 1993 Topical Meeting on Physics and Methods in Criticality Safety Workshop in Nashville, TN.
- Sept. 30 R. J. Gromada and S. J. Hensel presented the current status on high temperature celotex thermal model at Gaithersburg, MD.

COMPUTATIONAL MODELING
(J. R. Pelfrey, Manager)

Engineering Modeling

Thermal Analysis of Glass Waste Storage Canisters - S. J. Hensel

Customer: DWPT

Abstract: A preliminary thermal analysis of the glass waste storage canisters has been completed and documented in WSRC-TR-93-520.

The general purpose thermal analysis software P/Thermal was used to determine the maximum glass temperatures for free standing canisters. The canisters were cooled by natural convection only. The energy was assumed to be uniformly deposited in one of two regions, the glass or the steel cylinder adjacent to the glass. Assuming energy deposition in the glass only and the ambient temperature to be 37.78°C (100°F), the glass temperature limit of 400°C is not exceeded for heat generation rates which are three times the 460 watts per cannister used as a design basis for the Glass Waste Storage Building. Depositing all of the energy in the steel resulted in even lower peak glass temperatures.

Deflagration Analysis of DWPF Tanks - S. J. Hensel

Customer: STS

Abstract: The computer code DPAC, developed to determine the hypothetical pressure transient during an ITP deflagration, will be used to analyze potential DWPF deflagrations.

The DWPF tanks under consideration are significantly smaller than the ITP tanks previously analyzed with DPAC. The flame propagation model will be modified since the DWPF tanks do not contain center columns. These tanks contain numerous vent lines. Some lines are tank to tank while others act as vents to larger cell volumes. The various vent paths will be incorporated into the analysis as well as the friction effects during venting of the deflagration. Preliminary results should be forthcoming at the end of October.

Thermal Evaluation of the 9965, 9966, 9967, and 9968 Shipping Packages - J. W. Jerrell, S. J. Hensel

Customer: Packaging and Transportation Group

Abstract: Revisions to the dimensions of the 9965, 9966, 9967, and 9968 shipping packages are being incorporated into the thermal models and the SAR documentation is being completed. Benchmarking of the high temperature celotex thermal model continued.

Several minor changes to the package dimensions and materials have recently been made by the customer. Although the changes are estimated to have an insignificant impact on package temperatures, the models and analyses are being revised accordingly for incorporation into the Safety Analysis Report (SAR). Eliminating as many discrepancies as possible between the physical package and model may help to reduce the number of questions that arise during the approval process. Additionally, to insure that the package fiberboard temperature does not exceed 250° F and degrade, the internal source loading for the packages is being limited to 13 W (9965), 16 W (9966), 20 W (9967), and 23 W (9968).

An estimated two-thirds of the documentation for the normal conditions of transport has been delivered to the customer for review. Analysis results are being included in the documentation as they are completed.

The high temperature celotex thermal model was benchmarked against furnace temperature data taken during testing of the 9971 package and the DT-18 package. Agreement between the analysis using the proposed celotex thermal model and the test data was fair.

Structural Analysis of Closure Cap Barriers - A Pre-test Study for the Bentonite Mat Demonstration Project - C. Gong

Customer: Environmental Restoration Department

Abstract: *The U. S. Environmental Protection Agency (EPA) recommended waste site cover system design capitalizes on the performance characteristics of both natural and man-made materials. The introduction of man-made geosynthetic materials increases performance capabilities of both hydraulic and structural characteristics of the cover system. This provides the cover system strength to maintain its integrity under greater stress than natural soils.*

SCS has been asked to computationally model the mechanical behavior of the clay cap closure. The initial task is to carry out the Pre-Test numerical modeling of the Bentonite Mat Demonstration Project (BMDP).

According to the EPA-recommended closure cap design a waste site can either be covered with a single layer cap made of 36 inch of compacted soil (clay) or with a multilayer cap consisting of an upper vegetative layer underlain by a drainage layer over a low permeability layer.

The Environmental Restoration Department of WSRC is in the process of testing the composite clay cap barriers recommended by EPA. The Bentonite Mat Demonstration Project (BMDP) is a field demonstration study to determine the construction / installation requirements, permeability, and subsidence performance characteristics of a composite barrier. The composite barrier will consist of on-site sandy-clay blanketed by a bentonite mat and a flexible High Density Polyethylene (HDPE) liner (also called flexible membrane liner). Construction of one control test pad and three bentonite test pads are planned. The control test pad will be used to establish baseline data. Underneath the composite clay cap is a four-foot loose sand layer in which cavities will be created by evacuation of sand.

This study provides a mathematical model for the testing project. The mathematical model will be used to simulate the mechanical and structural responses of the composite clay cap during the testing processes. With sufficient field tested soil mechanical properties and cavity configurations, the mathematical model could predict the structural behavior of the clay caps in great accuracy. At present, the soil test data and the cavity configurations are not available. Based upon engineering experience and technical references, a set of nominal soil parameters have been selected. Since the configuration of the cavities created in the testing process is irregular and unpredictable, two extreme configurations are considered in this mathematical model, viz., the circular cavity and the infinitely long trench in the sand underneath the cap. This approach will provide bounds for the testing results.

An axially symmetric model is constructed for the cap covering circular cavities, and a plane strain model for the cap bridging the trenches. The two dimensional finite element mesh for both models are identical. The flexible membrane liner is meshed with shell elements. The responses of the cap are calculated for circular cavities ranges from 3-foot to 12-foot in diameter and trenches widths from 3-feet to 10-feet.

The loads upon the cap system are gravity and 2 psi pressure on the top surface of the cap. In both models the maximum deflection of the cap is at the center of the cavity and the deflection increases with the size of the cavity. The regions of maximum stresses and large deformations are in the vicinity of cavity edges and the center of the cavity. The maximum deflection for the 12-foot circular cavity model is 2.13 inches, while the maximum deflection for the cap over the 10-foot trench is 6.08 inches. The composite clay cap which spans over the 10-foot trench reaches its load carrying capacity.

Though the results from the mathematical analysis demonstrate the credible structural behavior of the clay cap, realistic in-situ mechanical properties of materials are needed for a good mathematical model which can accommodate prediction for the actual cap behaviors.

Post-test investigation and analysis of the BMDP will provide feedback for the mathematical model. The finite element analysis model can be further improved with the input of test data. Further studies of the composite clay cap barrier are recommended.

High Level Waste Simulation Package - M.V. Gregory

Customer: High Level Waste Management Division

Abstract: The 2H/ESP SPEEDUP model will be expanded to include all significant High level waste complex operations in at least a skeletal fashion. One of the four new elements (the H-Area Waste Removal Tanks) has been completed. In addition, modeling of the ESP slurry pump seal leakage will be attempted.

Rather than integrating in the detailed In-Tank Precipitation (ITP) model, the customer has requested that the existing SPEEDUP model encompassing the 2H Evaporator system and the Extended Sludge Processing (ESP) facility be expanded to include all the other significant elements in the high level waste processing complex. Initially, these new elements would be implemented in a "skeletal" form, just so the detailed, overall system connectivity would be correctly represented. In follow-on development, these new "black boxes" would be revisited in a staged manner in order to flesh out more detailed unit operation models.

For this initial "skeletal" model, four elements will be added to the existing model: the H-Area Waste Removal Tanks, the 1H Evaporator System, the F-Area Complex, and the New Waste Transfer Facility. The first element has been completed (implemented and fully tested). Though it is but one of the four new elements, the implementation of the H-Area Waste Removal Tanks "black box" required the development of generalized front-end models which will accept feeds from anywhere in any combination for the ESP and ITP connections. This will allow the remaining "black boxes" to be hooked up more easily. The commitment has been made to complete all four new elements by 31 October.

In parallel to the above work, an effort will be made to add a dynamic slurry pump seal leak model to the existing ESP model. This is a new area of interest. The leakage dynamics can have a significant effect in three areas: upon the additional volume of tank farm inventory that needs to be decanted and disposed of, upon inhibitor addition requirements, and also upon the actual sludge composition as it is transferred to DWPF.

Training on F-Canyon Ventilation Model - J. E. Aull

Customer: Separations Engineering, Environmental Air Systems

Abstract: A week-long training session was conducted for personnel in the Separations Engineering Group and the Environmental Air System Group on Bechtel's Dynamic Analysis Program (DAP) and the DAP model of the F-canyon ventilation system.

A week-long training session was conducted for personnel in the Separations Engineering Group and the Environmental Air System Group on Bechtel's Dynamic Analysis Program (DAP) and the DAP model of the F-canyon ventilation system. Dr. Frank Chen of Bechtel, San Francisco provided the bulk of the training but I conducted a four hour session on enhancements to the DAP program, transfer of data for display on the Interactive Engineering Analyzer (IEA), and fundamentals of using the IEA.

High Level Waste Model User Interface - J. E. Aull, K. L. Shanahan

Customer: High Level Waste Management Division

Abstract: The 2H/ESP SPEEDUP model was modified to read batch sequencing information that controls the simulation as it runs.

SPEEDUP models may have parameters input as part of the model source listing but this causes problems as any changes would force the user to edit and recompile the model source. But user revision of the source is tedious, time-consuming, and makes configuration control nearly impossible. Another approach is to use the External Data Interface (EDI) feature of SPEEDUP which calls FORTRAN routines which read the value of parameters from text files. The text files contain data such as the schedule for turning valves on and off and the composition of input streams. Other packages such as RS/1 can then be used to generate data input screens and to graph and permanently store the input data. A prototype for this type of user interface was added on to the 2H/ESP model.

SPEEDUP Installation on VAXstation - J. E. Aull, K. L. Shanahan

Customer: High Level Waste Management Division

Abstract: SPEEDUP was installed on a VAXstation within the SRTC VAXcluster. Models execute at approximately 60% the speed of the VAX 8810, node SLLAB2.

SPEEDUP problems tend to use a lot of CPU time. The VAX 8810 (SLLAB2) was the only VAX on the SRTC cluster where SPEEDUP could execute so it was installed on a VAXstation 3100 (SLVS14) that is also part of the cluster. As a baseline, we ran a problem using SLLAB2. It took 59 seconds with SLLAB2 in a fairly non-busy state. The same problem took 1:38 when it ran on the VAXstation with the data being stored on SLLAB2's disk. When two SPEEDUP jobs were run concurrently on SLLAB2, the elapsed time grew from 59 seconds to 1:28. The job still took 1:38 when it was run on the VAXstation with another SPEEDUP job running on SLLAB2. So from this we conclude that the VAXstation gives comparable performance to SLLAB2 when SLLAB2 is busy and even when SLLAB2 is not busy the VAXstation is running about 60% as fast as SLLAB2.

APPLIED STATISTICS
(R. C. Tuckfield, Manager)

Environmental Monitoring Section's Data Analysis Program (EMDAP) Delivered - M. D. Wise, R. C. Tuckfield, G. R. Morton, E. W. Jenkins

Customer: Environmental Monitoring Section (EMS)

Abstract: *EMDAP is a menu-based interface to the EMS data bases which allows automated generation of pre-defined reports. EMDAP was made available to EMS users in early September.*

The Environmental Monitoring Section's Data Analysis Program (EMDAP) is a modular menu-based report generating program which allows user-friendly access to EMS data in Ingres® databases through the SAS® system. Standard EMS reports can be output, both on-screen and printed, based on user-defined data ranges. Through the combination of Ingres® and SAS®, EMDAP simplifies the reporting process and allows access to a broader base of users. In the process of developing EMDAP, several data consistency errors were identified by ASG which have since been fixed by EMS. EMDAP Version 1.0 was made available to EMS users in early September 1993. Documentation included with EMDAP consisted of a User's Manual, System Manager's Manual and Technical Specifications.

Aluminum Nitrate Testing at the Effluent Treatment Facility - M. D. Wise

Customer: High Level Waste Engineering/Cognizant Engineering Section

Abstract: *Addition of Aluminum Nitrate to the Wastewater Collection Tanks has been shown to improve the performance of the Effluent Treatment Facility(ETF) filters. Testing during FY93 has helped identify a predictive model of filter run capacity and areas of improvement to be investigated in FY94.*

Addition of Aluminum Nitrate to the Wastewater Collection Tanks has been shown to improve the performance of the ETF filters. Three tests were conducted in the months of February, April, and September. The tests yielded data that validated earlier conclusions that the addition of Aluminum Nitrate to non-routine feed has a positive effect on the performance of ETF's submicron filtration unit. Performance was observed to increase from 30 to 309%, depending on the season. The data also supports earlier conclusions that an optimal aluminum concentration exists in the range of 30-40 ppm, and concentrations above this range begin to retard filtration performance.

A rudimentary mathematical model that would predict Stage 1 flux was also developed during FY93. The model allowed for a more concise comparison of filter test runs, as well as an increase in the efficiency of the testing program by allowing shorter test runs to be conducted. It is postulated that the model can be further optimized to include aluminum concentration and time of year as independent variables that determine Stage 1 flux.

The Applied Statistics Group is providing test planning and data analysis report to this continuing effort. Fiscal Year 1993 results have been summarized in WSRC-TR-93-513, coauthored by M. D. D. Goodman (HLWE/CES) and M. D. Wise (SRTC/ATS).

APPLIED PHYSICS
(C. E. Apperson, Manager)

Methods Development- R. E. Pevey

Programmer's Environment and Configuration Control - P. W. Wyatt

Customer: Code Developers in General

Abstract: SCS has a software product (NPA_E, developed by Tom Arnold in 1990-91) which unites the advantages of the UNIX utility "imake" and a configuration control system. The imake utility is PORTABLE. It allows a user to make Makefiles on a wide variety of platforms without worrying about the machine-dependent idiosyncracies of the UNIX utility "make". Makefiles are a labor-saving device for compiling and linking complicated programs, and imake is a labor-saving device for making Makefiles, as well as other useful software (like a description of a program's internal dependencies on included files). Tom originally wrote his NPA_E for C code to run on Sun-4's and RS6000's. In the past month, the NPA_E has been modified to handle C code on the Cray (using UNICOS) and on an SGI Indigo (using IRIX). It has also been modified to handle FORTRAN on a Sun-4. This means that large FORTRAN programs can be managed in much the same way that UNIX developers managed the development of X -- with order and planning in the way the code is controlled, updated, compiled, linked, and installed. It also means that Makefiles can be created and used by people who are not expert UNIX programmers.

Development of engineering applications often began without a means of managing the software in an ordered, modular fashion. This is particularly true of applications that were originally coded under operating systems which do not lend themselves to a development environment. Sometimes, you may still find applications consisting of few (perhaps one) large FORTRAN sources in a simple directory structure (or lack of structure).

On a system where a user's "own" space is limited, they may not even fit into your edit buffer. This situation was later addressed under UNIX with Makefiles. The Makefile is an input file for the UNIX executable "make." This utility uses other UNIX utilities to find sources, compile and link them, and deliver an executable somewhere. It may also sort and discover dependencies on included files, usually by using the C preprocessor. This means that when you add a new (perhaps hidden) dependency to a source, the "make" utility will sense which sources need to be recompiled and will do the operation for you. To update the dependencies, you need only type "make depend". To recompile and link with the new sources and dependencies, you must type the name of whatever is new (say header new_header.h) into the (portable) imake input file (Imakefile) and type "make Makefile", followed by "make depend", and "make". The Imakefile is simple and has none of the Makefile's annoying dependencies on TABs. If you change a source that already appears in the Makefile and its dependency file (".depends"), just type "make".

So why not just use "make", which is a powerful tool, to manage code development? There are several reasons. In the first place, "make" does not recognize conditionals. So to port from one platform to another, you must edit each Makefile to suit the new platform. If you have a lot of Makefiles, you must do a lot of editing. But imake, which uses a series of datafiles that allow conditionals, requires little editing (which in the case of the NPA_E is the responsibility of the NPA_E custodian -- not the user). Also, "make" has no flow control and any Makefile dependencies on headers are inherently nonportable. We can limit editing to a few key points with imake and take most of the burden off the user. The user will usually have to tailor some of the NPA_E directory structure to be mnemonically named. Also, the prototype library structure (two user libraries delivered to a single executable) may not be sufficiently general for everybody.

Tom Arnold's NPA_E combines configuration control with imake (which he edited and whose data files like Imake.tmpl, Project.tmpl, etc., he edited extensively). There is a baseline directory featuring places for the modified imake and its data files, two suites of Bourne shells layered over imake, source locations, architecture-dependent residences for object code and executables, and delivery points for "finished" stuff. The user creates a "workspace", which is a mirror image of the baseline but with certain simplifications. The imake delivery and Tom's ".ws" and "ws" shells are not copied into the workspace. Nor is any unnecessary object code copied from the baseline to the workspace. Instead, such resources are "automatically" pointed to with soft links when a.depends is created. This reduces the likelihood of error and conserves disk space. Also, Imakefiles for "standard" directories like "lib" are copied into the workspace. The user may create other directories (for new libraries or executables) with one of the "ws" shells. Initial Makefiles are also created at this time. The user may then copy sources (including headers) out of the baseline or may invent new ones. Each time new ones are invented, the Imakefile must be edited and the local Makefile must be rebuilt with "make Makefile". Then the dependencies on headers (the.depends file, which starts out empty) must be updated with "make depend". Typing "make" creates a new executable, and "make install" delivers it to a point where it may be run from outside the workspace. The dependencies are discovered with the ".ws_srcdepend" shell, which replaces the imake releases's "makedepend" utility, and searches for include files with the C preprocessor. The NPA_E has been modified for use with FORTRAN sources on the Sun-4 so that these may be processed with the C pre-processor just like C sources.

Tom included many useful utilities in the two groups of Bourne shells. Some are accessed from outside the NPA_E (workspace). Others may only be used inside it. Sources may be copied or checked out from the baseline. They may be checked into the baseline by "authorized" users. The baseline itself is typically protected by limiting both ownership and write permission. There are utilities for quick comparisons between the baseline and the workspace, for importing and linking blocks of new code, identifying who has something checked out (and thereby denied to other users until checked back in), and for quickly showing what local files are new, or different from, or the same as the baseline. This automates a great deal of what is sometimes done administratively with other configuration control systems. What might well be more important is that it could encourage the use of mechanically generated Makefiles (and a code structure that mirrors a baseline template) among programmers who are not experts in constructing Makefiles on multiple platforms. It would be interesting to extend the NPA_E from its prototype status to use in managing someone's engineering application.

Criticality Methods and Analysis - J. F. Mincey

Experimental Benchmark Descriptions - E.F. Trumble, R.L. Frost, J.B. Justice

Customer: C.E. Apperson, APG

Abstract: Work continues on the development of experimental descriptions and benchmark specifications for criticality safety benchmark experiments in support of both on-site validation and a DOE sponsored, complex wide, Criticality Safety Benchmark Evaluation Working Group.

The experiment description and benchmark specification for the unmoderated portion of the Phase I plutonium "button" arrays carried out at Lawrence Livermore were completed. These writeups were included in the first draft of a DOE Handbook on Evaluated Criticality Safety Benchmark Experiments which was published on October 1, 1993.

Work has been started on the moderated portion of Phase I, as well as on both Phase II and III of these experiments which will be included in the next draft of the DOE Handbook to be issued next fall.

DOE Order 5480.24 Compliance - R. L. Reed

Customer: Ken Yates, ESH&QA

Abstract: APG has submitted tables detailing SRTC facility level compliance with DOE Order 5480.24 and associated implementation plans for identified non-compliances. ESH&QA has submitted them for WSRC management approval.

ESH&QA provided a list of compliance requirements for DOE Order 5480.24, "Nuclear Criticality Safety," to SRS organizations responsible for criticality safety at SRS facilities. The requirements as they pertain to SRTC facilities were reviewed by APG personnel. The preliminary tables of compliance and noncompliance were reviewed by numerous SRTC personnel, including the Criticality and Accountability Review Committee to assure accuracy and completeness. APG has submitted to ESH&QA

1. Requested table indicating for SRTC facilities:
 - Documents and procedures that ensure compliance with the order,
 - Items of noncompliance
 - Activities proposed or underway to improve compliance.
2. Implementation plans to correct the noncompliances
 - Analyses are needed of NIM locations in SRTC
 - Improvements in testing of NIM systems to comply with ANS 8.3 recommendations for alarm bell audibility.

ESH&QA has submitted the complete SRS compliance assessment package to WSRC management for approval.

100 Area Fuel Consolidation Support Activities - R. L. Reed and S. Y. Lee

Customer: Marc Rosser (RRD/RED)

Abstract: APG has performed calculations to assess the degree of subcriticality maintained in Assembly storage arrays proposed for the unirradiated fuel consolidation in K Area. Calculations for increased storage in Disassembly have been initiated.

Proposals have been made (and are being studied) to increase the fuel storage capability in both Assembly Area and Disassembly Area of 105-K.

Strong consideration has been given to a proposal to relocate borated concrete fuel storage racks to K Area to increase the total unirradiated fuel storage capacity. Questions were raised about the protection available to assemblies in the racks during seismic events or severe weather (tornadoes, hurricanes) and assurances that assemblies will remain intact in the borated racks during such events. Under a task plan (TP 93-006-I-E-1), APG performed HRXN-KENO calculations to determine the critically safe number of Mark 22 fuel assemblies in a regular rectangular array outside the borated concrete storage rack.

Without moderation, a very large number (>500) of fuel assemblies may be arrayed without attaining criticality. With moderation, no more than four assemblies should be allowed in a grouping, consistent with current Technical Specification limits. Variation in the lithium content of the outer targets of Mark 22 fuel assemblies is evident, but is small. Crushing the fuel assemblies increases reactivity of a dry array, but decreases reactivity of a moderated array since crushing effectively reduces the amount of moderator in the assembly array. For the arrays considered, optimum moderation is provided by full density water. Moderators such as heavy water were not considered since their presence in Assembly Area in vicinity of storage racks is not credible. A report (SRT-CMA-930065) documenting these calculations has been drafted and is in review.

Means of increasing the Disassembly capacity for fuel storage include increasing the number of assemblies stored in a slot in the horizontal storage racks. APG has agreed to examine the changes in subcriticality margin from current storage configurations and the means proposed to ensure maintenance of a minimum margin of safety. A task plan (TP 93-006-I-E-1) has been written and approved to perform the study, utilizing the HRXN-KENO and MGBS-TGAN-KEFF combinations of computer codes. The calculations are being initiated.

100 Area Support Activities -Mark 42 Criticality - R. L. Reed

Customer: Marc Rosser (RRD/RED)

Abstract: Criticality potential of irradiated Mark 42 assemblies in P Area Disassembly Basin has been requested.

Evaluation has been requested by RED of the criticality potential associated with array storage of the irradiated Mark 42 assemblies in P Area. The concern centers around the actinides, such as curium and americium, generated by neutron absorption in plutonium. Even though the plutonium content of the irradiated Mark 42 assemblies is now far too little to be of criticality concern by itself, some of the irradiation daughter products, such as ^{242}mAm , are much more reactive than plutonium and an evaluation is desired. APG has agreed to perform the evaluation.

100 Area Support Activities -PVC Enclosures for K-15 Fuel - R. L. Reed

Customer: Marc Rosser (RRD/RED)

Abstract: Evaluation of the criticality aspects of enclosing the K-15 Mark 22 fuel assemblies in PVC pipes before placing them in the borated fuel storage racks has been requested.

The Mark 22 fuel assemblies designated for the K-15 charge were previously in a reactor and thus are slightly contaminated. Concerns about long-term storage of fuel on hangers in Final Storage has prompted examination of methods to place the K-15 fuel in borated fuel storage racks. The fuel is currently in plastic sleeves (for contamination control). The plastic sleeves are not expected to remain intact during insertion into a borated rack storage location. APG has agreed to evaluate the criticality aspects of placement of Mark 22 fuel into sealed PVC containers to provide intact contamination control throughout handling during storage relocation.

Technical Reviews: K Disassembly VTS Cleanup - R. L. Reed

Customer: M. A. Rosser (RED)

Abstract: The RED evaluation (RRD-RED-930306) of the criticality potential associated with VTS sludge removal was reviewed and approved.

Initial sludge removal in the K Disassembly Basin will relocate the sludge from VTS to the Monitor Basin. Based on analytical results of sludge sample contents, there is insufficient fissionable material in the VTS basin at the isotopic composition of the fissile and fissionable materials in the aqueous mixture in the basin to result in a criticality. The evaluation used a number of conservatisms, such as using the maximum isotopic concentration of multiple sample results and deliberately underestimating effects of absorbers (such as U-238 and iron) in the sludge. Comments and suggestions for evaluation improvement were provided to and implemented by the evaluation author. SRT-CMA-930049 documents the APG review.

Technical

Technical Reviews: TA -93-0003-0001 (Loading of Borated Racks in 321-M with defueling ingots) - R. L. Reed

Customer: G. F. Couture, RMET

Abstract: *A proposed Test Authorization to approve loading of defueling ingots into borated storage racks in 321-M was reviewed and comments provided to the author.*

A proposed Test Authorization to approve loading of defueling ingots into borated storage racks in 321-M was reviewed. The technical basis of the TA is an NCSA (WSRC-RP-93-321-214A) previously reviewed and approved by APG. Comments provided to the author concerned mainly the presentation and clarity (intent) of the TA material rather than technical issues. The APG review is documented in SRT-CMA-930051.

Technical Reviews: Improved Storage of Corroding Mark 31A Slugs in L Area - R. L. Reed

Customer: M. A. Rosser (RED)

Abstract: *The RED evaluation (RRD-RED-930343) of the criticality potential associated with modified storage of corroding Mark 31A slugs in the L Disassembly basin was reviewed and approved.*

Although it has been previously established that Mark 31 slugs in slug buckets are critically safe in any arrangement, an evaluation was performed to support the enclosure of each slug bucket in a closed container so that corroding material can not escape to the basin environment. The evaluation depended on comparisons of material fissile contents in the slugs and comparisons with standard sub-critical mass and concentration limits from TID-7016. The comparisons to the TID-7016 data required extrapolation of TID-7016 curves outside their stated ranges of applicability. APG performed HRXN-ANISN calculations to verify the conservatism of the extrapolations made. SRT-CMA-930055 documents the APG review, including the calculational results.

Technical Reviews: Disassembly Basin Sludge Cleanup in L Area - R. L. Reed

Customer: M. A. Rosser (RED)

Abstract: *The RED evaluation (RRD-RED-930373) of the criticality potential associated with sludge removal activities in the L Disassembly basin was reviewed.*

The sludge sample results for L Disassembly Basin were evaluated with the same methodology previously employed in RRD-RED-930306 to show that sludge removal in K Disassembly is critically safe. Insufficient fissile mass is in L Disassembly Basin to support a critical situation. The APG review concurs with the evaluation. SRT-CMA-930065 has been drafted to document the APG review.

USF Waste Handling Facility NIM Studies - J. F. Zino, K. C. Okafor, and R. L. Webb

Customer: NMPD

Abstract: *A study to recommend locations for NIMs within the Uranium Solidification Facility (USF) waste handling facility is nearing completion, and preliminary results have been released.*

In support of the design and construction of the USF waste handling facility, scoping studies have been completed that deal with the placement of Nuclear Incident Monitors (NIMs) within the facility. The preliminary results were released in SRT-APG-930085 and recommended two NIM pair locations. The analyses required for the final report has become quite involved due to nature of the facility - many different materials will be handled and a number of different fission sources need to be considered. The final study is nearing completion and the recommendations of the preliminary report have largely been upheld, though it has been necessary to make a minor adjustment to the location of one NIM pair. A final report is expected by mid-November.

AMPX-77 Certification - K. A. Niemer

Customer: Applied Physics Group

Abstract: Certification of the AMPX-77 modular code system has begun.

AMPX-77 is a modular code system for generating coupled multigroup neutron-gamma cross section libraries from ENDF-B data. AMPX-77 was written at Oak Ridge National Laboratory. It will be used for Criticality and Radiation Shielding analyses.

Certification of the forty-seven AMPX-77 modules has begun. The modules have been divided into three groups. Group 1, consisting of eight modules, is scheduled to be certified by January 1, 1994.

Installation and Testing of SCALE4.1 - ORIGENS - J. H. Hightower

Customer: Applied Physics Group

Abstract: The ORIGENS code of the SCALE4.1 modular system of computer codes has been installed on the CRAY machine.

ORIGENS is one of the codes from the Oak Ridge National Laboratory SCALE4.1 modular system of computer codes. It has been installed on the CRAY machine and testing is in progress. During the process, ORIGENS data libraries were built in order to run some of the test problems. Testing of ORIGENS should be complete within a couple of weeks.

EXPERIMENTAL THERMAL HYDRAULICS (D. R. Muhlbaier, Manager)

Enhanced Waste-Tank Level Model - M. R. Duignan

Customer: High Level Waste Engineering

Abstract: Modeling of environmental effects on the waste level in the waste tank located in H-area has been initiated.

With the increased sensitivity of waste level measurements in the waste tanks, located in H-Area, level changes have been recorded which are unexplained. An unexplained change of one (1) inch in the waste level is a reportable event. Qualitative observations indicate that much of the unexplained level change may be explained by environmental effects, i.e., changes in level due to changes in atmospheric pressure, temperature, and relative humidity. Quantitatively, some of the level changes have been explained by using a model that indicates the thermal expansion of the tanks' contents (but the contents are assumed to consist of only supernate). Unfortunately, that model does not work for all tanks. That model is limited in scope, but can be made more accurate by incorporating other changes which occur because of environmental changes. To this end, development began on a more extensive model to determine the waste level changes in the H-Area Tanks. In this way, reported unexplained level changes will be more meaningful. The projected completion of this work is February 2, 1994.

FRR Spent Fuel Dry Storage Development - H. N. Guerrero

Customer: Ray Conatser, Technology Programs

Abstract: The Department of Energy has a program to develop dry storage as a means of storing Foreign Research Reactor (FRR) spent fuel in the interim period prior to acceptance of the fuel in a final repository. This is needed in view of the present plans to phase out Separations Area facilities and the continuing delivery of FRR spent fuel over a period of 10 to 15 years. The objective of the ETF portion of the program is to determine how one of the four commercial dry fuel storage canister designs can be adapted to meet thermal storage requirements of the FRR spent fuel.

The thermal-hydraulic development task was initiated during this monthly reporting period. The initial task is a scoping analysis of the application of the commercial dry storage concepts to aluminum research reactor type spent fuel. For the development work on four commercial canister designs, the finite element analysis program, FIDAP, will be utilized for its facility of application to irregular geometries and three-dimensional modeling. After an optimum design has been reached, the finite difference code, COBRA, previously used in licensing the commercial designs, will be used for an independent design verification. The initial FIDAP analysis involves modeling an unmodified NUHOMS-24 P horizontal canister. A 180° sector model with 12 fuel sleeves and fuel elements has been generated and has been successfully run for a few simple cases.

Work has also been initiated in designing an electrically heated MTR type fuel element mockup. Plans are to pass direct current through 0.050-inch thick aluminum plates in order to ideally simulate thermal conductivity and thermal emissivity properties of the aluminum fuel plates. The fuel element mockup will be utilized to obtain basic thermal characteristic information required by FIDAP and COBRA, such as effective thermal conductivity, heat transfer coefficients, and friction factors. A second element of the experimental program will then be the fabrication and testing of a mockup section of a canister sufficient to simulate a full size canister with fuel elements.

Pilot Scale Demonstration of HEME Dissolution Process - Z H. Qureshi

Customer: DWPT

Abstract: The High Efficiency Mist Eliminators (HEME) used in the melter feed preparation process will be dissolved in a caustic solution for their ultimate disposal. A pilot-scale demonstration of this dissolution process will be conducted in the Thermal-Fluids Lab. This task is scheduled to be complete by June 94.

The Defense Waste Processing Technology (DWPT) Section of SRTC has identified several tasks to be performed by the Experimental Thermal-Fluids Group during FY94. One of the high priority tasks is to completely develop the HEME dissolution process on a prototypical scale. Prior studies of the process were made on a bench scale with mixed success. A major aspect of the proposed demonstration tests is to study the effects of mechanical agitation on the dissolution process. A preliminary technical and cost proposal was prepared for DWPT's review and input. The Task Technical Plan is under preparation now. It is anticipated that the task will be complete by the request date of June 94.

ITP Filter Replacement Capability - A. C. Smith

Customer: ITP

Abstract: This task will establish the capability to replace the ITP filters and dispose of the unusable filter.

The EPA variance has been approved. Work has resumed on those items which were deferred because of budget limitations at the end of FY93. These include the filter box design review, box fabrication, SWDF safety assessment and crane access drawing revision. The design review cannot take place until supporting testing is completed at TNX. The schedule is being revised to reflect the influence of the benzene testing delays.

Plasma Technology Users Facility - T. L. Spatz

Customer: Interim Waste Technology (IWT) and Office of Technology Development (OTD)

Abstract: A Plasma Technology User Facility has been proposed by Interim Waste Technology (IWT) and Office of Technology Development (OTD) to be set up at TNX. An existing plasma arc furnace has been donated by the South Carolina Research Authority (SCRA) at Charleston. The project is still in its infancy but the ultimate goal is to have a multi-purpose/multi-user plasma furnace.

A literature search and meetings have been ongoing to establish an understanding of both the existing plasma arc furnace and the intended uses of the furnace. The two may not be compatible in their present form and the ETF group hopes to be actively involved in the retrofitting process.

E7 Manual Orientation - T. J. Steeper

Customer: Safety Technology Department

Abstract: E 7 Manual Orientation has been completed for our section

Orientation was provided to our department on the Conduct of Engineering and Technical Support Manual (E7) this month. Five people were oriented; Jim Herman oriented the remainder of the persons in the department.

Technical

Crossflow Filter Test - J. L. Steimke

Customer: DWPT

Abstract: A test loop for a crossflow filter has been designed and built.

In preparation for delivery to the Defense Waste Processing Facility, slurry from Tank 49 will be washed in a filtering process where the filter retains solids in the flow loop and liquid is removed and replenished with wash water. Filter technology is key to this process. A ten foot long Du Pont cross-flow filter will be tested in vertical orientation with simulated waste slurry in the Thermal Fluids Laboratory (TFL). This test will determine the effectiveness of filtering the slurry, of back-pulsing to remove solids from the surface of the filter, and of cleaning the filter. The test will also produce washed feed for downstream semi-works processes, such as the one-fifth scale PHEF, to be performed at TNX.

With the exception of connection to 80 psig building air, the vertical filter test loop has been completed in the Thermal Fluids Laboratory by C. M. Hart's team. As soon as the connection is made, shakedown of the loop will begin with distilled water. Irradiated simulated waste slurry (not a radiation hazard) will arrive for testing in a week.

Air Cooling of Glass Canisters - J. L. Steimke

Customer: DWPT

Abstract: A proposal was made to address technical questions for the Glass Waste Storage Building.

Canisters containing glassified waste will be held in the Glass Waste Storage Building. They will be cooled in air by a combination of forced convection and natural convection, which is called mixed convection. A computational fluid dynamics code will be ordered to analyze heat transfer for the glass canisters. However, the vendor of the code admits that there would be large uncertainties if the code were applied to this mixed convection problem unless there were experimental data for tuning. I prepared a proposal for the TFL to run two experiments. The first experiment would measure heat transfer coefficients for a full scale single canister. The second would measure temperature and air flow distributions for two dozen scaled down canisters connected in parallel.

Proposal for Foaming Study - J. L. Steimke

Customer: DWPT

Abstract: A proposal was made to address foaming concerns for the SRAT and SME.

During the course of processing high level waste, chemical mixtures are boiled in the Sludge Receipt and Adjustment Tank (SRAT) and the Slurry Mix Evaporator. Tests with simulated waste have indicated that foaming and carryover are problems. I prepared a proposal for the TFL to address these problems. The first sub-task would be benchtop scale tests to measure the effect on foaming of boilup rate, mercury or noble metals in the waste and vessel diameter. The second sub-task would be a vendor literature survey for probes to measure foam height. The third sub-task would be the testing of foaming in a roughly quarter linear scale model of a SRAT.

Rectifier Operating Procedure - J. L. Steimke

Customer: Thermal Fluids Laboratory

Abstract: The rectifier operating procedure is being revised.

Six large rectifiers are used as a power sources for experiments in the Thermal Fluids Laboratory. The rectifiers are presently shut down awaiting a new operating procedure which is being revised to make it consistent with the Employee Safety Manual (8Q) and the Conduct of Operations Manual (2S).

Support to Low Level Mixed Waste Vitrification Program - J. C. Whitehouse

Customer: DWPT

Abstract: Instrumentation and Data Acquisition Systems were installed at the DOE/Industry Waste Vitrification Center at Clemson University.

Simulated low level mixed waste (LLMW) streams are being vitrified in two pilot scale melters, under a SCUREF contract, at Clemson's Environmental Systems Engineering School. ETF is supporting this effort by supplying instruments and a Data Acquisition System (DAS). To date, two melters have been instrumented. Test runs with M-Area simulated waste were recently completed in both melters. The instrumentation and DAS performed well, providing useful information on melter performance. Work was recently completed instrumenting the off-gas system for one of these melters. This additional instrumentation will be used to characterize the performance of the off-gas system.

Organizational Chart

L1100, Scientific Computations

Melvin R. Buckner
Section Manager
773-A A-230 — 5-3149

Parent Organization:
L1000 - Nuclear Rx Tech & Sci Comp

Administrative Secretary: Susie Gibson McKinney
773-A A238 — 5-1102

L1110	Compliance Mgmt Technology	Ames, Philip L	5
	Gillespie, Lisa Ann	Senior Sec773-42A 184	5-8462
	Henkel, Deborah	LSE-Prof773-42A 151	5-8199
	Krieger, John W.	Sr Scientist A773-42A 150	5-8201
	Sherbine, Eric L	Assoc Scientist773-42A 149	5-8209
	Parks, W. Scott	Scientist773-42A 152	5-8204
L1120	Computing Technology	Beckmeyer, Russell R	10
	Bell, B J	Admin Clerk773-42A 157	5-7172
	Harris, Hugh Lee	Scientist773-42A 179	5-7386
	Grove, Constance Rae	LSE-Prof773-42A 114	5-4192
	Heavner, Loy C	Senior Engineer A773-42A 171	5-5311
	Mansour, Khalid A	Senior Engineer A773-42A 181	5-5157
	McGrath, Marybeth	Scientist773-42A 118	5-1111
	Sims, Randal N	Fellow Scientist773-42A 129	5-8347
	Smetana, Andrew O	Prin Eng773-42A 127	5-5133
	Suich, John Edward	Exp Experienced773-42A 173	5-5613
	Thomas, Shirley Ann	Gen Clerk704-2S N/A	7-1086
	Henkel, Charles S	Senior Engineer773-42A 180	5-5060
	Jensen, James C	Sr Fellow Sci773-42A 120	5-5147
	Joshi, Ashok	Senior Engineer A773-42A 112	5-8087
	Lance, Susan E	Sr Scientist773-42A 138	5-5159
	Rahenkamp, Samuel M	Sr Scientist A773-42A 117	5-1173
	Shaffer, Douglas H	LSE-Prof773-A A-230	5-3149
	Westmoreland, B. Wayne	Sr Scientist773-42A 126	5-1785
	Wright, Michael David	Assoc Comp Spc773-42A 178	5-9780
L1130	Applied Physics	Apperson, Courtney E	25
	Anderson, W. J.	Assoc Engineer773-22A 11	5-3899
	Biswas, Debdas	Senior Engineer A773-22A 10	5-3406
	Boman, Christa E	Senior Engineer786-1A 8	5-5626
	Cefus, Gregory R	Engineer735-A B001	5-1011
	Chandler, Lawrence R	Fellow Engineer773-42A 145	5-2520
	Clark, Hugh	Lse-Prof773-22A 11	5-2718
	Frost, Robert L	Senior Engineer786-1A 6	5-8195
	George, Darin L	Engineer786-1A 9	5-5864
	Goslen, A. Q	Senior Engineer A773-22A 06	5-5526
	Graves, William E	Exp Experienced773-42A 173	5-4546
	Grove, Robert E	Senior Engineer773-42A 122	5-5145

Organizational Chart

Hightower, Josephine H.....	Sr Scientist A.....	773-42A 113	5-8210
Le, Thuy T	Senior Engineer	773-42A 141	5-5300
Mincey, James F.....	Prin Eng.....	773-22A 7	5-2718
Nierner, Keyes A.....	Senior Engineer	786-1A 1	5-2622
Okafor, Kenneth C	Senior Engineer	786-1A 04	5-8194
Painter, S. D.....	Engineer	773-22A 05	5-5993
Paulson, L. E.....	Criticality Safety Engineer.....	773-22A 04	5-4650
Pevey, Ronald E.....	Prin Eng.....	773-42A 119	5-1611
Rahn, R. R.	Criticality Safety Engineer.....	773-22A 01	5-8230
Rathbun, Roy W	Senior Engineer A.....	786-1A 3	5-8232
Reed, R. L.....	Fellow Engineer	773-42A	5-0000
Skiles, Samuel K	Senior Engineer A	786-1A 7	5-1977
Summers, L. Kaye	Gen Clerk/Typist	773-42A 186	5-8211
Taylor, James J	Engineer	773-42A 148	5-5323
Trumble, Edward F.....	Senior Engineer	786-1A 10	5-4196
Vescovi, Peter J	Senior Engineer	773-22A 3	5-3335
Webb, Roger L	Prin Eng.....	786-1A 13	5-8459
Williamson, T. G.....	Senior Advisor Scientist.....	773-42A 123	5-5999
Zino, John F.....	Senior Engineer	773-22A 8	5-1964

L1170	Computational Modeling.....	Pelfrey, James R	14
Aull, John E	Sr Scientist A.....	773-42A 144	5-2288
Davis, Ricardo C.....	Scientist	773-42A 137	5-5172
Gong, Chung.....	Prin Eng.....	773-42A 154	5-3167
Gregory, Michael V.....	Sr Advisory Eng.....	773-42A 142	5-3696
Hammer, Kim E.....	Senior Engineer	773-42A 115	5-2677
Hensel, Steve J.....	Senior Engineer	773-42A 155	5-5094
Jerrell, Jeffrey W	Senior Engineer	773-42A 153	5-1727
Wolf, Ralph J	Sr Scientist A.....	773-42A 136	5-5158
Wyatt, Paul W.....	Fellow Engineer	773-42A 116	5-5132

L1155	Applied Statistics.....	Tuckfield, R. Cary	
Edwards, Thomas B	Principal Sci	773-42A 125	5-5148
Jenkins, E. W.	Senior Scientist	773-42A 177	5-5304
Harris, Stephen P.....	Principal Sci	992-W1 112	4-5032
Morton, George R.....	Senior Engineer A	773-42A 128	5-5151
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