



NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT



MONTHLY REPORT

SEPTEMBER 1984

UNITED STATES DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE

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SUMMARY

NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT

SEPTEMBER 1984

KEY ACTIVITIES

WBS 2.1, SYSTEMS

During September, work on the NNWSI System Description Document (SDD) continued as the highest priority of Sandia National Laboratories (SNL). At the end of September, draft input was complete for all of the systems that make up the Yucca Mountain Mined Geologic Disposal System (MGDS). All draft inputs were reviewed by the SNL team responsible for the SDD and revision was started. The introduction and descriptions for 10 of the 17 major systems were revised and submitted for peer review.

Mineralogy data from x-ray diffraction tests were entered into the Tuff Data Base as reported in recently published Los Alamos National Laboratory (LANL) reports LA-9706-MS, LA-9707-MS, and LA-9577-PR. Stratigraphic information from USGS reports USGS-DFR-83-855, USGS-DFR-83-853, and USGS-DFR-83-856 was also entered into the Tuff Data Base.

The program UPLLOT was transferred to the CDC computer where the Tuff Data Base is stored. UPLLOT is a general plotting routine that can be used to plot information. This program will be evaluated for possible incorporation into the Tuff Data Base User Friendly Interface.

Instructions were rewritten for creating files to update the Tuff Data Base, modifying the Tuff Data Base, storing backups of the Tuff Data Base and update files on the MASS system, creating backup microfiche and hard copies of the update files, and keeping records of updates made to the Tuff Data Base.

In September, work continued on TOSPAC Hydrodynamics Module stability. Changes in the code included a) adding material compressibility terms to the moisture-content derivative in order to mitigate a numerical discontinuity at the saturated/unsaturated zone interface, b) reducing the timestep so that water moves one-eighth of a cell length per timestep, and c) using a more precise iterative scheme for computing the boundary condition pressures. With these changes, the hydrodynamics appear to be relatively stable when given a static initial condition with an instantaneous, 100 percent increase in flux at the boundary. A plot has been developed of the advancing wetting front at successive times after an increase in infiltration flux from 4 mm/yr to 8 mm/yr.

A pair of coupled transport equations were derived that are believed to be applicable to fractured, unsaturated tuffs under the approximation of dual porosity flows with a common pressure head in the rock's matrix and fracture system. These equations will be implemented in the Transport Module of TOSPAC.

WBS 2.2, WASTE PACKAGE

Work continued in September on a fully three-dimensional numerical model with which the stability of rock blocks adjacent to emplacement holes can be analyzed. Detailed plans for the structure of the model and coding and testing of major parts of the model were completed this month. Portions of the model that were completed incorporate a solution for an arbitrary initial three-dimensional stress field around an emplacement hole.

Post-test examinations of the Series 1 Cladding Containment Credit Test specimens (Turkey Point fuel in deionized water) is nearly complete. No apparent fuel surface corrosion was observed in a metallographic specimen from the one year Series 1 laser-punctured clad specimen. Total cumulative released uranium measured in the test was $\sim 6 \times 10^{-5}$ percent of inventory, which is equivalent to only about 2 angstroms of uniform fuel particle surface dissolution.

Preparations were made for a full parametric testing of the ATM-8 (Actinide) glass. Four series of tests will be started in October: glass with deionized water; glass with J-13 water; glass with J-13 water and crushed fuff; and glass

with J-13 water, stainless steel, and crushed tuff. Crushed glass will be used with the first two tests and glass in the form of discs will be used with the third and fourth tests. All tests will be run as Surface Area to Volume ratios (SA/V) = 0.3 cm^{-1} for 7, 14, 28, 56, 91, and 182 days.

The parametric test series involving DWPF Savannah River Laboratory (SRL) and Pacific Northwest Laboratory (PNL) 76-68 simulated and actinide doped glasses in a gamma radiation field was completed.

The SRL glass composition for the simulated and actinide doped samples are the same except for the actinide elements and, as expected, values for pH and mass for each glass were within experimental error and the data for each glass type was combined. However, the PNL glass compositions were slightly different and the data for each glass type are distinguishable.

An access tube was installed in the LLNL gamma pit during the past month. Experiments can be conducted at elevated temperatures as the access tube allows insertion of heating elements which are isolated from the radiation moderating water. In the coming months, the electrochemical corrosion potential and polarization behavior of candidate stainless steels will be determined over a range of temperatures. Further, the electrochemical corrosion behavior of copper-based alloys will be surveyed under irradiated environmental conditions.

Because of the recent interest generated in examining copper-base materials as possible nuclear waste containment materials, a survey experiment was begun of corrosion performance in the J-13 well water environment and in the saturated steam phase directly above the water at 100°C .

The same ASTM G-1 and G-31 test procedures were followed for the copper-base material weight-loss coupons as are used for the stainless steel coupons. The copper-base coupons are exposed in a different cell from the stainless steel because of possible cross-contamination of the different corrosion products from the dissimilar metals.

The first phase of an effort to model matrix diffusion of fission products through Topopah Spring tuff has been completed. Solution concentration data for this analysis was obtained from the LLNL/Savannah River Laboratory saturated release tests of the DHLW waste form. An abstract for this presentation entitled "Matrix Diffusion Coefficients for the NNWSI Waste Package Environment" has been sent to WMPD/NV for programmatic review. Further analyses are planned to determine the effect of highly soluble caliche material in the tuff sample.

WBS 2.3, SITE

Samples of soil and tuff have been collected from Yucca Mountain to determine the infiltration of rainfall during the past 25 years by means of the ^{36}Cl bomb pulse technique. This month the samples selected for ^{36}Cl analyses were prepared for chlorine mass ratio determinations on the University of Rochester tandem accelerator mass spectrometer.

The thermodynamic model for analcime has been used to examine the possible reasons for crystallization of authigenic albite in areas where analcime is present. It appears that silica activities between those in equilibrium with cristobalite and quartz and the formation of highly ordered albite may be necessary. The considerable analcime formation despite the apparent greater stability of highly ordered albite may have two explanations: 1) the very slow kinetics for the formation of highly ordered albite, and 2) the more easily formed disordered albite being less stable than the analcime.

Six-week sorption runs are complete for three tuff samples and water from Well H-3 (pH 9) with strontium, cesium, barium, europium, and tin tracers. Desorption runs have started. Sorption experiments with thorium in the partial carbon dioxide atmosphere are complete and the samples are being counted.

Studies have also been started on the sorptive properties of layered, mixed hydroxides, which have some anion exchange capacity and should exhibit some thermal stability. Four sets of samples containing either nickel and aluminum or nickel and iron were prepared.

Three plutonium experiments in the presence of bacteria were started this month. The purpose of the work is to determine if microbial activity, particularly for species capable of degrading drilling fluids, can influence the mobility of Pu. Preliminary results suggest that sorption is enhanced by the presence of bacteria.

TRACR3D calculations were completed of two ES tracer experiment borehole scenarios to aid in designing proposed experiments involving tracer transport by diffusion. The scenarios, one vertical and one horizontal, included matrix material properties of the Calico Hills member sample supplied by SNL. Dimensional models were calculated out to 7 months.

Downhole borehole magnetometer tests have been completed which satisfactorily meet LLNL's specifications. Documentation will be completed next week. Two downhole runs were completed with the resulting data virtually identical, thereby satisfying the stability tests. The resolution is plus or minus two gammas. The one final test remaining to be completed is to mate the tool with the Birdwell cablehead, and then complete a cursory test to verify that it is operable.

Instrumentation is being redesigned for the packer tests in connection with the ground-water flow investigation. Additional evapotranspiration, water level and moisture tension and content data at Franklin Lake playa have been collected for the ground-water discharge study. Preparations were also made for the pumping test of UE-25c#3 to be performed in mid-October.

In the unsaturated-zone hydrology investigation, test hole USW UZ-6 was drilled to 1,887+ feet on September 26. A suite of dry hole geophysical logs is being made in addition to the standard suite of logs. TV camera surveys, vibroseis and magnetometer surveys also will be made. Test hole USW UZ-4 is drilling at 237+ feet. Continuous core was cut using the HCQ-3 core barrel from 100+ feet to present depth. Coring of the nonwelded rocks of the Yucca Mountain Member is progressing very well. Projected total depth of the well is estimated at 340 feet, about 80 feet less than anticipated.

Laboratory studies have been completed of strombolian and inferred hydro-volcanic deposits of the Lathrop Wells cone. This work shows that the strombolian deposits do not contain a hydrovolcanic component and that the pyroclastic surge and well-bedded deposits are hydrovolcanic. This means that the effects of hydrovolcanic activity have not been included in past analyses of the radiological consequences of volcanism.

The planned NNWSI Project/NRC Geology Data Review was held September 17-24. An average of 18 NRC and NRC-Contractor personnel participated. Primary NNWSI Project support was provided by USGS.

WBS. 2.4, REPOSITORY

A scheduled design review with URS/J. A. Blume & Associates was held on September 27. This review presented work being done in the development of seismic design criteria to be used in the conceptual design of the repository. This work includes site, surface, and underground facilities. The seismic design criteria encompasses ground-motion considerations from both natural and underground nuclear explosion (UNE) sources.

The NNWSI design team has been selected by DOE/HQ to interact with the Independent Cost Estimate (ICE) team to understand the difference between the Projects' cost estimating and the ICE team's values. This interaction resulted in two meetings during September in the San Francisco Bechtel National, Inc. (BNI) offices. A follow-up resolution meeting is currently scheduled for October 17 and 18 in Washington, D.C.; DOE/HQ, DOE/NV, and the ICE team will be represented at this meeting.

Bulk density measurements were completed on a small number of USW G-4 samples in support of data requirements for the EA reference document "Fracture and Matrix Hydrologic Characteristics of Tuffaceous Materials from Yucca Mountain, Nye County, Nevada," (SAND84-1471).

SNL has begun a comparison of closed-form stress solutions with finite-element analyses for mined-opening-type problems. The closed-form solutions will be modified to include thermal effects. This effort will assist in verification of the finite-element material models being used.

WBS 2.5, REGULATORY/INSTITUTIONAL

A NNWSI Project/NRC management meeting that was scheduled originally for September 5 was delayed at NRC's request. A tentative date of October 15 was requested by WMPO as an alternative. One of the purposes of the meeting was to discuss approaches to scheduling and conducting future workshops and data reviews. Because of logistics problems, the planned October 15 date was not acceptable, and a new recommendation will be developed.

Regulatory Compliance staff continue to track the status of activities relative to revision amendments of applicable regulations including 40CFR191 and 10CFR60 (unsaturated zone, HLW definition, and "NWSA Procedural" amendments). It is expected that a number of site-specific technical positions will be issued by NRC for comment within the next month.

Economic, social, and community services profiles have been developed for communities that could be affected by potential repository development. A draft report that incorporates existing data for these areas was released for review this month.

NNWSI Project representatives attended a September 6 meeting at the Nye County Board of Commissioners in Tonopah. The Project Manager gave a presentation to the commissioners.

WBS 2.6, EXPLORATORY SHAFT

Formal design reviews were conducted on F&S Title I design studies on the size and location of the second shaft (ES-2). Comments were transmitted to DOE/NTSO.

A draft QA procedure is being developed for assigning QA levels to the ESF design, construction, and testing efforts.

Under contract to Los Alamos, Golder Associates will complete its review of the ESTP, Rev. 0, by October 1. Additionally, Golder is to provide Los Alamos with a review of techniques for extrapolating data across the Yucca Mountain geologic block.

The IDS Conceptual Design Report was approved by DOE/NV. The prototype IDS power distribution system has been installed, and the development system is now configured to restart automatically after power failures. LANL held preliminary discussions with the calibration group to begin work on the IDS calibration strategy.

WBS 2.7, TEST FACILITIES

Spent Fuel Test-Climax

Two extensive campaigns of in situ stress measurements were conducted at the SFT-C. An apparent hysteresis response was observed during field calibration of the subcontractor's USBM overcore cells which were used to make over half of the stress measurements.

A new technique was utilized to calibrate IRAD vibrating-wire stressmeters. The stressmeters were retrieved by overcoring so that they could be calibrated in the laboratory while they were still located within the same section of rock. Recovery was not totally successful because geological discontinuities resulted in stressmeter cables breaking and the cores splitting. Laboratory calibration of the stressmeters which were successfully recovered was completed this month. The draft report was prepared and is being reviewed internally prior to submittal to the DOE/NV.

Production of the updated SFT-C documentary film was completed. A distribution list was established under advisement from DOE/NV. Copies of the film will be prepared and distributed in October.

E-MAD

All canisterized fuel assemblies that are located in the drywells and LSPs are in a safe configuration. The maximum recorded canister temperatures are well below the canister design limits.

All monitored fuel assemblies reflect a normal profile over the past month.

The Fuel Temperature Test (FTT) month 17 operation was completed. Month 18 was initiated and the criteria met. The maximum fuel temperature for this month will be 230.5° Celsius.

WBS 2.9, PROGRAM MANAGEMENT

During September, the SAIC PMS staff prepared a set of progress reporting forms, copies of networks, and other schedule information for use by project participants in reporting monthly status in accordance with NNWSI Project Administrative Procedure 3-2. These will be distributed to project participants in early October so that status information can be forwarded by the tenth working day of the month.

Both ESF shafts now have been incorporated into the construction network. This network also was updated during the month with status received from participants. Copies of the network were distributed to members of the ES Construction Committee for review during September.

A proposed NNWSI Project WBS was developed that is an extension of the DOE/HQ-mandated Program WBS. This was distributed to the project participants for their review and comment. It is anticipated that the resulting WBS will be presented to the Change Control Board (CCB) for baseline action in October.

A draft WBS dictionary was forwarded to Project participants for review and comment during September. This document incorporated previous comments and is consistent with the currently baselined WBS. A complete re-work is now required based upon the DOE/HQ-directed Program WBS and upon action taken by the CCB to baseline the revised NNWSI Project WBS.

Information will be requested early in October from all of the TPOs relative to their work plans for FY 85. This information will be used as input for the Project Management Plan (PMP) which is planned to be sent to DOE/HQ December 15. Preliminary descriptions of supporting plans to the PMP have been developed for review and comment.

Quality Assurance:

A strawman of quality levels has been developed for the ES tests. These levels will be tied to the ES WBS and associated networks to depict application of Levels I, II, and III to ES tests. This activity, when completed, will meet the requirements in NVO-196-17, Rev. 2.

NNWSI-SOP-15-01 and NNWSI-SOP-03-01 were approved by DOE/NV on September 28, 1984, and were issued to NNWSI Project participants.

The Participating organizations and NTS support contractors were instructed to revise their QAPPs and QA administrative procedures to meet the new QA requirements invoked by NVO-196-17, Rev. 2, NNWSI Project QAO. The target date for their submittal to DOE/NV was September 19, 1984. As of September 29, 1984, five draft QAPPs have been received from USGS, LANL, SNL, H&N, and WEC.

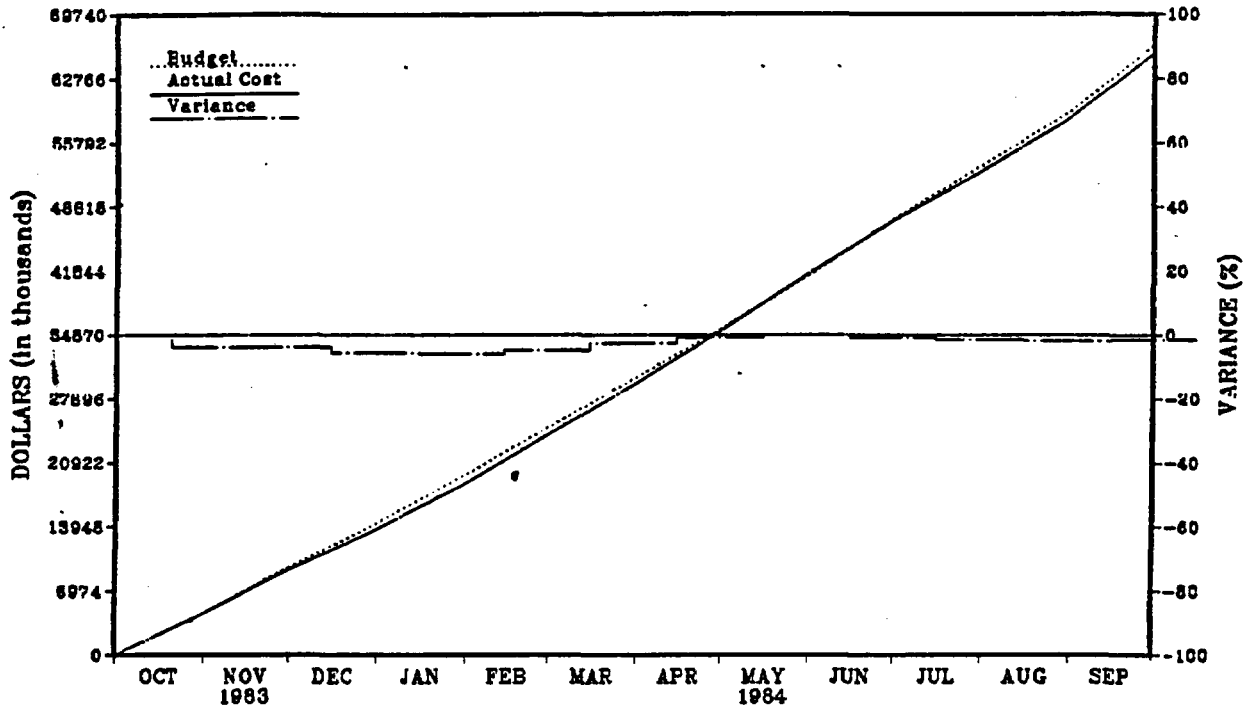
FUNDING OVERVIEW

The month-end programmatic estimated costs were \$65,519,000 against a plan of \$66,425,000 resulting in a cost underrun of \$906,000 through the month of September.

The following are the year-to-date plans, costs, and variances:

	<u>Plan</u>	<u>Cost</u>	<u>Variance</u>
2.1 Systems	\$3,524,000	\$3,203,000	\$321,000
2.2 Waste Package	4,865,000	4,890,000	<25,000>
2.3 Site	24,253,000	23,873,000	380,000
2.4 Repository	12,214,000	12,105,000	109,000
2.5 Regulatroy and Institutional	3,194,000	3,373,000	<179,000>
2.6 Exploratory Shaft	2,470,000	2,377,000	93,000
2.7 Test Facilities	6,003,000	5,885,000	118,000
2.9 Program Management	8,005,000	8,082,000	<77,000>
NTS Allocation	947,000	930,000	17,000
State Grant	<u>950,000</u>	<u>801,000</u>	<u>149,000</u>
Total	\$66,425,000	\$65,519,000	\$906,000

NNWSI Project GOVERNMENT FISCAL YEAR 1984

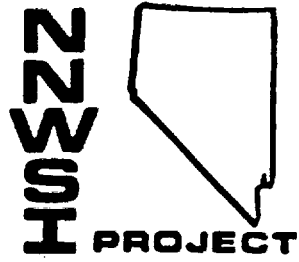


Budget (x1000)	4559.	9501.	14393.	19713.	24850.	30297.	35370.	41407.	47535.	53332.	59106.	60425.
Cost (x1000)	4385.	9207.	13579.	18556.	23681.	29452.	35221.	41435.	47166.	52546.	58203.	65519.
Variance (x1000)	174.	374.	614.	1157.	1169.	645.	349.	32.	369.	786.	983.	906.
% Variance	-4.	-4.	-6.	-6.	-5.	-3.	-1.	0.	-1.	-1.	-2.	-1.

NNWSI PLANNING AND SCHEDULING
BUDGET BASELINE

SEPTEMBER, 1984

<u>CONTRACTORS</u>	<u>BEGINNING FUNDING</u>	<u>CHANGE</u>	<u>ENDING FUNDING</u>
SNL	\$17,757	(1,094)	16,663
LLNL	8,298.	(300)	7,998
LANL	9,090	-	9,090
USGS	7,777	-	7,777
SAIC	5,861	799	6,660
REECo	9,538	1,699	11,237
H&N	470	161	631
F&S	1,168	163	1,331
WESTINGHOUSE	2,746	(389)	2,357
WSI	200	(25)	175
PAN AM	30	-	30
MISCELLANEOUS	579	-	579
NTS ALLOCATION	850	97	947
RESERVE	<u>46</u>	<u>(46)</u>	<u>-0-</u>
TOTAL	\$64,410	\$1,065	\$65,475
FORWARD FINANCING	(500)	500	-0-
STATE GRANT	1,200	(250)	950
CAPITAL EQUIPMENT	<u>3,090</u>	<u>100</u>	<u>3,190</u>
TOTAL	\$68,200	\$1,415	\$69,615



PROJECT STATUS

2.1 SYSTEMS

OBJECTIVE

The objective of this task is to apply the concept of systems to the development and design of the repository, both the surface and subsurface facilities, and to the evaluation of the effectiveness of the geologic and hydrologic environment in isolating radionuclides.

ACTIVITIES

During September, work on the NNWSI System Description Document (SDD) continued as the highest priority of Sandia National Laboratories (SNL). At the end of September, draft input was complete for all of the systems that make up the Yucca Mountain Mined Geologic Disposal System (MGDS). All draft inputs were reviewed by the SNL team responsible for the SDD and revision was started. The introduction and descriptions for 10 of the 17 major systems were revised and submitted for peer review.

Members of the SDD team attended a meeting in Richland, Washington that convened to discuss plans for the implementation of Systems Engineering by OCRWM projects. The SDD being written by SNL will be the cornerstone of the NNWSI systems engineering and will present the requirements that must be met by the HLW disposal system at Yucca Mountain. Other systems-engineering activities and documents will be concerned with NNWSI's specific plans for translating the requirements in the SDD into facilities, equipment, personnel, and procedures that will work together to meet the requirements.

Mineralogy data from x-ray diffraction tests were entered into the Tuff Data Base as reported in recently published Los Alamos National Laboratory (LANL) reports LA-9706-MS, LA-9707-MS, and LA-9577-PR. Stratigraphic information from USGS reports USGS-DFR-83-855, USGS-DFR-83-853, and USGS-DFR-83-856 was also entered into the Tuff Data Base.

The program UPLOTT, originally developed and presently maintained on the VAX computer, was transferred to the CDC computer where the Tuff Data Base is stored. A few modifications to the program were required so that it would run on the CDC computer. UPLOTT is a general plotting routine that can be used to plot information. At present, users are required to make minor adjustments to the data files so that the files are in the UPLOTT format. This program will be evaluated for possible incorporation into the Tuff Data Base User Friendly Interface.

Instructions for updating the primer for the User Friendly Interface were written and updated. Instructions were rewritten for creating files to update the Tuff Data Base, modifying the Tuff Data Base, storing backups of the Tuff Data Base and update files on the MASS system, creating backup microfiche and hard copies of the update files, and keeping records of updates made to the Tuff Data Base.

The remainder of the tasks necessary to complete the first released version of the software for the Tuff Data Base Interface were defined and a time schedule completed. The software for the first version is to be completed in January.

TOSPAC Development

The development of the special-purpose Total System Performance Assessment Code (TOSPAC) will involve the derivation and numerical implementation of mathematical models representing waste release, hydrologic, and radionuclide transport phenomena that apply to the total system. These phenomena will interact in a one-dimensional model.

In September, work continued on TOSPAC Hydrodynamics Module stability. Changes in the code included a) adding material compressibility terms to the moisture-content derivative in order to mitigate a numerical discontinuity at the saturated/unsaturated zone interface, b) reducing the timestep so that water moves one-eighth of a cell length per timestep, and c) using a more precise iterative scheme for computing the boundary-condition pressures. With these changes, the hydrodynamics appear to be relatively stable when given a static initial condition with an instantaneous, 100 percent increase in flux at the

boundary. A plot has been developed of the advancing wetting front at successive times after an increase in infiltration flux from 4 mm/yr to 8 mm/yr. The damped oscillations behind the wetting front are artifacts of the numerical solution; however, the rapid damping indicates that the solution is basically stable. An attempt will be made to eliminate or at least minimize these oscillations.

A pair of coupled transport equations were derived that are believed to be applicable to fractured, unsaturated tuffs under the approximation of dual porosity flows with a common pressure head in the rock's matrix and fracture system. These equations will be implemented in the Transport Module of TOSPAC.

The joint Pacific Northwest Laboratories (PNL) Sandia National Laboratories (SNL) document, "Fracture and Matrix Hydrologic Characteristics of Tuffaceous Materials from Yucca Mountain, Nye County, Nevada," has, after peer review, been rewritten. The document will go to line review in the week of October 1-4, 1984. The document is a reference for the Project environmental assessment document.

Revisions based on first-level management review at SNL were completed for a draft report "Preliminary Bounds on the Expected Postclosure Performance of the Yucca Mountain Repository Site" by S. Sinnock, Y. T. Lin, and J. P. Brannen. It summarizes the available information on hydrology, geochemistry, and rock characteristics, as pertinent for a bounding performance assessment, and presents the results of calculations by a simple computer code, SPARTAN. The calculations project expected performance in terms of releases from the engineered barrier system, taken to be dissolution of the waste, to the accessible environment, taken to be the water table, at the end of a 200 year saturated flow path and at the end of a 2000 year saturated flow path. Releases are projected for a range of flux, solubilities of uranium, and percentage of total flux intercepting waste packages. Waste packages are assumed to fail completely at 300 years, at 1000 years, or at an exponentially increasing rate beginning immediately after closure of the repository. This report, and associated milestone, was scheduled for delivery to DOE/NV on September 19, 1984 but will be about one month late.

Incorporation of peer review comments by SNL was begun for a contractor report from Lawrence Berkeley Laboratory (LBL) entitled "Hydrologic Mechanisms Governing Fluid Flow in Partially Saturated, Fractured, Porous Tuff at Yucca Mountain." It presents a conceptual approach to modeling the effects of discrete fractures on the water movement through the unsaturated zone at Yucca Mountain. This report is currently scheduled for delivery to DOE/NV sometime during the middle to end of October.

Peer review was begun at SNL on a report entitled "Preliminary Report on the Reduction of Well-Test Data for Test Well USW H-1 adjacent to the Nevada Test Site, Nye County, Nevada" (SAND84-0637). It provides an independent approach to estimating hydraulic conductivity and storativity values from drawdown and recovery tests of well USW H-1 to complement results obtained by the USGS. The report is scheduled for delivery to DOE/NV in middle to late October.

The report entitled "Effect of Water Flux on Spent-Fuel Dissolution in a Potential Nuclear Waste Repository in Tuff" (SAND84-1007) has been submitted for line review. Following approval by immediate supervision, the report will be submitted to NVO for policy review.

The report entitled "Effect of Host-Rock Dissolution and Precipitation on Permeability in a Nuclear Waste Repository in Tuff" (SAND84-0192) is being printed. Final distribution should occur during October.

LBL has submitted a paper to SNL for review titled "Modeling of Strongly Heat-Driven Flow in Partially Saturated Fractured Porous Media." This paper will be included in the proceedings of the Seventeenth International Congress of Hydrogeologists in January, 1985. The content of the paper represents the progress LBL made during FY 84 on their contract with SNL to study near-field hydrology.

The SNL contract with RE/SPEC, Inc. to study thermomechanical effects on near-field joint apertures was extended through the end of FY 85. The effort will be limited to approximately one-half of a man year because, with the expected predominance matrix flow, any change in aperture should only have a very small impact.

A draft of the report "Mass Balance Computation in SAGUARD" was completed by Sandia's Fluid Mechanics and Heat Transfer Division. The SAGUARD code has been developed and used for two-dimensional hydrologic modeling for engineered barrier system and site analyses. The report is being reviewed. It documents recent routines added to SAGUARD by modelers in order to enhance demonstration of accuracy.

A draft of "Benchmarking NNWSI Flow and Transport Codes: COVE 1 Results" (SAND84-0996) was completed and is in review. This is the final report for the comparisons of the TRACR3D, SAGUARD, FEMTRAN, TRUST, TRUMP, and GWVIP codes for the COVE 1 benchmarking activity which was conducted during FY 84. The report "FEMTRAN - A Finite Element Computer Program for Simulating Radionuclide Transport through Porous Media," (SAND84-0747) was submitted to DOE/NV. The FEMTRAN code can be coupled to any one-dimensional or two-dimensional hydrology code to predict two-dimensional radionuclide transport for performance assessment analyses. It has been especially adapted to accept pressure field inputs from the SAGUARD code. The report was approved by DOE/NV and is now being prepared for publication.

PLANNED WORK

Peer review of descriptions for all systems that make up the proposed Yucca Mountain MGDS should be complete by mid-October. SNL management review and submission to DOE/NV will follow.

Work during November and December will focus on restructuring the approach to modeling the movement of fluids and transport of wastes through the Yucca Mountain site. The issue that needs resolution concerns the practicality of using two- and three-dimensional codes for simulating the behavior of the site in light of the paucity of geographically distributed data generally needed to support the multi-dimensional computer codes.

The document "Effect of Water Flow on Spent-Fuel Dissolution in a Potential Nuclear Waste Repository in Tuff," (SAND84-1007) will be revised as required and will be formally issued by December 1984.

SNL will participate in the definition of a near-field hydrological problem to be solved simultaneously at SNL, Lawrence Livermore National Laboratories (LLNL), and LBL. A meeting will be held at LLNL in mid-October to initiate activity in the hydrologic-modeling studies of SNL and LLNL and to benchmark the three codes being used (NORIA, TOUGH, and WAFE).

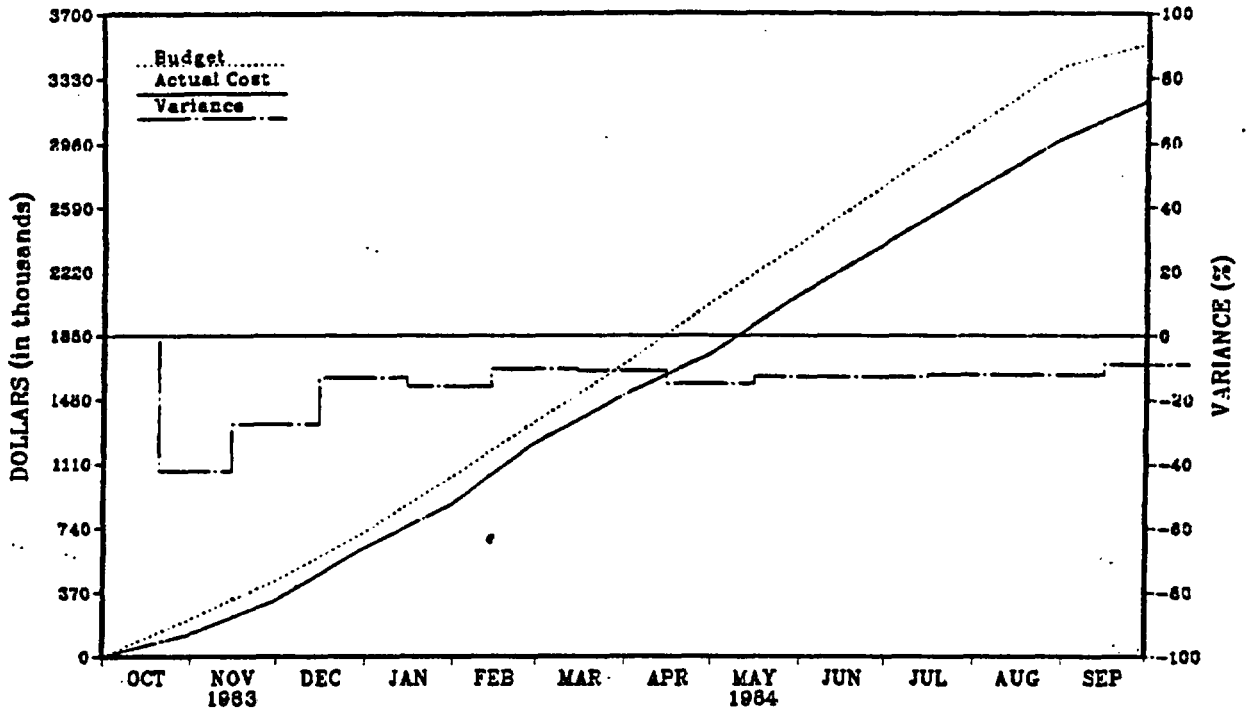
The sensitivity study identifying the important parameters that affect the time-dependent radionuclide release rates from the waste package will be completed and a paper on this study entitled "Source Term Considerations for a Potential Nuclear-Waste Repository Located in Unsaturated Tuff" will be written. This paper will be presented at and published in the proceedings of the Organization of Economic Cooperation and Development (OECD) Nuclear Energy Agency/DOE-sponsored workshop on the "Source Term for Radionuclide Migration from High-Level Waste or Spent Nuclear Fuel." This workshop will be held in Albuquerque on November 13-15, 1984.

A report titled "NORIA - A Finite Element Code for Water/Vapor/Air/Heat Transport" (SAND84-2057) is in preparation. The NORIA code has been developed for performance assessment two-dimensional hydrothermal modeling in the rock surrounding waste packages. A status report on the TRACR3D results at SNL for the test cases provided by LANL is in preparation.

PROBLEM AREAS

Involvement in the NNWSI Performance Assessment division's "Data Priority Study" will be delayed until November because of a commitment of staff to completion of the NNWSI System Requirements Document. Two of the five performance measures being used to identify the important parameters in the priority study are associated engineered barriers and have significant impact on the schedule for satisfying the milestone associated with the Data Priority Study.

WBS 2.1, Systems
GOVERNMENT FISCAL YEAR 1984



Budget (x1000)	220.	442.	724.	1043.	1362.	1692.	2046.	2307.	2726.	3059.	3398.	3524.
Cost (x1000)	127.	320.	628.	877.	1219.	1504.	1741.	2083.	2378.	2682.	2981.	3203.
Variance (x1000)	93.	122.	96.	166.	143.	188.	305.	304.	348.	377.	417.	321.
% Variance	-42.	-28.	-13.	-16.	-10.	-11.	-15.	-13.	-13.	-12.	-12.	-9.

Variance Explanation: Continued delays in staffing additional personnel have reduced data base costs. In addition, there has been a reduction in costs because of EA efforts.

NNWSI LEVEL 1 MILESTONES

RESP. AGENCY	WBS	MILESTONE DESCRIPTION	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
SNL	2.1	PRELIMINARY PERFORMANCE ASSESSMENT FOR EA			△	◆											
SNL	2.1	PRELIMINARY SYSTEM DESCRIPTION DOCUMENT										△					◇
SNL	2.1	USERS MANUAL FOR DATA BASE SYSTEM FOR PARTICIPANTS										△					◆

△ PLANNED MILESTONE COMPLETION DATE
▲ COMPLETED AS SCHEDULED

◇ REVISED MILESTONE COMPLETION DATE
◆ COMPLETED AS REVISED

2.2 WASTE PACKAGE

OBJECTIVE

The primary objective of this task is to develop a technical basis and engineering capability to design, test, and fabricate a waste package that is compatible with the hydrological conditions and geochemical environment in the unsaturated zone beneath Yucca Mountain.

ACTIVITIES

Scanning Electron Microscopy (SEM) observation and Electron Microscope Probe (EMP) analysis of a polished core wafer run in experiment DB14 Topopah Spring tuff ((Tpt) sample G1, J-13 water, 90°C, 48 d) were begun. Initial examination shows that the metastable illitic clays observed previously at 150°C and 250°C have formed even at this low temperature.

The manuscript entitled "Hydrothermal Interaction of Topopah Springs Tuff with J-13 Water as a Function of Temperature" was prepared this month and sent to the session chairman for peer review prior to presentation at the Symposium on the Scientific Basis for Nuclear Waste Management in the 1984 Materials Research Society (MRS) National meeting in Boston this fall. The paper will be published in a symposium proceedings volume. This report focuses on the results of drill core samples run in the Dickson-type, gold-cell rocking autoclaves.

Work continued in September on a fully three-dimensional numerical model with which the stability of rock blocks adjacent to emplacement holes can be analyzed. Detailed plans for the structure of the model, and coding and testing of major parts of the model were completed this month. Portions of the model that were completed incorporate a solution for an arbitrary initial three-dimensional stress field around an emplacement hole.

During the month of September, the draft of a report entitled "Transport Properties of Topopah Springs Tuff" was completed. This report is now undergoing internal review.

Post-test examinations of the Series 1 Cladding Containment Credit Test specimens (Turkey Point fuel in deionized water) is nearly complete. Dried fuel particles from the bare fuel test were partially coated with a light colored reaction layer after approximately one year in deionized water. Metallographic examination of these fuel particles showed that easily observable amounts of fuel dissolution had occurred at grain boundaries near the fuel particle surface. Total cumulative uranium measured in test and strip solution samples in this test was approximately 0.025 percent of the initial inventory. This quantity of uranium corresponds to about 0.1 microns of uniform dissolution from the fuel particle surfaces which is consistent with the post-test metallographic specimen appearance.

No apparent fuel surface corrosion was observed in a metallographic specimen from the one year Series 1 laser-punctured clad specimen. Total cumulative released uranium measured in the test was $\sim 6 \times 10^{-5}$ percent of inventory, which is equivalent to only about 2 angstroms of uniform fuel particle surface dissolution. Preparation of the post-test slit defect metallographic specimen is in progress. Delivery to LLNL of the draft topical report on the Series 1 Tests will be delayed until November 30, 1984, to incorporate expanded radio-metallurgical examination results into this report.

The electrochemical corrosion scoping test to investigate corrosion behavior of Zircaloy is continuing. It consists of bundles of spent fuel cladding each wrapped with a strip of 304L stainless steel and immersed in 90°C J-13 well water that is equilibrated with crushed tuff. Turkey point defueled cladding is being used for the experiment. Separate test assemblies were prepared for 2-, 6-, and 12-month experiments. The 2-month test was completed this month and is presently being examined and samples are being prepared for metallographic and Scanning Electron Microscope examination. Visual observations suggest change on the cladding surface next to the stainless steel wrap. The 6- and 12-month experiments continue to run. A baseline cladding specimen has

been sectioned and examined. In addition a "C-ring" stressing machine suitable for operating stress corrosion cracking tests in a hot cell has been designed and is being assembled.

Ceramographic examination of the pulverized fuel used in the 225°C test indicated grain boundary oxidation attack. Examination by electron microprobe and x-ray diffraction were not fruitful due to the high sample background. New sample preparation methods are being tried. An additional thermogravimetric analysis run is in progress at 200°C with a fragment sample. A synthesized air mixture of N₂ + 20 percent ¹⁸O₂ is being used to enhance post-test examination capabilities.

Preparations were made for a full parametric testing of the ATM-8 (Actinide) glass. Four series of tests will be started in October. These are: glass with deionized water; glass with J-13 water; glass with J-13 water and crushed tuff; and glass with J-13 water, stainless steel, and crushed tuff. Crushed glass will be used with the first two tests and glass in the form of discs will be used with the third and fourth tests. All tests will be run as surface area to volume ratios (SA/V) = 0.3 cm⁻¹ for 7, 14, 28, 56, 91, and 182 days.

The parametric test series involving DWPF Savannah River Laboratory (SRL) and Pacific Northwest Laboratory (PNL) 76-68 simulated and actinide doped glasses in a gamma radiation field was completed. The SRL glass composition for the simulated and actinide doped samples are the same except for the actinide elements and, as expected, values for pH and mass for each glass were within experimental error and the data for each glass type was combined. However, the PNL glass compositions were slightly different and the data for each glass type are distinguishable. For SRL glass the initial reaction of the glass with the water is small, and the pH decreases from 7.1 to 6.5 after 56 days and the weight change is directly proportional to the reaction time. For PNL simulated glass there is a greater initial reaction which drives the pH to more basic after 14 days. However, for the 28- and 56-day periods the pH becomes more acidic as the rate of reaction, as measured by weight loss, declines.

When tuff is included in the system the same pH trends are evident although they are moderated, except for the 56-day pH for the PNL actinide-doped glass which shows a definite change to a more basic pH. Note that the solution pHs and weight changes for the two PNL glass types are extremely sensitive to the small changes in glass composition. The same trends as are noted for pH and mass are observed for the more leachable elements in the glass, boron, lithium, sodium, and molybdenum.

A long-term series of tests using defense glass (165 black frit) doped with uranium, cesium, and strontium was started June 14, 1984. This series of tests is using the final version of the test apparatus and procedure. Two tests were sampled at the 6.5 week interval on July 30, and at the 13-week interval on September 13. Two other tests were terminated on September 13. Tests F-11 and F-12 (blanks) were added to the matrix and started on September 13. A summary of the test procedure and results obtained to date will be presented at the November MRS meeting in Boston.

The analog test utilizes a tuff rock core the shape of a right circular cylinder 5" in length and 2-1/2" in diameter as a reaction vessel. The test was initiated by placing a mini waste package in the cavity machined in the center of the core and placing both sections of J-13 saturated tuff into a teflon sleeve. The input of water to the tuff core was supplied by a storage reservoir of water that was heated to ~ 130°C. The inlet line was also heated. The goal was to supply the tuff core with an evenly distributed supply of water vapor. The rate of flow through the tuff core could be regulated by the temperature (pressure) of the storage reservoir. Water, after passing through the tuff core, was collected in a vented bottle for analysis of radionuclides, cations, and anions. The results of the 90-day analog test are very similar to unsaturated test results for similar time periods. However, the results are from only one test and may represent only a portion of possible materials interaction. Analog tests that will run for six months and one year duration are in progress. The results of these tests will be compared to unsaturated test method results.

Work is continuing in the effort to understand the nature of electrochemical changes produced by gamma radiolysis of J-13 water and water vapor. Some recent work has focused on more concentrated electrolytes, e.g., 10x and 100x concentrated J-13 water by boil down.

The effects of on-off gamma cycles (3.3 Mrads/hr) on the corrosion potential of 316L stainless steel in 10x and 100x concentrated J-13 water are noted as follows. Application of the gamma source results in a positive corrosion potential shift generally on the order of 200 mV. Once a more oxidizing environment is created, the corrosion potential remains at the more positive value when the source is removed. Generally, within an hour under irradiated conditions, steady-state concentrations of metastable molecular species, such as hydrogen peroxide (H_2O_2), are reached and the corrosion potential adopts an effective constant value. Anodic polarization curves on 316L determined in more concentrated environments indicate that both the corrosion potential and the critical pitting potential are shifted positively and remain well separated. Thus, the positive shift of the corrosion potential in the irradiated aqueous environments does not appear to indicate any increased susceptibility to localized corrosion attack. This is a preliminary observation and more work is needed in this area, particularly with respect to subsequent changes of the corrosion potential with time in the irradiated environment.

It appears likely that the production of H_2O_2 under gamma irradiation is the main determinate of the corrosion potential shifts observed. Successive additions of H_2O_2 were made to a non-irradiated J-13 in which a 316L specimen was immersed; the resulting positive potential shifts of the corrosion potential corresponded to what was observed in the irradiated J-13 environment. Experimental data indicates that while the corrosion potential of 316L is strongly affected by the addition of H_2O_2 to the solution, the corrosion potential is not much affected by H_2 , which is also produced by gamma radiolysis of water.

In contrast to the behavior observed for 316L, the open-circuit or corrosion potential of platinum responds dramatically to hydrogen saturation of the solution, even when H_2O_2 is present. Upon saturation of the solution with

hydrogen, the platinum immediately responds as a normal hydrogen electrode and the value of the open-circuit potential drops to the equilibrium value corresponding to a pH of 7. Subsequent bubbling of solution with oxygen removes hydrogen from solution and the potential moves in the positive direction. Modeling of the effects of radiolytically-generated species on the corrosion behavior of stainless steels is continuing.

An access tube was installed in the LLNL gamma pit during the past month. Experiments can be conducted at elevated temperatures as the access tube allows insertion of heating elements which are isolated from the radiation moderating water. In the coming months, the electrochemical corrosion potential and polarization behavior of candidate stainless steels will be determined over a range of temperatures. Further, the electrochemical corrosion behavior of copper-based alloys will be surveyed under irradiated environmental conditions.

The matrix study of four-point loaded, bent-beam specimens (ASTM G-39) with specimens in the CSW (Cold-worked, furnace heat treated as a Sensitizing treatment, and Welded) condition has reached 4500 exposure hours in 100°C J-13 water and steam with no cracked specimens. Nine specimens each of Types 304, 304L, 316L, and 321 austenitic stainless steels in the above metallurgical condition are exposed in the J-13 water and another nine specimens each of these alloys are exposed in the steam. A companion study of specimens in the COW condition (Cold-worked, not furnace-sensitized, and Welded) is conducted in the same environment. These specimens have reached 2500 exposure hours with no cracked specimens observed to date.

As a pilot study to determine the efficacy of preparing weld simulated test specimens, some stock material was prepared of 304, 304L, 316L, and 321 stainless steel on the Gleeble. Each stock specimen is 1 inch by 0.125 inch in cross section and 4 inches long. These stock specimens will be machined to provide three bent-beam stress corrosion test specimens and a specimen for metallographic analysis. Stock specimens are heated to a maximum 800°C and strained to a maximum 2 percent and then cooled to 400°C at three different rates: 1°C/sec, 0.5°C/sec, and 0.2°C/sec. On half of the specimens, the

heating and cooling cycle is performed three times. Following machining to bent-beam specimen dimensions, the specimens will be exposed to 100°C J-13 water and steam environment.

Work is being performed under sub-contract at PNL on the corrosion performance of stainless steels exposed to alternate wetting and drying conditions. These conditions create a potentially aggressive environment that could be attained by periodic dripping of vadose water onto a hot canister surface, subsequent evaporation of the water leaving an ionic salt residue, with repetition of this event many times during the containment period. Forty U-bend stress corrosion specimens have now undergone 15 wet and dry cycles over the past four months. The autoclave was disassembled for examination of the test specimens.

The carbon content of the 304 was 0.063 percent, while that of the 304L was 0.017 percent. The reason for inclusion of the heavily-sensitized, high-carbon 304 material was to induce an early failure and show the test validity in discerning sensitivity to the degree of sensitization. This is exactly what occurred in this test. The morphology of the stress corrosion cracks in the sensitized 304 will be examined, because the crack morphology is indicative of the causative mechanism.

The water was analyzed and the pH of the solution was 8.78 and conductivity was 1360 micromhos. It appears that most of the soluble ionic species - chloride, sodium, and sulfate - have concentrated 6-7 times their starting concentration in J-13 well water. The more insoluble species - calcium, bicarbonate, and fluoride - have evidently precipitated. Nitrate ion is likely reduced to nitrite (and other valence states of nitrogen) at cathodic sites on the stainless steel surfaces. The increase in pH is probably due to the relative increase in concentration of sodium and other alkali species over the concentrations of calcium and other alkaline earth species which undergo partial precipitation. These data are comparable to those given in the August monthly report on concentrating J-13 water by boil-down in the laboratory.

Because of the recent interest generated in examining copper-base materials as possible nuclear waste containment materials, a survey experiment was begun of corrosion performance in the J-13 well water environment and in the saturated

steam phase directly above the water at 100°C. For this preliminary experiment, three coupons of CDA 110 (Electrolytic Tough Pitch Copper), CDA 706 (90/10 Cupronickel), CDA 715 (70/30 Cupronickel) were exposed and, for comparison, Monel 400 was exposed to the water. Another three coupons of each were exposed to the steam. The same ASTM G-1 and G-31 test procedures were followed for the copper-base material weight-loss coupons as are used for the stainless steel coupons. The copper-base coupons are exposed in a different cell from the stainless steel, because of possible cross-contamination of the different corrosion products from the dissimilar metals.

The copper weight-loss coupons were examined after 3000 hours of exposure to the water and steam environments. As expected, the coupons were covered by corrosion products which, on the high-copper materials, was an opaque black oxide film. The Monel 400 specimens developed a thinner, transparent film during the same exposure period. Copper and copper alloys often show decreasing rates of corrosion/oxidation with exposure time because of the protection given to the metal by formation of the oxide films. For this reason, it was decided to leave two of the three specimens with the film intact and to clean the film off of the third specimen to determine the corrosion rate by the weight loss.

The corrosion rates of the different materials in the water and in the steam are given in Table 1. The values given in Table 1 were determined for single coupons of each alloy in each environmental phase. As expected, the cupronickel coupons showed lower corrosion rates than the essentially pure tough pitch copper (CDA 110). The Monel specimen actually showed a weight gain. All of these coupons had been cleaned according to the ASTM G-1 procedure for copper and its alloys. The cupronickels are generally more corrosion resistant in oxidizing environments (such as J-13 water) than the pure coppers. Monel (a nickel-base alloy containing about 32 percent Cu) is quite resistant to corrosion in aggressive aqueous environments. The coupons which had been weighed were then re-replaced in the test cells along with the other coupons which had not been examined. The next planned inspection will be after 6000 accumulated exposure hours in the test environments. During this inspection, the previously cleaned specimens can be compared to those which had never been cleaned so that the protective role of the black oxide film can be determined.

TABLE 1
 Corrosion Rates of Copper-Based Materials
 Exposed to J-13 Well Water and Steam at 100°C.
 3000 Hours of Exposure

Alloy	Corrosion Rate (μ /yr)	
	J-13 Well Water	Saturated Steam
CDA 110	3.11	4.22
CDA 706	2.10	0.90
CDA 715	0.28	0.50
Monel 400	0.02	0.64 (wt. gain)

The amount of localized corrosion was also determined for each alloy tested. As with the corrosion testing for stainless steels, slotted Teflon washers were used to create an intentionally creviced area on each coupon. The maximum localized penetrations were found in this creviced region during the 3000 hours exposure period. Expressing these localized penetrations on an annualized basis, the rates fall in the range of 40-150 μ /yr and are considerably in excess of the general corrosion rates given in Table 1. The results suggest that the principal degradation mechanism for the copper base materials would be a localized penetration which would eventually perforate the canister wall. Subsequent exposure and inspection of these coupons should indicate whether projections of these localized penetrations do indeed dominate the corrosion attack.

Package Design

The Level I Milestone report "Preclosure Analysis of Conceptual Waste Package Designs for a Nuclear Waste Repository in Tuff" has been forwarded to DOE/NV.

Two thermal calculations were made for the current vertical emplacement canister design configuration with 10-year-old PWR spent fuel. Each canister contained six pre-consolidated fuel assemblies with a total decay heat power of 3.3 kW at time of emplacement. In each case, borehole and canister diameters were 76.2 cm and 70.0 cm respectively. One case considered the canisters

emplaced with a package pitch of 8 m and a drift pitch of 30.5 m, and the resulting peak fuel temperature was 299°C four years after emplacement. For the other case, the package pitch was 5 m and drift pitch was 46.9 m. A peak fuel temperature of 322°C was reached four years after emplacement. The maximum allowable waste temperature (350°C) was not exceeded in either case.

The report "Structural Analysis of Conceptual Waste Package Designs for a Tuff Repository" draft has been completed and is currently undergoing revision. Due to the peer reviews taking longer than anticipated, the final revision of this report will be finished and forwarded to DOE/NV in October.

Model verification and development for the mechanical and flow/transport sub-routines continued in support of the waste package system analysis code (WAPPA). During the past month the mechanical model (FMODEL) was modified to correct the previously identified logic and coding errors, and the stand-alone test of FMODEL was completed. FMODEL now performs as described in the WAPPA User's Manual, but some problems remain at the system level in tracking barrier property changes. A draft report documenting the results of this study is in preparation.

The first phase of an effort to model matrix diffusion of radionuclides through Topopah Spring tuff has been completed. Solution concentration data for this analysis was obtained from the LLNL/SRL saturated release tests of the DHLW waste form. Preliminary results will be presented at the ORNL Workshop on "The Application of Geochemical Models to High-Level Nuclear Waste Repositories" (October 2-5, 1984). An abstract for this presentation entitled "Matrix Diffusion Coefficients for the NNWSI Waste Package Environment" has been sent to WMPO/NV for programmatic review. Further analyses are planned to determine the effect of highly soluble caliche material in the tuff sample.

A draft report describing the use of high frequency electromagnetic (HFEM) geotomography techniques in fractured, welded tuff was completed and subjected to internal technical review in September. "Study of Water Flow in Welded Tuff using Geophysical Tomography" describes the HFEM measurements made in G-Tunnel at NTS and their analysis and interpretation.

Other activities in September included FY 85 planning, and administrative work associated with combining the Performance Testing and the Exploratory Shaft subtasks. Effective October 1, all effort in this activity will be reported under the 2.6 Exploratory Shaft category, consistent with the new program-wide WBS.

PLANNED WORK

Work on development of the three dimensional model to analyze the stability of borehole openings will continue. Thermally induced stress changes will be included in the model.

Experiments in the Dickson rocking autoclaves will continue, as will post test characterization of rock samples from DB14 and DB15.

A new series of flow-through experiments to study the dissolution rate of pure quartz and feldspar will begin. The test series will use 16 samples.

Following cleaning of the large fractured tuff sample, the dehydration-rehydration experiment will be restarted.

Planned activities for the coming month are microstructural examinations of the processed and heat treated plates.

Samples will be prepared to investigate the effect of mixtures of silica gel of various grain sizes on the properties of packing material based on crushed tuff. Initial tests will be done using various proportions of gel (5, 10, and 15 percent) and a single compression pressure (probably 2,000 psi). If any of the mixtures give promising results, a full pressure-density test will be done and a specimen prepared for thermal conductivity measurements.

During the first quarter of FY 85, documentation of the physical process submodel evaluations (TMODEL and FMODEL) will continue to meet the revised delivery dates for these milestones. Code development efforts will focus on implementation of an unsaturated flow/transport submodel for the WAPPA code and modification of the mechanical submodel to represent the expected emplacement

stresses. Later in FY 85 these physical process submodels will be combined with data bases for metal corrosion and waste form release rates into a waste package system model to predict the long-term performance of the NNWSI waste package subsystem.

The report describing the suitability of HFEM techniques for monitoring saturation changes in fractured, welded tuff will be forwarded to DOE/NV for review early in October. Review of other types of instrumentation, measurement, and sampling techniques will continue. Scoping calculations for experiment design will be commenced; this work is closely related to the numerical modeling being planned in the Waste Package Performance Analysis subtask.

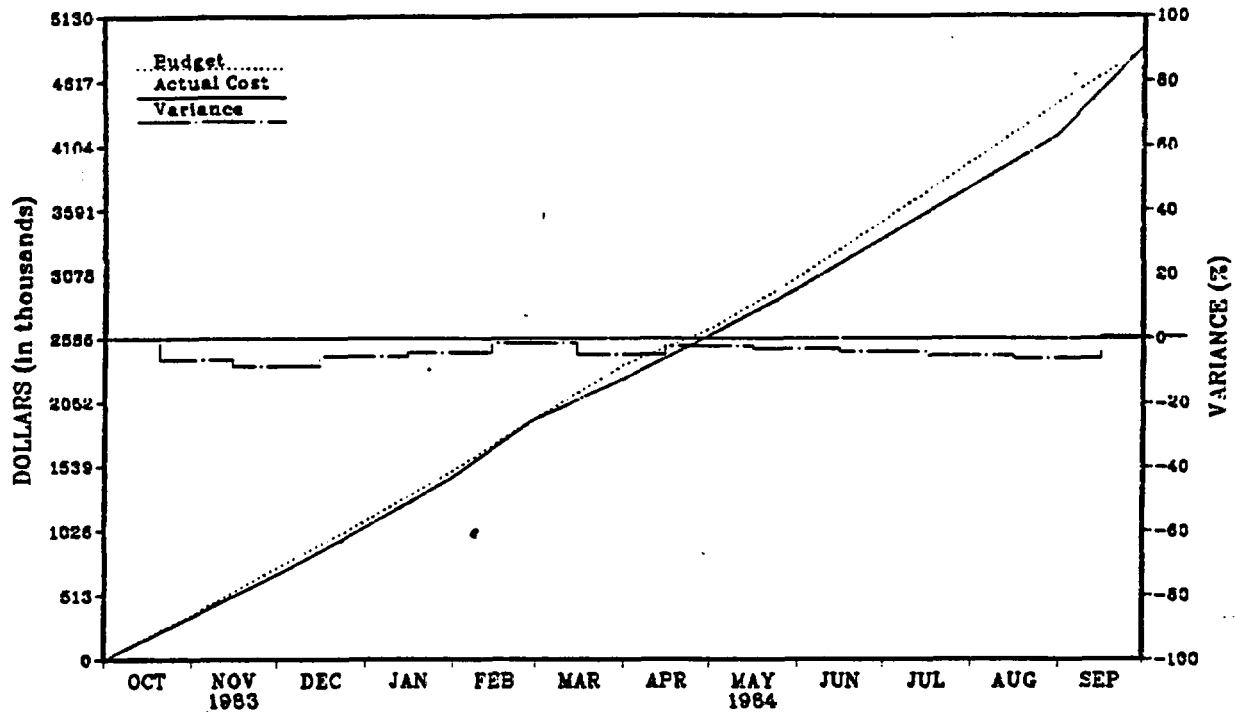
Initial test problems to exercise WAFE on the LLNL computer system will include the reanalysis of the preliminary 1-D waste package study completed in a joint LLNL/LANL effort. Successful execution of these two test problems will provide a starting point for future efforts to model flow within the waste package. In preparation for these analyses it will also be necessary to define the boundary conditions which characterize the waste package emplacement environment. LLNL will host a coordination meeting with LANL and SNLA on October 18, 1984 to define a common problem for modeling this near-field environment using NORIA, TOUGH, and WAFE.

PROBLEM AREAS

Lack of staff is still restricting the progress of other materials activities. Interviews are being conducted with a view to hiring a petrologist or geochemist to take over responsibility for this section of work.

An equipment failure has caused a set-back in the schedule for the dehydration and rehydration testing of tuff. The equipment is being repaired and the sample is being cleaned so that the experiment may be restarted. The impact on milestone schedules will be assessed after the experiment is restarted.

WBS 2.2, Waste Package GOVERNMENT FISCAL YEAR 1984



Budget (x1000)	352.	734.	1107.	1509.	1932.	2356.	2642.	3058.	3508.	3976.	4450.	4805.
Cost (x1000)	329.	671.	1045.	1442.	1903.	2237.	2581.	2954.	3359.	3764.	4175.	4890.
Variance (x1000)	23.	63.	62.	67.	29.	119.	61.	104.	150.	212.	275.	-85.
% Variance	-7.	-9.	-6.	-4.	-2.	-5.	-2.	-3.	-4.	-5.	-6.	1.

NNWSI LEVEL 1 MILESTONES

RESP. AGENCY	WBS	MILESTONE DESCRIPTION	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
LLNL	2.2	SUMMARY LOGIC NETWORK FOR WP DESIGN & DEVELOPMENT	—————▲															
LLNL	2.2	ESTABLISH INTERIM PRODUCE SPECIFICATIONS	—————												△	◇		
LLNL	2.2	PRE-CLOSURE ANALYSIS OF SELECTED CONCEPTUAL DESIGNS	—————												△	◇		

△ PLANNED MILESTONE COMPLETION DATE
▲ COMPLETED AS SCHEDULED

◇ REVISED MILESTONE COMPLETION DATE
◆ COMPLETED AS REVISED

2.3 SITE

OBJECTIVE

The objective of this task is to determine whether or not Yucca Mountain is a suitable location for a repository for high-level waste. The effort is divided into two areas of study. The first is the development of the understanding of the characteristics of the rock mass that lies below the surface of Yucca Mountain. This encompasses the study of the geology (structure and stratigraphy), hydrology (both saturated and unsaturated zone), geochemistry (chemical reactions that can be expected when waste is emplaced), and mineralogy and petrology (the study of the materials that will control the isolation and engineering characteristics of the rock). The second is the development of an understanding of the processes and events that could occur in the environs surrounding Yucca Mountain that could serve as a potential disruptive force to impact a repository. These efforts include the study of the tectonics, seismicity, volcanism, regional hydrology, paleohydrology, and paleoclimatology.

ACTIVITIES

A work order has been initiated for electrical services to operate the Los Alamos mobile laboratory at Well J-13. Once the laboratory is in place, a portion of the water pumped from the well will be filtered to obtain particulates from the water. When sufficient quantities of particulates are accumulated, they will be analyzed and used for sorption experiments. From these data it should be possible to estimate the upper limit of the amount of waste elements that can be transported by sorption on natural particulates moving in the groundwater.

Because of the results of the pumping experiments in Wells USW H-6 and H-3 and because of the DOE/NV request for work plans for 1985-86, the program plan for the groundwater chemistry task is being updated and changed to fit with the Work Plan outline.

The recently acquired Dionex 20211 Ion Chromatograph is being checked. One of the input-output chips in the microprocessor was found to be faulty and was replaced at the factory.

Samples of soil and tuff have been collected from Yucca Mountain to determine the infiltration of rainfall during the past 25 years by means of the ^{36}Cl bomb pulse technique. This month the samples selected for ^{36}Cl analyses were prepared for chlorine mass ratio determinations on the University of Rochester tandem accelerator mass spectrometer. The ^{36}Cl measurements are scheduled for next month.

Work is continuing to select an appropriate tracer for the water that will be used in mining the Exploratory Shaft (ES). Bromide analyses are being performed on a routine basis once again following resolution of various instrument problems. The bromide elution characteristics of a column containing Topopah Spring Member tuff are being measured with NaBr solutions.

The thermodynamic model for analcime has been used to examine the possible reasons for crystallization of authigenic albite in areas where analcime is present. It appears that silica activities between those in equilibrium with cristobalite and quartz and the formation of highly ordered albite may be necessary. The considerable analcime formation despite the apparent greater stability of highly ordered albite may have two explanations: 1) the very slow kinetics for the formation of highly ordered albite and 2) the more easily formed disordered albite being less stable than the analcime.

Work has continued on the effects of alpha-induced reactions on PuO_2 solubility determinations and on the carbonate complexation of Am(III). It has been determined that even when ^{242}Pu is used, the rates of alpha-induced reactions are large compared with that of



Equilibrium for this reaction is not attained; rather, steady states are approached that depend on the total concentration of Pu in the system. Thus, an equilibrium constant for the above reaction cannot be obtained for use in

calculating the solubility of $\text{PuO}_2(\text{coll})$, as had been anticipated. However, further study of the reverse of the reaction will enable an upper limit to be set.

Work is near conclusion on the measurements of AmOHCO_3 in 0.1 M of NaClO_4 solution at atmospheric CO_2 concentrations at 25°C at pH values of 6, 8, and 10. The $^{243}\text{Am}(\text{OH})\text{CO}_3$ was prepared by the formation and subsequent hydrolysis of the trichloroacetate complex in aqueous solution. The material was identified as crystalline AmOHCO_3 by powder x-ray diffraction analysis. Solution samples are being analyzed by counting the 75.44-keV ^{243}Am gamma-ray with a solid-state x-ray counting system.

The serial sorption measurements have been completed with plutonium. Desorption runs are underway. The sorption ratio for the first 6-week sorption gave an R_d similar to the one measured previously. The sorption ratio measured for 6 weeks and using the supernatant solution from the first 6-week sorption as the feed solution gave a value that is roughly 70 percent of the first one. The plutonium concentration of the first 6-week sorption was about 1×10^{-7} M, and the concentration of the feed for the second 6-week sorption was about 7×10^{-9} M. The 30 percent difference between the measurements may be due to isotherm effects or lack of reproducibility. The experiment has not yet turned up a major speciation effect. It is planned to expand this line of experiments to include a second set of sorption experiments using either the same concentration in the original feed solution and 4 serial sorption runs, or again doing 2 serial sorptions but reducing the concentration by about 50.

Six-week sorption runs are complete for three tuff samples and water from Well H-3 (pH 9) with strontium, cesium, barium, europium, and tin tracers. Desorption runs have started. Sorption experiments with thorium in the partial carbon dioxide atmosphere are complete and the samples are being counted.

Studies have also been started on the sorptive properties of layered, mixed hydroxides, which have some anion exchange capacity and should exhibit some thermal stability. Four sets of samples containing either nickel and aluminum or nickel and iron were prepared. In 3-week sorption experiments, sorption ratios were measured as high as 24 ml/g for iodine and 29 ml/g for technetium.

The materials warrant further study as a possible fill material to retard anions such as technetium.

Three plutonium experiments in the presence of bacteria were started this month. The purpose of the work is to determine if microbial activity, particularly for species capable of degrading drilling fluids, can influence the mobility of Pu. Bacteria cultured before the experiments were added to mixtures of crushed tuff and 10^{-8} - or 10^{-9} -M Pu. In the other experiment, the bacteria were incubated in the presence of tuff. Preliminary results suggest that sorption is enhanced by the presence of bacteria.

Two 2-m crushed tuff columns were eluted with tritiated water to determine the free column volume. This measurement will be used as a reference to measure the anion exclusion effect and the kinetics of sorption of actinides. Technetium-traced Well J-13 water was eluted through the 2-m G2-2017 column. The elution curve of technetium will be compared with that of simple anions, such as chloride and sulfate.

New MCRT data files for geochemical code EQ3/6 have been compiled for boron.

Work has begun to develop data files for some organic species like acetate and phthalate. These occur in the natural environment and are also important buffers in the laboratory experiments undertaken to provide necessary data.

A limited-access archival file storage directory has been established to backup the shared development directory for EQ3/6. This new directory will be updated monthly to protect and document the changes installed during the month.

Test cases have been successfully run on EQ6 using the newly installed precipitation kinetics. Acceptable fits to the experimental data of Rinstidt and Barnes (1980) for silica and of Reddy et al. (1981) for calcite have been obtained.

TRACR3D calculations were completed of two ES tracer experiment borehole scenarios to aid in designing proposed experiments involving tracer transport by diffusion. The scenarios, one vertical and one horizontal, included matrix

material properties of the Calico Hills member sample supplied by SNL. In both cases a nonadsorbing tracer was placed and sealed at the borehole end in a fully saturated, unpressurized state. The matrix saturation was set to 70 percent and the tracer was transported by diffusion into the matrix. The two-dimensional models were calculated out to 7 months and suggest the following:

- o Tracer propagates into the matrix in a spherical, symmetrical manner. The diffusion rate decreases rapidly as the source saturation approaches matrix saturation. In addition, the matrix saturation is not measurably changed by the proposed volume of fully saturated tracer solution.
- o A tracer at 1 percent of original concentration diffused to a 20-cm radius around the source after 7 months. The 1 percent level represents the practical lower detection limit, and the 20-cm radius is within current overcoring capability.
- o Tracer at 10^{-9} original concentration diffused to 80-cm radius at 7 months.

A direct method was developed for generating stationary Gaussian processes which is an alternative to the turning-bands method of Matheron. This method was considered in the early 70s but abandoned due to the computational burden. Subsequent developments in computational capacity favor this direct approach. A code has been written to generate values on a 100 x 100 grid. This code can be readily adapted to handle other two- and three-dimensional problems.

The logic network for the ES diffusion test was changed to a much more detailed level than used previously. Costs for the Los Alamos work were apportioned for each segment of the logic network. In addition, quality assurance levels were assigned to each aspect of the diffusion test.

The first results were obtained this month from modeling the ES diffusion tests with the TRACR3D code. The modeling will be used to help define the optimal experimental protocol for tracer, emplacement, overcoring, and post-test analyses.

The level I milestone report "Mineralogic Summary of Yucca Mountain, Nevada" was submitted through DOE/NV this month. This report summarized the methods used in quantitative x-ray diffraction analysis of Yucca Mountain samples and presents the current data on the recently prepared cross sections. The three-dimensional distribution of mineral and glass zones at Yucca Mountain is the major emphasis of this report. A companion report entitled "Distribution and Chemistry of Diagenetic Minerals at Yucca Mountain, Nevada" was prepared in first-draft form; the origins of zeolites and the amount of chemical exchange during zeolitization are described. For mineral stability studies, the duPont thermal analysis system has been repaired and is now functioning properly. Studies of alteration mineralogy were extended to include carbonate and silica minerals sampled from ridge flanks and fault zones around Yucca Mountain; these samples are being studied for evidence of temperature of formation (fluid inclusions) and for mineralogic composition.

At mid-month, a meeting was held at Los Alamos between representatives of the LLNL waste package program and the Los Alamos geochemistry program. This meeting brought up at least two areas of study (petrographic study of the Topopah Spring Member and experiments on Topopah Spring vitrophyre) where an exchange of technical expertise will be mutually beneficial.

The EA-referenced report entitled, "Stratigraphic and Structural Relations of Volcanic Rocks in Drill Holes USW GU-3 and USW G-3, Yucca Mountain, Nye County, Nevada" was distributed.

A list has been prepared of 60 names proposed for undesignated geographic features on and near Yucca Mountain. This will be submitted to the Geographic Names Committee for acceptance. Hopefully these terms will be available for use on both of the new 7-1/2-minute topographic maps being prepared to cover the old 15-minute Bare Mountain, Big Dune, and Lathrop Wells quadrangles, and on geologic maps using the existing 7-1/2-minute topography of the Yucca Mountain region.

Regional geophysics investigators have decided to use a 50-gamma interval computer plot of total magnetic intensity for the Kingman 1° x 2° sheet. The 1:250,000 scale plot is now being scribed. An earlier contract version of this

map had been rejected for publication by the Nevada Bureau of Mines and Geology (NBMG) because of poor legibility partially caused by too small a contour interval (10-gamma). These data include the southern half of the major (1000-gamma) anomaly over the Spring Mountains just south of NTS, and will make up an important component of a magnetic map being compiled of Yucca Mountain and vicinity to a radius of 100 km.

The report entitled "Preliminary Analysis of Geophysical Logs from Drill Hole UE-25p#1, Yucca Mountain, Nye County, Nevada" has been sent to the printer.

The borehole gravity report of drill holes USW G-3, UE-25p#1, and UE-25c#1 has been forwarded for printing.

A report on preliminary interpretation of paleomagnetism and magnetic properties data from drill holes USW G-1, G-2, GU-3, G-3 and VH-1 has undergone peer review. Also submitted was a second report for review, entitled "Paleomagnetic Orientation of Core from Drill Hole USW GU-3, Yucca Mountain, Nevada: Tiva Canyon Member of the Paintbrush Tuff."

Downhole borehole magnetometer tests have been completed which satisfactorily meet LLNL's specifications. Documentation will be completed next week. Two downhole runs were completed with the resulting data virtually identical, thereby satisfying the stability tests. The resolution is plus or minus two gammas. The one final test remaining to be completed is to mate the tool with the Birdwell cablehead, and complete a cursory test to verify that it is operable.

Camera-ready text and illustrations for the report entitled "Hydrology of Yucca Mountain and Vicinity, Nevada-California -- Investigative Results through Mid-1983" (revised Chapter 5 of the SCP) are being prepared. The report received the USGS Director's and DOE/NV approval for publication this month.

Instrumentation is being redesigned for the packer tests in connection with the ground-water flow investigation. Additional evapotranspiration, water level and moisture tension and content data at Franklin Lake playa have been

collected for the ground-water discharge study. Preparations were also made for the pumping test of UE-25c#3 to be performed in mid-October.

The report entitled "Ground-water Level Data and Preliminary Potentiometric-Surface Maps, Yucca Mountain and Vicinity, Nye County, Nevada," USGS WRI Report 84-4197, has been printed and distributed.

In the unsaturated-zone hydrology investigation, test hole USW UZ-6 was drilled to 1,887+ feet on September 26. At that depth, the drill pipe became stuck because of rock cuttings plugging the drill bit, subs and 2 drill collars. The drill pipe was worked free later in the day and was pulled from the hole. A suite of dry hole geophysical logs is being made in addition to the standard suite of logs. TV camera surveys, vibroseis and magnetometer surveys also will be made. Test hole USW UZ-4 is drilling at 237+ feet. Continuous core was cut using the HCQ-3 core barrel from 100+ feet to present depth. Coring of the nonwelded rocks of the Yucca Mountain Member is progressing very well. Projected total depth of the well is estimated at 340 feet, about 80 feet less than anticipated.

Characterization and validation of the UZ finite difference model continued. Some 70 runs have been made to date to determine limitations and bounds on the input data. The revised hydrological data have been received. The necessary input data are being prepared for six recharge periods (3 short rain periods with 3 dry periods in between) during one year and then simulation of a ten-year period. Fictitious data were used to determine input limits as well as to identify any discrepancies in model performance. The model has been exercised starting with very low initial saturation and then saturating the media by increasing the rain intensity. Some anomalies have been noted and will be addressed in the coming weeks. Some inconsistencies were noted in the saturation and pressure data for the Topopah Spring Member.

Sediment samples from Walker Lake cores which are to be analyzed for chemical, geochemical, geologic, and isotopic parameters have been sampled and distributed to investigators for analysis except for paleomagnetic and texture studies.

A report is being prepared for open-file release describing trenching of the Beatty fault. An attempt is underway to date single stratigraphic units from the two trenches with complementary isotopic methods -- the shorter term carbon-14 analysis and the longer term uranium-trend dating system.

During September, a digital ground-motion-measurement system was evaluated during two events. At Well J-11, two identical canisters were placed side by side, one making use of the three-channel prototype digital system. Information from both systems was telemetered to the fire station for recording. Paper playbacks indicated that the new system functioned properly.

Laboratory studies have been completed of strombolian and inferred hydrovolcanic deposits of the Lathrop Wells cone. This work shows that the strombolian deposits do not contain a hydrovolcanic component and that the pyroclastic surge and well-bedded deposits are hydrovolcanic. This means that the effects of hydrovolcanic activity have not been included in past analyses of the radiological consequences of volcanism. Additionally, LANL has reviewed the petrologic data for volcanic ashes sampled in the trenches of Crater Flat. The ashes are correlated with either the 1.2- or 0.3-Myr volcanic cycles. LANL is unable to correlate the ashes uniquely by geochemical or petrologic means.

PLANNED WORK

The draft MCRT User's Manual, which incorporates the recently added random access file capability of the code, is in progress. Although the summer-hire has left, some additional work is in progress to complete additions to the thermodynamic data base.

The elution of bromide from the Topopah Spring Member tuff column will be measured relative to the elution of tritiated water. If the bromide elutes no later than the tritium, then NaBr will be recommended as the ES water tracer.

Another set of serial sorption experiments will be performed with plutonium and batch sorptions using americium in a carbonate solution. Studies of anaerobic biodegradation of drilling fluids will continue when the incubation chambers are made air-tight.

Data are being collected concerning available core bit sizes, operating temperatures, and rates of fluid flow during coring operations. These data will be used as input for additional TRACR3D simulations of the diffusion experiments.

The report on "Distribution and Chemistry of Diagenetic Minerals at Yucca Mountain, Nevada" will be revised and submitted to DOE/NV. Studies of fluid inclusions and of mineralogy on carbonate and silica samples from ridge flanks and fault zones at Yucca Mountain will be pursued to interpret the origins of those samples.

During October, more accurate comparisons of data from the three-channel conventional system and the three-channel prototype digital system will be made. It is expected that the new digital system will solve the low-frequency problems of double integration of acceleration data.

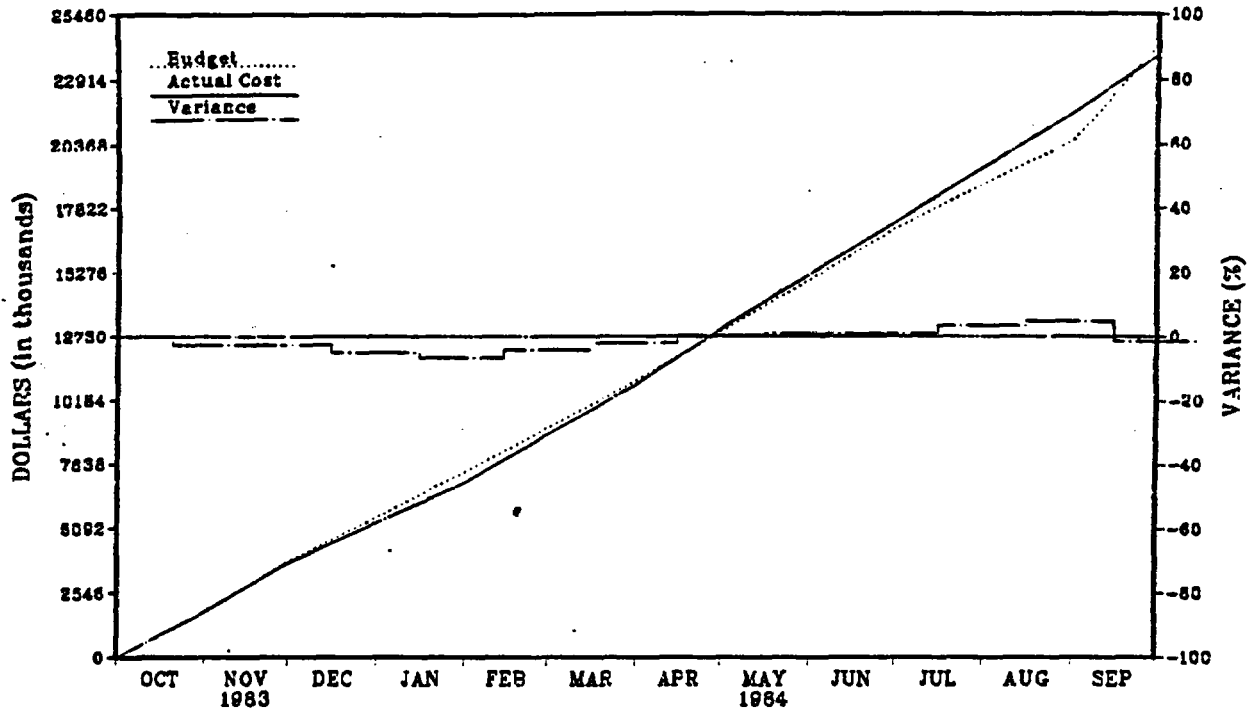
Additional field work will be completed to sample and to study the trench ashes of Crater Flat.

PROBLEM AREAS

During the installation of the precipitation kinetics to EQ6, bugs developed. They had to be found and corrected before work could continue. This, together with the September meetings at LANL and Oak Ridge as well as the Penrose Conference, has delayed the draft MCRT User's Manual one month.

The integral inversion program INVPOS has not resolved a bimodal mixture of polystyrene colloids. Theoretically, the code should be able to separate these distributions. The code will be examined to determine the cause of this shortcoming. This technique is being developed to make the study of particulate size distributions in plutonium solution and groundwater possible in a non-interfering method.

WBS 2.3, Site
GOVERNMENT FISCAL YEAR 1984



Budget (x1000)	1794.	3809.	5500.	7356.	9106.	11003.	12907.	15016.	17026.	19760.	20400.	24253.
Cost (x1000)	1748.	3707.	5285.	6869.	8726.	10785.	12997.	15167.	17184.	19376.	21490.	23873.
Variance (x1000)	46.	102.	215.	487.	380.	218.	-90.	-149.	-158.	-608.	-1010.	380.
% Variance	-3.	-3.	-6.	-7.	-4.	-2.	0.	1.	1.	3.	5.	-2.

NNWSI LEVEL 1 MILESTONES

RESP. AGENCY	WBS	MILESTONE DESCRIPTION	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
LANL	2.3	DRAFT RPT. ESTIMATING WATER FLOW & RN TRANS. ALONG FLOW PATHS	—————▲															
USGS	2.3	GROUNDWATER LEVEL DATA & PRELIMINARY POTENTIOMETRIC SURFACE MAPS, YUCCA MOUNTAIN	—————◆									△						
LANL	2.3	LETTER REPORT GROUNDWATER CHEMISTRY ALONG FLOW PATHS	—————												△		◇	
LANL	2.3	COMPLETE REPORT ON VOLCANIC HAZARDS ANALYSIS	—————												△		◇	
LANL	2.3	PROGRESS RPT. ON 3-D MINERALOGIC MODEL OF YM	—————												△		◇	

△ PLANNED MILESTONE COMPLETION DATE
▲ COMPLETED AS SCHEDULED

◇ REVISED MILESTONE COMPLETION DATE
◆ COMPLETED AS REVISED

2.4 REPOSITORY

OBJECTIVE

The objective of this task is to develop the engineering capability to design, construct, operate, and decommission a repository in tuff. Four specific technical areas are involved that include (1) the determination of the physical and mechanical properties of the rock matrix and rock mass that are important to the design and construction of an underground structure; (2) the engineering analysis and evaluation of the various technical details that are important to the design and operation of a repository; (3) the development of the techniques of sealing a repository as part of decommissioning; and (4) the preparation of a site-specific design that will be accommodated within the development of the equipment to construct the repository, handle the waste and the waste package, and transfer the waste and the waste package within the repository system.

ACTIVITIES

Systems Engineering

The RCG Design Activity Structure Subgroup held its initial meeting in Denver on September 18 and 19, 1984. The objectives of this meeting were to:

- o establish a common Design Activities Structure (DAS) to be utilized by all the DOE Repository Project Offices for the Repository WBS Element;
- o define the level of detail required to identify each of the DAS elements and to permit project-to-project comparison of the level-of-effort and design deliverables;
- o report the results of the above, including unresolved issues, to a second RCG subgroup chaired by Virgil Lowery.

The meeting participants, representatives of all four repository projects, reviewed the Repository WBS Element (1.2.4 for NNWSI) and the associated subelements and as group recommended a Design Activities Structure.

The recommended DAS represents the opinion of the majority of the subgroup. The NNWSI representatives and representatives from the other projects disagreed with several of the DAS elements. Therefore, Dean Stucker (Weston) agreed to develop a strawman DAS structure with a description of the content of each DAS element and to forward this strawman to the DOE Project Offices for review and comment. Dates for the review and comment period were not established.

The first draft of "Reference Waste Descriptions for a Geologic Repository at Yucca Mountain, Nevada," (SAND84-1848), was completed and submitted for peer review. Waste characteristics and production rates are taken from Appendix B of the DOE guidance document "Generic Requirements for a Mined Geologic Disposal System," which is scheduled for baselining in late September. Spent-fuel-container capacities are based on preliminary designs by LLNL. The report presents waste receiving and emplacement schedules for use in the design of the repository waste-handling facilities and equipment, and as an input to the timetable for developing the underground disposal area.

The NNWSI design team has been selected by DOE/HQ to interact with the Independent Cost Estimate (ICE) team to understand the difference between the Projects' cost estimating and the ICE team's values. This interaction resulted in two meetings during September in the San Francisco Bechtel National, Inc. (BNI) offices. The first meeting was with Weston personnel to help them understand the level of detailed backup. The second meeting was with DOE/HQ, Weston, and ICE to understand where the differences were and what caused the differences. The second meeting resulted in an extensive list of differences that must be analyzed to determine areas of estimating errors and areas of different design philosophy. A follow-up resolution meeting is currently scheduled for October 17 and 18 in Washington, D.C.; DOE/HQ, DOE/NV, and the ICE team will be represented at this meeting.

Conceptual Design

The draft report "Two-Stage Repository Development at Yucca Mountain: An Engineering Feasibility Study," (SAND84-1351), has passed peer review and is in management review.

A scheduled design review with URS/J. A. Blume & Associates was held on September 27. This review presented work being done in the development of seismic design criteria to be used in the conceptual design of the repository. This work includes site, surface, and underground facilities. The seismic design criteria encompasses ground-motion considerations from both natural and underground nuclear explosion (UNE) sources.

A repository/interface meeting with attendees from USGS, DOE/NV, SAIC, and SNL is to be held on October 3, 1984. The purpose of this meeting is to address the geologic and tectonic investigation efforts required to support development of the conceptual design and subsequent Title I engineering. SNL and USGS are working jointly to establish an agenda for the meeting. It is expected that continuing interaction among the above noted agencies will be required.

Tentative plans are to have the A/E's for the Repository Conceptual Design (BNI and Parsons Brinckerhoff) present their scheduled design review at SNL, Albuquerque during the week of October 29.

A document outlining a two-stage repository study has been written and submitted for line review.

The document titled "Recommendation for a Second Access for the Yucca Mountain Exploratory Shaft Facility," (SAND84-1261), is in line review and DOE/NV policy review.

The document "Conceptual Operations Report for a Repository at Yucca Mountain," (SAND83-7446), has been published.

The report "Lining Considerations for a Circular Vertical Shaft in Generic Tuff," (SAND83-2068), is in line review and DOE/NV policy review.

During September, Agbabian Associates submitted a memo summarizing their review and evaluation of the ubiquitous joint material model for the ADINA Code. This memo documents their check of the code for future code validation and verification activities. Their review identified several possible inconsistencies in the code. These are currently under review by SNL. SNL has completed model implementation (convergence testing, time-step evaluations, comparison to elastic solutions, etc.) for analyses of drift stability using the ubiquitous joint material model and the ADINA code. Calculations of the thermomechanical effects around the drifts as a function of standoff have been completed. These calculations will be used together with ventilation studies by Parsons-Brinckerhoff (PB) to select the appropriate standoff between the waste and the drift.

Work is continuing on enhancement of the surface modeling techniques for the three-dimension graphics geological model.

Equipment Development

The rough draft is complete for "Retrieval of Fuel from a Nuclear-Waste Repository in Tuff," (SAND84-1748A), that addresses legislative and regulatory requirements and presents SNL's means of compliance. The document also defines SNL concepts of demonstration of capability for retrieval and allowable residuals.

A report titled "Disposal of Canistered Waste in Vertical Boreholes--A Description of the System, Equipment, and Procedures for Emplacement and Retrieval (NNWSI)," (SAND84-1010), is complete. This report is in the peer review process. A report titled "Disposal of Canistered Waste in Horizontal Boreholes--A Description of the System, Equipment, and Procedures for Emplacement and Retrieval (NNWSI)" is being written. The report is scheduled to be in peer review process by November.

The Robbins Company report on horizontal borehole drilling and lining systems has been completed and is in review.

Input was provided for section 4.5 (Stress Field) of the SCP. This subsection provides an assessment of the in situ stress state at Yucca Mountain based on regional geologic studies, in situ stress measurements, and finite-element calculations. The work has been summarized in "In Situ Stress at the Nevada Test Site: Implications About In Situ Stress at Yucca Mountain, Nevada," (SAND84-2021A). The abstract has been submitted for line review and will be submitted to the U.S. Symposium on Rock Mechanics.

"Measurement and Calculation of the Mechanical Properties of a Highly Fractured Rock," (SAND84-2020A), and "Calculation of Laboratory Stress-Strain Behavior using a Compliant Joint Model," (SAND84-7210A), were submitted for line review. Both of these abstracts, to be submitted to the U.S. Symposium on Rock Mechanics, summarize the combined efforts of SNL and RE/SPEC, Inc. to begin to verify and validate the compliant-joint material model.

Funding for the RE/SPEC, Inc. contract was increased in order to continue initial validation and verification studies pertaining to the compliant-joint material model, to provide input to the in situ stress report, and to cover costs incurred with respect to the siting guidelines.

The document "Preliminary Characterization of the Petrologic, Bulk, and Mechanical Properties of a Lithophysal Zone within the Topopah Spring Member of the Paintbrush Tuff," (SAND84-0860), is still in line review. Data analysis of the thermal-expansion results continues. A keystone memo containing recommended matrix and rock-mass bulk, mechanical, and thermal properties for tuff units at Yucca Mountain was written and peer reviewed. The memo should be available the first week of October.

Bulk density measurements were completed on a small number of USW G-4 samples in support of data requirements for the EA reference document "Fracture and Matrix Hydrologic Characteristics of Tuffaceous Materials from Yucca Mountain, Nye County, Nevada," (SAND84-1471).

Preparation has been completed of "Repository Sealing Plan -- Fiscal Years 1984 to 1990 for the Nevada Nuclear Waste Storage Investigations Project", (SAND84-0910).

The report "Hydrologic Calculations Contributing to Development of Concepts for Sealing a Prospective Waste Repository at Yucca Mountain, Nevada," (SAND83-2465), was revised in response to peer review comments and was submitted in early August for line review. An abstract presenting the results given in this report was submitted to "Waste Management '85." The sealing concepts report should be printed by October 8, 1984.

Peer reviews of the report "Repository Sealing Concepts for the NNWSI Project," (SAND83-1778), were received from D. Evans, R. D. Ellison, and D. Stephens. The comments will be incorporated into the conceptual-design activity, as appropriate.

Several analyses included as part of the Preliminary Conceptual Models Task were conducted. These included potential flooding into the shaft from surface water, typical hydraulic-conductivity values for shaft fill, additional calculations on drainage at the base of the shaft, settlement of shaft fill, and the pressure acting on the station plug.

Work is in progress to extend the LANL contract to PSU to FY 85. Studies during this period have addressed the reactivity of sealing materials at elevated temperatures up to the maximum credible temperature expected around waste package emplacement drifts or boreholes in the Topopah Spring Member. Both saturated and undersaturated conditions are being investigated at 150°C and 90°C following earlier tests at 200°C. A new chemically modified grout is also being tested at 200°C and 150°C. Studies have also been made on long-term durable cementitious analog materials.

A major effort has been applied during this period to interpret new data and prepare the topical report sections that detail the stability of selected sealing materials PSU 82-22 and 84-12.

The final 150°C agitated-concrete experiment with Topopah Spring tuff and PSU 84-12 was prematurely terminated because of equipment failure -- leakage of the Parr autoclave. However, seven of the ten solution samples have been collected. By this elapsed time in the experiment, the majority of the chemical alteration in the aqueous phase had been completed and solution

compositions were nearing a steady state. Solution analyses of these samples are in progress, as is the characterization of the resulting solid reaction products.

PSU has completed a draft version of "Ancient Concrete Studies as Analogs of Cementitious Sealing Materials for a Tuff Repository." The durability of ancient concretes has been investigated to provide information applicable to determining the longevity of concrete materials for sealing a nuclear waste repository in tuff. Because of the use of tuff and volcanic ash in the concretes near Rome, the results are especially applicable. Evidence from the investigations of these analog materials suggests that sealing materials are compositionally and microstructurally similar to the ancient pozzolanic cementitious materials and will be likely to adjust slowly to such an environment, to perform well, and to remain stable.

Building renovation and reinstallation of experimental equipment at LANL were completed this month. A creep deformation experiment on Topopah Spring tuff was started after equipment debugging and currently is in the pore saturation phase. This will be the only experiment conducted on Topopah Spring tuff before work terminates. The primary objective was formulation of an empirical constitutive relationship for incorporation into predictive calculational models that will be applied to borehole sealing, ES experiment design and interpretation, and repository design and performance assessment. In LANL's opinion, however, this experiment will yield too little information on which to base any conclusions on the importance of time-dependent degradation of tuff strength.

PLANNED WORK

A long range program planning session for WBS 1.2.4 activities will be held in Albuquerque, NM on October 8-10, 1984. A description of individual elements in the NNWSI DAS will be developed for WBS 1.2.4. This description should be available for project review by December 1, 1984. The new programwide Work Breakdown Structure (WBS) will be implemented for WBS 1.2.4 on October 1, 1984.

Work with URS/J. A. Blume will continue through November 1984 and will terminate with a technical report intended to be published as a SAND document. This contract is scheduled to be completed by the end of December 1984.

During October, two near-field analysis reports will be peer reviewed: "Thermo-mechanical Analysis of Access Drifts, Storage Drifts and Alcoves, and the Access Drift/Storage Drift Intersection" and "Thermal Analysis of BWR - Spent Fuel Vertical Emplacement Scheme."

Conceptual-design work is underway for a multi-geology horizontal-emplacement and retrieval system. A report depicting concepts should be completed in October.

SNL has begun a comparison of closed-form stress solutions with finite-element analyses for mined-opening-type problems. The closed-form solutions will be modified to include thermal effects. This effort will assist in verification of the finite-element material models being used.

Experiment evaluations are the major remaining activities for the small-diameter heater and heated-block experiments.

The U12g.12 drift is scheduled to be completed during October. It is planned to monitor drift convergence with a tape extensometer at a number of stations during the final mining. Also preparations are being made for permeability testing that is to be included with the mining evaluation. Permeability-testing equipment is being procured and fabricated. Shake-down testing is planned for existing boreholes in late October or early November.

During the period October-December, 1984, measurements of thermal conductivity and thermal expansion of lithophysal Topopah Spring Tuff, and measurements of heat capacity of tuff units expected to be in the thermal field of a repository in the densely welded Topopah Spring tuff will be performed.

Samples already tested at PNL for saturated conductivities, water-retention data and bulk-property data will be re-tested for grain densities at SNL due to the observation that PNL grain-density values are generally higher than values

for samples previously tested in the rock mechanics program. Grain-density values affect both porosity and maximum saturation values of the samples.

Upon completion of the line review and approval of the Quality Assurance Plan for the fracture-flow experiment apparatus, saturated fracture-conductivity versus confining-stress data will be measured for fractured Topopah Spring core samples. Samples will be pressure loaded (up to approximately 100 bars) and unloaded (to near ambient pressure) and the cycle repeated until hysteresis has been eliminated.

A Topopah Spring core sample is being tested for the response of matrix permeability to temperature increases. The sample has no apparent fractures.

LANL will analyze the Calico Hills data and write a final report on the results. The test on time-dependent deformation of Topopah Spring tuff will be completed.

In preparation for modeling work, LANL will compile a list of mineral phases that are of possible importance in the seal material and adjacent tuff.

PROBLEM AREAS

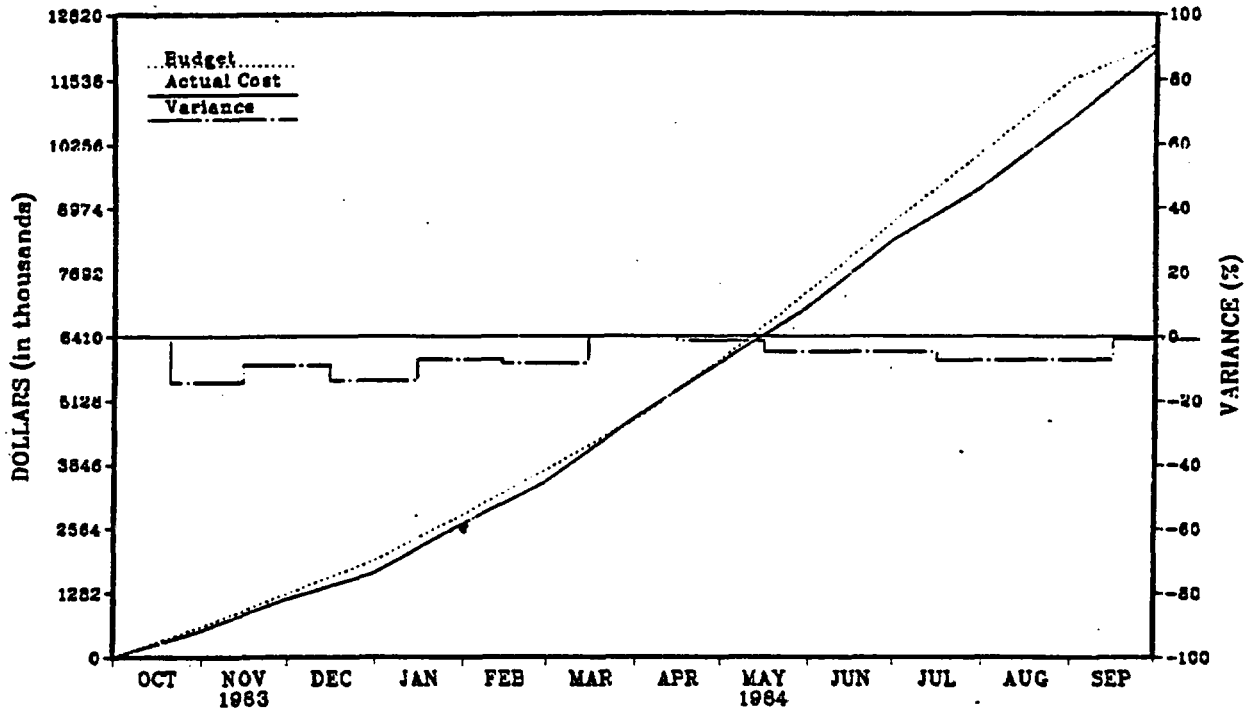
Preparation of Chapter 6, "CONCEPTUAL DESIGN OF A REPOSITORY," for the SCP has been delayed due to lack of DOE/HQ guidance regarding required content and format.

Revision, based on peer-review comments, of "Underground Facility Area Requirements for a Nuclear Waste Repository at Yucca Mountain," (SAND84-1153), has been delayed because of heavy FY year-end contract-management activities and involvement in peer review of the SR document.

Due to reassignment of priorities within the SNL organization (Geomechanics Division), testing of parameter effects on mechanical properties of Topopah Spring tuff probably will be delayed by two months. Associated testing at RE/SPEC, Inc. should begin the first week of October. The delay will also impact completion of comparative mechanical testing between RE/SPEC, Inc., Terra Tek, and SNL.

There was a delay in testing while equipment was moved at LANL. This delay and the longer-than-anticipated tests on Calico Hills tuff will result in insufficient time to complete work on Topopah Spring tuff before the task termination date.

WBS 2.4, Repository GOVERNMENT FISCAL YEAR 1984



Budget (x1000)	613.	1273.	1951.	2652.	3749.	4763.	5902.	7337.	8713.	10107.	11544.	12214.
Cost (x1000)	525.	1158.	1680.	2646.	3436.	4763.	5867.	6993.	8307.	9361.	10717.	12105.
Variance (x1000)	88.	115.	271.	206.	313.	2.	95.	344.	406.	746.	827.	109.
% Variance	-14.	-9.	-14.	-7.	-9.	0.	-2.	-5.	-6.	-7.	-7.	-1.

NNWSI LEVEL 1 MILESTONES

RESP. AGENCY	WBS	MILESTONE DESCRIPTION	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
SNL	2.4	SUBMIT SUMMARY LOGIC NETWORK FOR REPOSITORY				▲											
SNL	2.4	SEAL DEVELOPMENT PLAN FOR REPOSITORY							△								◇

△ PLANNED MILESTONE COMPLETION DATE
▲ COMPLETED AS SCHEDULED

◇ REVISED MILESTONE COMPLETION DATE
◆ COMPLETED AS REVISED

2.5 REGULATORY/INSTITUTIONAL

OBJECTIVE

The objective of the Regulatory/Institutional task is to provide the capability for interfacing with all the institutions and to meet the requirements identified in the various laws and regulations pertaining to the siting, design, and construction of a nuclear waste repository and a test and evaluation facility. The principal laws and regulations which govern the licensing of these include the Atomic Energy Act of 1954, the National Environment Policy Act (NEPA) of 1969, and the Nuclear Waste Policy Act (NWPA) of 1982, 10 CFR Part 60 and 40 CFR Part 191. To facilitate understanding, regulatory and institutional activities may be further subdivided into five categories: (1) Site Recommendation Report, (2) Repository Licensing, (3) Site Characterization Plan (SCP), (4) Environmental Assessment, and (5) State Interactions.

ACTIVITIES

Environmental Assessment (EA)

A program-wide review meeting to discuss and resolve issues relating to the EA, the Executive Summary, and Weston comments, was held in Washington, D.C. in early September. At this meeting, evaluations and positions taken by each of the project offices with regard to the provisions of DOE's "General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories," were discussed.

The EA is now scheduled for public release on December 20, 1984.

LLNL waste package staff completed a review of Section 6.3.2 (Version 6-Sept-84/EA6C, "Postclosure System Guideline" and two reviews of Section 6.4.2 (Version 26-Aug-84/EA6C), "Preliminary Analysis of Postclosure Performance" of the August 1, 1984 draft of the NNWSI Environmental Assessment. D. Alexander (DOE/HQ) offered several comments to the waste package staff regarding Section

6.4.2; his comments and LLNL concerns were transmitted to DOE/NV. In a separate review of Sections 6.3.2 and 6.4.2 requested by SAIC several technical, typographical and logic errors were identified; a summary of page-specific comments was forwarded to DOE/NV.

Site Characterization Plan (SCP)

On September 5 and 6, support was provided to the SCP Coordinating Group meeting held in Richland, WA. Presentations on the format and content of Chapter 10 of the SCP were given by BWIP and NNWSI Project. The BWIP systems approach and NNWSI Project Issue approach appear to be quite similar. The major differences appear to be in the use of terminology. At the conclusion of the meeting, an action item was assigned to BWIP and to the NNWSI Project to prepare detailed annotated outlines for the SCP Chapter 10 using the new working draft Regulatory Guide 4.17 and guidance from DOE/HQ. A detailed table of contents for Chapter 10 will be prepared and reviewed by the NNWSI Project participants, and a detailed annotated outline will be prepared by the end of October 1984.

A list of NNWSI Project's issues hierarchy was sent to C. Cooley, DOE/HQ, to be compared to the issues hierarchy in the Mission Plan. The NNWSI Project and the Mission Plan have significant similarities down to the information-need level.

DOE/NRC Interaction

The planned NNWSI Project/NRC Geology Data Review was held September 17-24. An average of 18 NRC and NRC-Contractor personnel participated. Primary NNWSI Project support was provided by USGS. The first week of the review was conducted at the NTS including visits to the core library, G-Tunnel, and the Yucca Mountain vicinity. Emphasis during the week was on geologic activities including mapping and trench studies. During the second week of the review, two days were spent at USGS facilities in Menlo Park, California and the remaining three days were spent in Denver. This portion of the review covered topics of general geologic interest including seismic studies, geophysics, and age-dating techniques.

A NNWSI Project/NRC management meeting that was scheduled originally for September 5 was delayed at NRC's request. A tentative date of October 15 was requested by WMPO as an alternative. One of the purposes of the meeting was to discuss approaches to scheduling and conducting future workshops and data reviews. Because of logistics problems, the planned October 15 date was not acceptable, and a new recommendation will be developed.

Comments on a draft "Report on Applicability of non-HLW Regulatory Guides to a HLW Repository" were prepared. The report was prepared by EBASCO under contract to ONWI and was distributed for comment by Licensing Coordinating Group members. The draft report was extremely comprehensive in its coverage of available NRC regulatory guides. However, a concern was expressed in the comments that premature reference to a non-HLW regulatory guide potentially applicable to a HLW repository could result in unnecessary commitments on the part of the Project and/or the entire Program.

A representative of the SAIC/McLean office attended several meetings in Washington on behalf of the regulatory compliance tasks. These interactions included a DOE/HQ-NRC meeting on QA on September 17, a workshop on Borosilicate Glass HLW forms, September 18-19, and a DOE/HQ-NRC Information Management Systems meeting on September 20.

Regulatory Compliance personnel represented the NNWSI Project at a Licensing Coordination Group meeting in Richland, Washington on September 25-26. General licensing issues and NRC interactions were discussed.

Regulatory Compliance staff continue to track the status of activities relative to revision amendments of applicable regulations including 40CFR191 and 10CFR60 (unsaturated zone, HLW definition, and "NWSA Procedural" amendments). It is expected that a number of site-specific technical positions will be issued by NRC for comment within the next month.

Environmental Compliance

A draft radiological compliance plan will be available for review by October 5, 1984.

Revisions were completed to the Environmental Compliance Plan and the Environmental Data-Base Management Plan.

Environmental Checklists for the NNWSI Project boreholes were completed and transmitted to DOE/NV for review. Permitting activities for site characterization are being reviewed.

Meteorological Monitoring

Formal comments on the draft Meteorological Monitoring Plan (MMP) from DOE/NV were incorporated into another draft that then went through a review by SAIC's technical editing staff. This draft MMP was transmitted to DOE/NV for review. The final is ready to distribute to various permitting agencies subject to DOE/NV release.

Socioeconomic/Institutional

Economic, social, and community services profiles have been developed for communities that could be affected by potential repository development. A draft report that incorporates existing data for these areas was released for review this month.

The Socioeconomic Issue Status System Report will be presented to DOE/NV in October.

A draft report on how to assess local attitudes and perceptions is being prepared following the interim progress report on issues relating to public polls regarding a high-level radioactive waste repository at Yucca Mountain. A presentation on the status of this activity is planned for mid-October.

NNWSI Project representatives attended a September 6 meeting at the Nye County Board of Commissioners in Tonopah. The Project Manager gave a presentation to the commissioners.

NNWSI representatives participated in the Institutional/Socioeconomic Coordination Group meeting held in Denver. In response to action items, the Nevada State Fact Sheet was prepared for review and transmittal to DOE/HQ. A draft strawman plan for EA interactions was prepared, which included EA release, briefings, and public hearings. A PERT chart of the various responsibilities associated with each of the three EA interaction activities was prepared by SAIC. As the first undertaking in the EA interaction process, correspondence was prepared for D. L. Vieth to the Chairman of the Nye County Commissioners requesting the preferred location in Nye County to host a public hearing.

The first draft of the SAIC/Oak Ridge paper on transportation of commercial spent fuel was completed on September 12 and reviewed by SAIC/Las Vegas. Substantial changes and additional material were requested to chart the sequential list of tasks and responsible parties for all activities associated with shipment of HLW. The request was transmitted to SAIC/Oak Ridge on September 24 and the revised draft is scheduled for delivery on October 3.

Final arrangements were made for the Project Manager to meet with the City of Caliente, Lincoln County Joint Committee on Impact Mitigation on October 22. A full agenda and brief description was received from Mike Baughman on September 24. In addition, arrangements have been made for a group of interested state, county, and local planners (including those from Caliente, Lincoln County) to tour the Nevada Test Site, including Yucca Mountain, on October 23.

PLANNED WORK

The tourism study, which is to assess potential impacts to Southern Nevada tourism if a repository were to be constructed at Yucca Mountain, is being revised and will be ready for DOE/NV review in November.

2.6 EXPLORATORY SHAFT

OBJECTIVE

The objective of this task is to identify and plan the tests that need to be conducted at the repository horizon as a part of detailed site characterization and to design and construct the Exploratory Shaft (ES) and the underground test area in Yucca Mountain. The primary focus of this effort will be to establish the basis for evaluating the unsaturated zone in a welded tuff formation. In addition, the effort will be conducted to define not only the nature of the unsaturated zone with regard to water content and water movement, but the nature of the natural barriers between the repository horizon and the static water level as well.

ACTIVITIES

An ESF Project Status Meeting was held on September 5 at DOE/NTSO, Mercury, Nevada, to discuss plans for resumption of design- and construction-related activities for the ESF.

Estimates of monthly costs for ESF construction and testing were made for FY 85-90. These estimates are somewhat rough but will be updated after they are reviewed with the responsible organizations.

Formal design reviews were conducted on F&S Title I design studies on the size and location of the second shaft (ES-2). Comments were transmitted to DOE/NTSO.

A draft QA procedure is being developed for assigning QA levels to the ESF design, construction, and testing efforts.

The principal ESTP activities this reporting period have been the continued updating of test logic networks, budget estimates, and the assignment of QA levels to test elements/activities.

Under contract to Los Alamos, Golder Associates will complete its review of the ESTP, Rev. 0, by October 1. Additionally, Golder is to provide Los Alamos with a review of techniques for extrapolating data across the Yucca Mountain geologic block.

Only limited revisions (resulting from the LLNL internal peer review) have been made in the current internal (LLNL) version of the waste package environment test plan. No revisions have yet been made in the version that is included in the ESTP. This work has been delayed by incomplete review comments from the La Jolla ESTP Review Workshop.

The IDS Conceptual Design Report was approved by DOE/NV. The prototype IDS power distribution system has been installed, and the development system is now configured to restart automatically after power failures. LANL held preliminary discussions with the calibration group to begin work on the IDS calibration strategy.

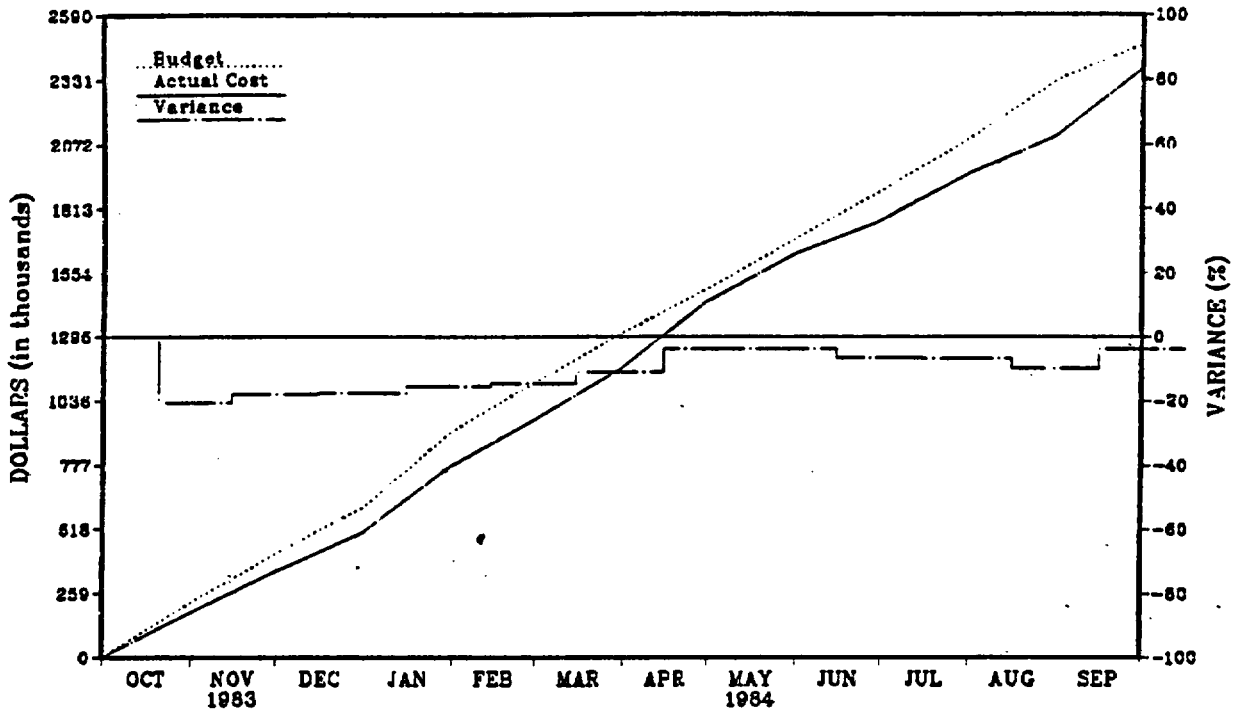
PLANNED WORK

Revision of the Test Plan will proceed as soon as the remainder of the review comments from the March ESTP retreat are received. In the interim, test accounting and scheduling is being revised to reflect changes in the project WBS structure.

LANL will update logic networks, budgets, and QA levels before scheduling meetings between the Principal Investigators and the Project Manager. In addition, LANL will continue working on the testing rationale section of the ESTP. Once additional guidance is received from DOE/NV regarding the adequacy of proposed tests, work on the ESTP, Rev. 1 will significantly increase.

October efforts will focus on a first draft of the detailed hardware design for the IDS in conjunction with top-level software design for the IDS system. This structural design will support the more detailed design for Phase I software.

WBS 2.6, Exploratory Shaft GOVERNMENT FISCAL YEAR 1984



Budget (x1000)	224.	421.	612.	917.	1113.	1313.	1492.	1695.	1907.	2094.	2332.	2470.
Cost (x1000)	178.	348.	504.	773.	949.	1169.	1436.	1629.	1762.	1949.	2100.	2377.
Variance (x1000)	46.	75.	108.	144.	164.	144.	56.	66.	125.	145.	232.	93.
% Variance	-21.	-18.	-16.	-16.	-15.	-11.	-4.	-4.	-7.	-7.	-10.	-4.

NNWSI LEVEL 1 MILESTONES

RESP. AGENCY	WBS	MILESTONE DESCRIPTION	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
LANL	2.6	COMPLETE ESTP & SUBMIT TO HQ FOR FINAL REVIEW & APPROVAL											△				

△ PLANNED MILESTONE COMPLETION DATE
▲ COMPLETED AS SCHEDULED

◇ REVISED MILESTONE COMPLETION DATE
◆ COMPLETED AS REVISED

2.7 TEST FACILITIES

OBJECTIVE

The major objective of this task is the design, construction, and operation of the test facilities that support technology development for other waste management programs and other Geologic Repositories Projects. The two major facilities operated under this WBS element include the Climax Spent Fuel Test Facility and the E-MAD Facility.

ACTIVITIES

Spent Fuel Test-Climax

Data analysis and reporting continue to be the dominant activities following completion of field work. Two draft topical reports were completed this month and are being peer reviewed prior to submittal to DOE/NV. An abstract which summarizes the results of in situ deformability measurements was submitted for possible inclusion in the 26th U.S. Symposium on Rock Mechanics. Analysis of instrumentation calibration data continues.

Analysis of borehole jack data obtained during post-test characterization of the SFT-C has raised questions concerning the validity of recommended data reduction procedures. The recommended procedures, which are contained in a proposed ASTM Standard, appear to severely bias the data to lower modulus values. The Goodman jack has a long history of development and evaluations which primarily relate to the complex manner in which it interacts with the borehole. The evaluations and associated corrections have, to date, not been applied as a composite.

Given the importance of deformability data in the calculation and analysis of rock responses to excavation and heating, the original scope of the in situ deformability measurements is being extended to include laboratory testing of the response of the jack. Initial evaluations will be made by testing the jack in a large cubical aluminum block. Procurement actions were completed this

month to obtain the block. Techniques for heat-treating the block and for boring and sequentially enlarging the test borehole were established. A test procedure is currently under development. Testing is planned for late November to early December.

Two extensive campaigns of in situ stress measurements were conducted at the SFT-C. An apparent hysteresis response was observed during field calibration of the subcontractor's USBM overcore cells which were used to make over half of the stress measurements (the other measurements were made with a different type of cell). In addition, the standard calibration procedure was determined to be inadequate. An investigation of these problems is in progress. This month, a set of data was obtained using the standard calibration technique to confirm that the phenomena occurred in the overcore cell which will be used in the investigations. Hysteresis on the order of hundreds of microstrains was observed. This is of the same magnitude as the gauge response to overcoring and, therefore, is very significant. An initial set of data was also obtained using a recently completed laboratory calibration fixture. Analysis of these data is awaiting completion of the data processing software.

All displacement transducers and associated laboratory calibration data sheets were obtained from the subcontractor. This completes the actual calibrations and makes the data available for analysis of the reliability of these transducers.

A potential problem with the long-term stability of the MBI-series borehole extensometers was detected in the rod- and anchorage-integrity testing data. These data were obtained as part of the post-test instrumentation analyses. The reference plug which the instrument transducer contacts was found to slip under certain conditions. A test procedure was prepared to evaluate the stability of the reference plug in the laboratory. Necessary test components were obtained from the SFT-C and are being prepared for testing.

A patent disclosure was filed for the strain-gauged proving-ring transducers which were utilized to measure deformations in the canister emplacement boreholes following spent-fuel retrieval.

Several attempts have been made to model the complex rock responses observed during the mine-by experiment which was conducted at the SFT-C. Scoping calculations have indicated that the observed displacements may result from blast-induced permanent deformations of the rock mass. Attempts to properly model the excavation process have been unsuccessful to date, but a new approach was identified late this month which may lead to a solution. The new approach should avoid the numerical instabilities which have made the problem unsolvable to date.

Production of the updated SFT-C documentary film was completed. A distribution list was established under advisement from DOE/NV. Copies of the film will be prepared and distributed next month.

Significant progress was made on two studies of thermal and radiation effects on Climax stock quartz monzonite. The first set of thin sections of rock obtained adjacent to the spent-fuel canister emplacement boreholes was prepared by the vendor and received at LLNL. Mineralographic and petrographic analyses of these sections will be done to detect and document changes which may have occurred as a result of heating and irradiation. Comparisons will be made with pre-test unheated, unirradiated specimens which were obtained immediately adjacent to the post-test specimens. The second study measured key characteristics of microfractures in specimens obtained at various radial distances outward from electrical heaters. All necessary data have been collected, processed, and analyzed. Detailed statistical interpretation of the data has been undertaken to support the logical arguments presented in the draft report. Previous microfracture studies of this rock have shown that rather sophisticated statistical treatments of the data are required because of the high natural variability of microfracturing.

Preparation of a complete database containing the results of post-test core logging was initiated this month. A database format was established and over 80 percent of the pertinent fracture characteristics and orientations have been entered into the database. These data will form the basis of a report on the post-test drilling and sampling activities.

Technical and project reviews of the revised draft report "Structural Geology of the SFT-C" were completed. Suggested technical changes have been incorporated in the draft and it is being edited prior to submittal to the DOE/NV.

A new technique was utilized to calibrate IRAD vibrating-wire stressmeters. The stressmeters were retrieved by overcoring so that they could be calibrated in the laboratory while they were still located within the same section of rock. Recovery was not totally successful because geological discontinuities resulted in stressmeter cables breaking and the cores splitting. Laboratory calibration of the stressmeters which were successfully recovered was completed this month. The draft report was prepared and is being reviewed internally prior to submittal to the DOE/NV.

PLANNED WORK

Staff efforts will continue to concentrate on analysis of field data and compilation and analysis of post-test calibration results. Revisions to thermal and thermomechanical models will continue.

PROBLEM AREAS

None.

E-MAD

ACTIVITIES

Thermal monitoring results for this reporting period are as follows.

The maximum storage area thermocouple (T/C) temperatures recorded for the period August 29 through September 25, 1984, predicted decay heat rates, and predicted fuel clad temperatures for fuel assemblies currently stored at E-MAD for Drywells 1, 2, 3, 5, and Lag Storage pit canisters.

All canisterized fuel assemblies that are located in the drywells and LSPs are in a safe configuration. The maximum recorded canister temperatures are well below the canister design limits.

All monitored fuel assemblies reflect a normal profile over the past month.

Fuel Temperature Test (FTT)

The Fuel Temperature Test (FTT) month 17 operation was completed. Month 18 was initiated and the criteria met. The maximum fuel temperature for this month will be 230.5° Celsius.

Gas and full volume filtration samples were taken from the FTT system and the atmosphere was exchanged. With this gas sampling, FY 84 fuel integrity monitoring was completed.

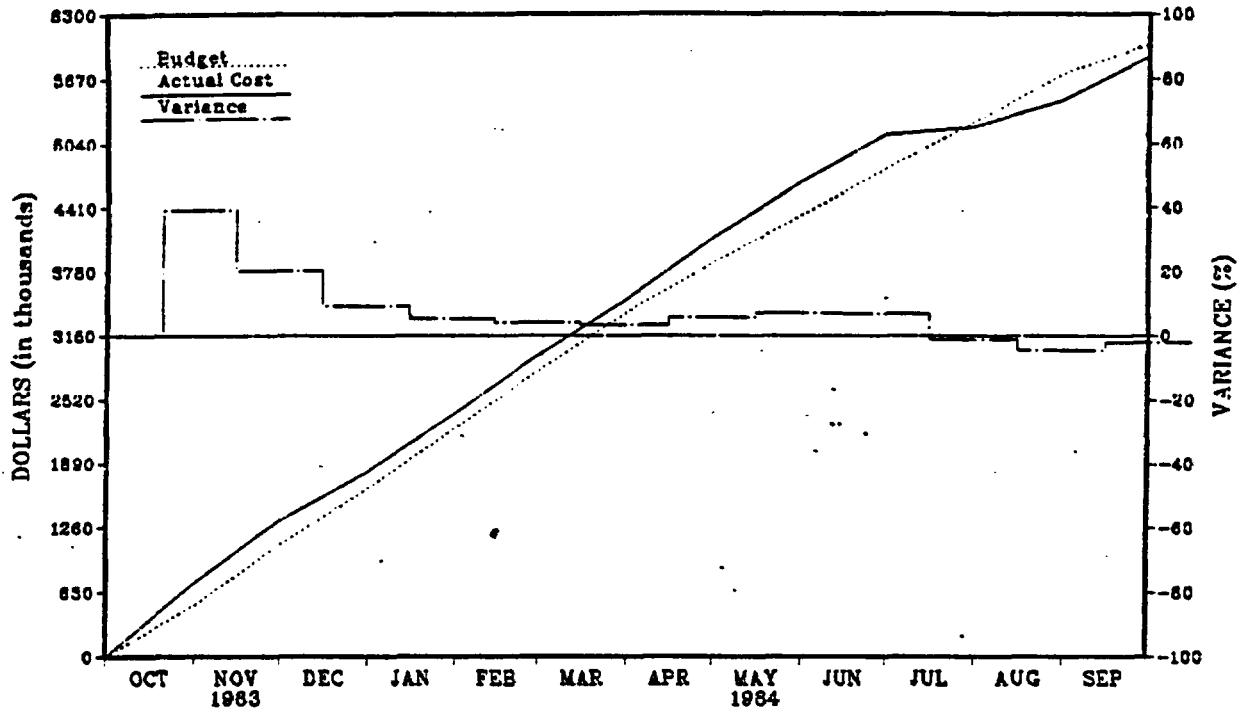
Results of gas sample analyses indicate that during a nine day period in June and July the krypton-85 activity increased from 10 pCi/cc to 211 pCi/cc. During a 39-day period in July and August, the krypton-85 activity increased from 10 pCi/cc to 589 pCi/cc.

An investigation is in progress of the indication of an air leak in the FTT atmosphere control system which became evident during measurement of systems pressure during month 16 operation. A preliminary evaluation of the leakage was made and the systems seemed tight, but during test operation, the pressure has continued to increase due to the leak.

Analysis results of gas samples from canisters containing fuel assemblies B03, B41, D01, D09, D16, D18, D22, D35, D40, D46, and D47 were received from LLNL.

Analysis results of integrity monitoring swipes taken from fuel rod surfaces of fuel assemblies B43 and D34 were received from the REECO laboratory. No indication of fuel rod integrity violation was noted.

**WBS 2.7, Test Facilities
GOVERNMENT FISCAL YEAR 1984**



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Budget (x1000)	506.	1100.	1651.	2249.	2015.	3388.	3870.	4337.	4797.	5258.	5728.	6003.
Cost (x1000)	705.	1323.	1803.	2373.	2932.	3503.	4090.	4648.	5125.	5197.	5464.	5885.
Variance (x1000)	-199.	-223.	-152.	-124.	-117.	-114.	-220.	-309.	-328.	61.	264.	118.
% Variance	39.	20.	9.	6.	4.	3.	6.	7.	7.	-1.	-5.	-2.

NNWSI LEVEL 1 MILESTONES

RESP. AGENCY	WBS	MILESTONE DESCRIPTION	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
LLNL	2.7	TERMINATION OF ROUTINE ACCESS & LLNL TOUR SUPPORT OF SFT-C													△		◇
LLNL	2.7	COMPLETE DECISION ANALYSIS ON USE OF CLIMAX FACILITY														△	

△ PLANNED MILESTONE COMPLETION DATE
▲ COMPLETED AS SCHEDULED

◇ REVISED MILESTONE COMPLETION DATE
◆ COMPLETED AS REVISED

2.8 LAND ACQUISITION

OBJECTIVE

The objective of this task is to maintain access to the land adjacent to the Nevada Test Site that is controlled by the U.S. Air Force and the Bureau of Land Management and to protect the land that could be used for a high-level waste repository and the surrounding buffer zones.

ACTIVITIES

None.

PLANNED WORK

To be included in future NNWSI Project Monthly Reports.

PROBLEM AREAS

None.

2.9 PROGRAM MANAGEMENT

OBJECTIVE

The objective of this task is to manage all activities of the NNWSI Project by all contractors. The five major areas identified are Project Management, Project Control, Interface Activities, Quality Assurance (QA), and GRD Support.

ACTIVITIES

Project Management System (PMS):

During September, the SAIC PMS staff prepared a set of progress reporting forms, copies of networks, and other schedule information for use by project participants in reporting monthly status in accordance with NNWSI Project Administrative Procedure 3-2. These will be distributed to project participants in early October so that status information can be forwarded by the tenth working day of the month.

The Systems summary network was updated to reflect recent planning changes on the Systems Overview network.

USGS networks were modified slightly to conform to conventions required to produce standard progress reporting forms. PMS personnel provided assistance to USGS and SAIC/Golden in producing network charts for use in detail planning by USGS PIs.

A draft of the new Repository Design network for FY 84 was completed based upon data received from SNL. An additional draft of the Repository Summary network was completed with the design data. Information on Sealing and Tuff Rock Properties, which corresponds to the FY 85 planning, has not been received yet from SNL.

The regulatory and institutional SCP network was updated to reflect progress through September, and the total network was revised to reflect the latest DOE/HQ guidance.

An EA activity network was prepared this month that outlines the process for release of the EA to the public.

Work continued on preparing a separate network for each of the proposed ES tests. Almost all of these were developed and delivered to the responsible PI for review. The remainder will be completed during October.

Both ESF shafts now have been incorporated into the construction network. This network also was updated during the month with status received from participants. Copies of the network were distributed to members of the ES Construction Committee for review during September.

A proposed NNWSI Project WBS was developed that is an extension of the DOE/HQ-mandated Program WBS. This was distributed to the project participants for their review and comment. It is anticipated that the resulting WBS will be presented to the Change Control Board (CCB) for baseline action in October.

A draft WBS dictionary was forwarded to Project participants for review and comment during September. This document incorporated previous comments and is consistent with the currently baselined WBS. A complete re-work is now required based upon the DOE/HQ-directed Program WBS and upon action taken by the CCB to baseline the revised NNWSI Project WBS.

Input was received from only one project participant for FY 85 Level 1 and Level 2 milestones. Therefore, the MSA Report for September, which requires a three-month forecast of anticipated work, will be based upon either the February data (operating draft baseline) or the most recently obtained milestone forecasts from the project participants.

An adjusted budget baseline was requested by DOE/RMB for FY 84. Additional detail is required from all project participants by the end of October to support development of monthly reports to DOE/HQ.

Revision of the draft Project Plan is still in progress. It is scheduled to be sent to DOE/HQ by November 1.

Information will be requested early in October from all of the TPOs relative to their work plans for FY 85. This information will be used as input for the Project Management Plan (PMP) which is planned to be sent to DOE/HQ December 15. Preliminary descriptions of supporting plans to the PMP have been developed for review and comment.

Detailed schedules were completed for the participants of recent planning meetings as follows: Geologic Investigations, Tectonics and volcanism, Future Climate, and Future Hydrology. These schedules will be sent to each USGS PI for review and correction.

Preparation of initial input for the Participant Management Plan was reinitiated. The Project Plan from FY 84 is being used as the basis for developing the charts, figures and tables. The preliminary work book for the plan was ready by the end of the month. The next step will be to identify the sources to provide narrative input for the various sections.

Input data files are being prepared by SAIC/Golden for Regional Hydrochemistry and Future Hydrologic Conditions based on planning meetings with the principal investigators. It has been recommended by the PI's that these activities be retitled Future Hydrology and Future Climate, respectively.

The WBS for Site Activities was reviewed by SAIC/Golden and modified to reflect FY 85 needs. The cost plan and milestone will be submitted this week consistent with the revised WBS.

Quality Assurance

A strawman of quality levels has been developed for the ES tests. These levels will be tied to the ES WBS and associated networks to depict application of Levels I, II, and III to ES tests. This activity, when completed, will meet the requirements in NVO-196-17, Rev. 2.

TRACR3D was reviewed for compliance with USNRC Regulatory Guide 0856. The majority of the Regulatory Guide has been met. TRACR3D will be revised at a later date to meet the remaining requirements.

The Los Alamos NNWSI QAPP and 12 supporting QA procedures have been revised to comply with NVO-196-17, Rev. 2.

LLNL has begun work on setting up procedures for the LLNL NWMP QA records archival system. The system will be computerized using the "INMAGIC" software package with an IBM PC.

The LLNL NWMP QA Task Leader released guidelines for use in implementing the NWMP Management Assurance Plan to be used in conjunction with the NWMP overall QA plan.

NNWSI-SOP-15-01 and NNWSI-SOP-03-01 were approved by DOE/NV on September 28, 1984, and were issued to NNWSI Project participants.

Drafts of NNWSI-SOP-03-02 and NNWSI-SOP-03-03 were sent to DOE/NV on September 20 for comment and issuance to NNWSI Project participants for their comment.

The revised plan and fourteen implementing procedures were submitted to DOE/NV on August 3 and are in the DOE/NV review cycle.

The QASC conducted surveillance activities of UE-25 and UZ-4 coring, sampling, and testing activities on September 21, 1984. The report is in preparation for issuance to the inspected participant. As a result of the surveillances performed to date, there have been four nonconformances generated, three of which have dealt with problems associated with procedures.

A proposed schedule for FY 85 surveillances is being prepared for transmittal to DOE/NV by October 31, 1984.

The Participating organizations and NTS support contractors were instructed to revise their QAPPs and QA administrative procedures to meet the new QA

requirements invoked by NVO-196-17, Rev. 2, NNWSI Project QAO. The target date for their submittal to DOE/NV was September 19, 1984. As of September 29, 1984, five draft QAPPs have been received from USGS, LANL, SNL, H&N, and WEC.

The revised USGS QAPP was delivered on schedule to DOE/NV for their review. Revised drafts of nine quality procedures were also delivered ahead of the required schedule.

LANL performed surveillance of USGS geochronology activities and of the metrology laboratory at the Colorado Department of Agriculture. Areas of geochronology checked included: radiometric age data bank, sample preparation laboratory, records control system, calibration, and quality assurance procedures.

LANL reviewed the final draft of HP-27, "Operation of the Iron Horse." The document is now ready for final approval and distribution. Also completed was a draft of QP-11, "NNWSI Organization," which was submitted to USGS for comment.

A calibration checklist for USGS instruments in the calibration system was compiled by LANL.

LANL received comments on the draft procedure, "Seismic Reflection Data Acquisition and Processing," from Hans Ackermann and the text was revised accordingly.

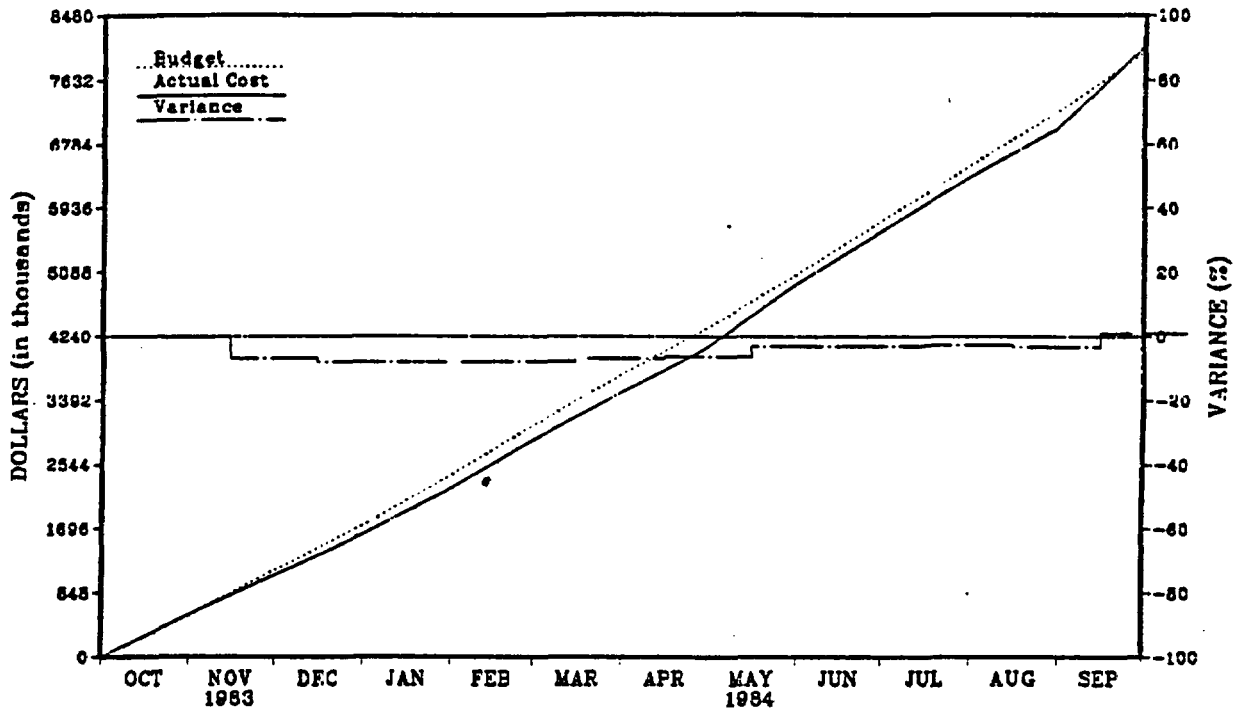
PLANNED WORK

Upon receipt of an authorization letter from DOE/NV, the ES QAPP will be rewritten per DOE/NV input and instructions.

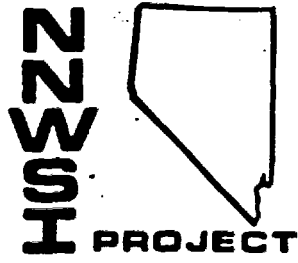
PROBLEM AREAS

None to report.

WBS 2.9, Program Management GOVERNMENT FISCAL YEAR 1984



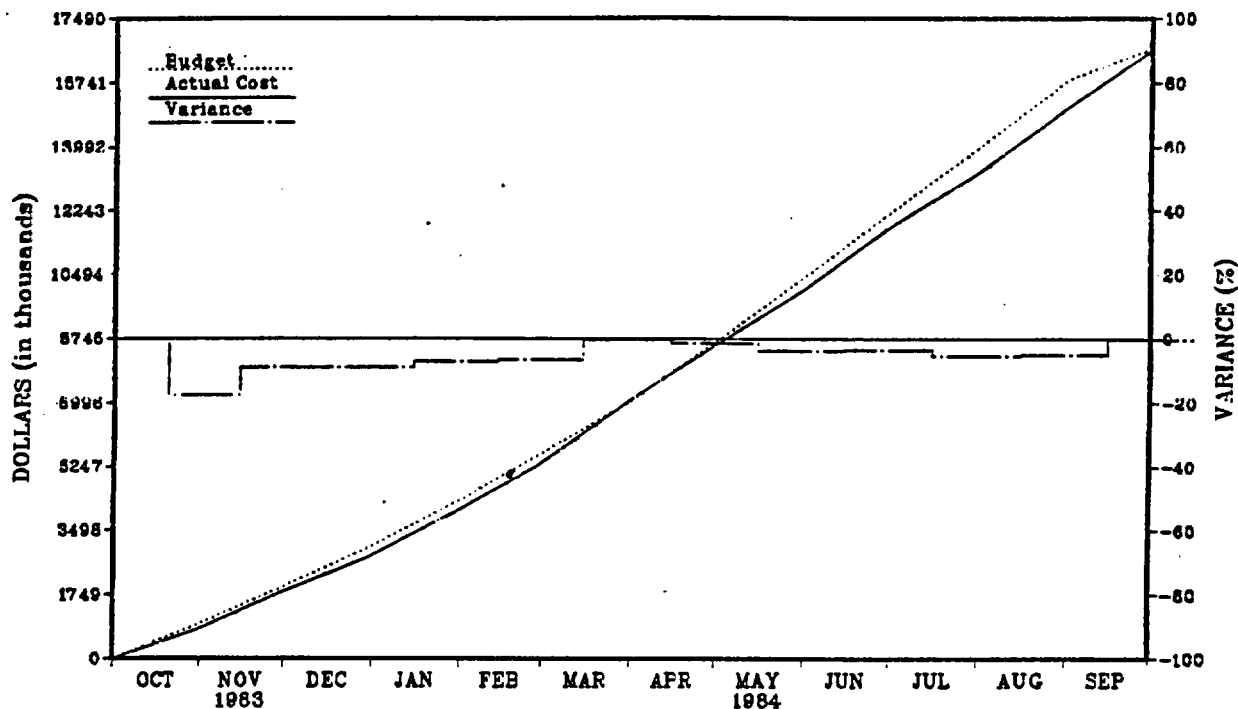
Budget (x1000)	552.	1153.	1730.	2404.	3067.	3751.	4366.	5079.	5787.	6510.	7231.	8003.
Cost (x1000)	551.	1073.	1599.	2208.	2828.	3495.	4091.	4923.	5617.	6328.	6985.	8082.
Variance (x1000)	1.	80.	131.	196.	239.	256.	275.	156.	170.	182.	246.	-77.
% Variance	0.	-7.	-8.	-8.	-8.	-7.	-6.	-3.	-3.	-3.	-3.	1.



PARTICIPANT

BUDGET vs COST

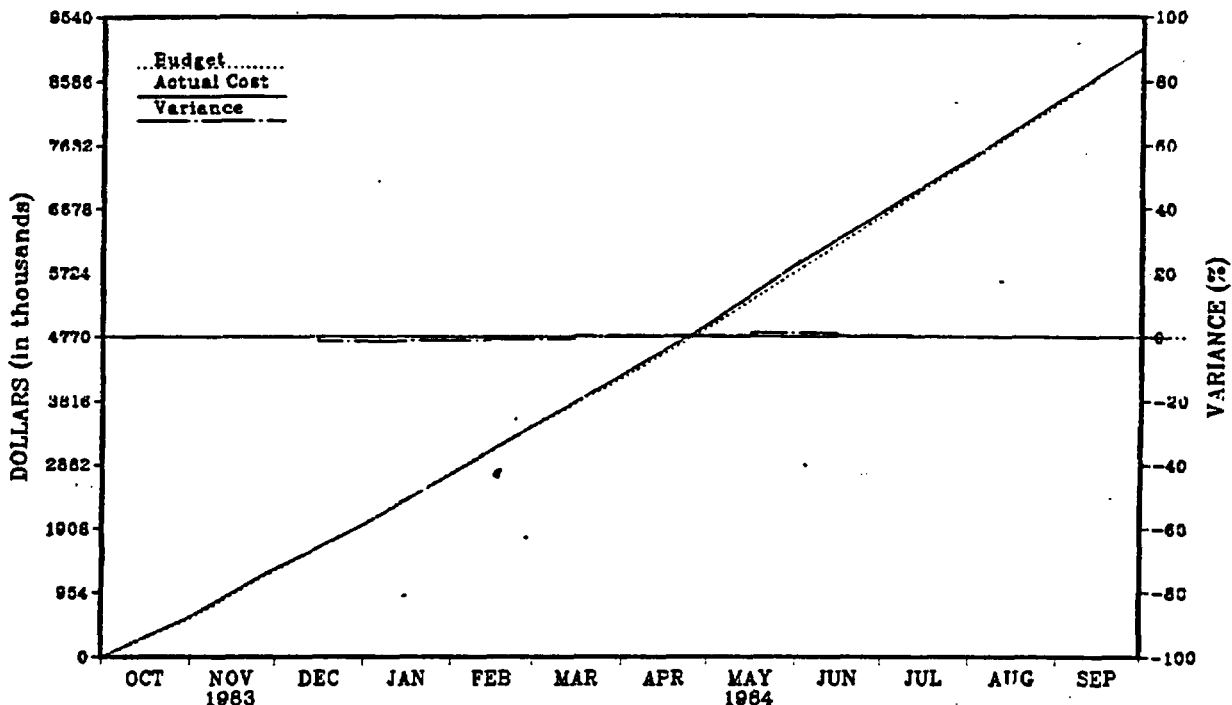
Sandia National Laboratories GOVERNMENT FISCAL YEAR 1984



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
	1983							1984				
Budget (x1000)	960.	1971.	3068.	4330.	5629.	7060.	8673.	10454.	12195.	13994.	15022.	16603.
Cost (x1000)	790.	1796.	2788.	4025.	5259.	7043.	8536.	10059.	11745.	13245.	15000.	16621.
Variance (x1000)	170.	175.	280.	305.	370.	17.	139.	395.	450.	749.	822.	42.
% Variance	-15.	-9.	-9.	-7.	-7.	0.	-2.	-4.	-4.	-5.	-5.	0.

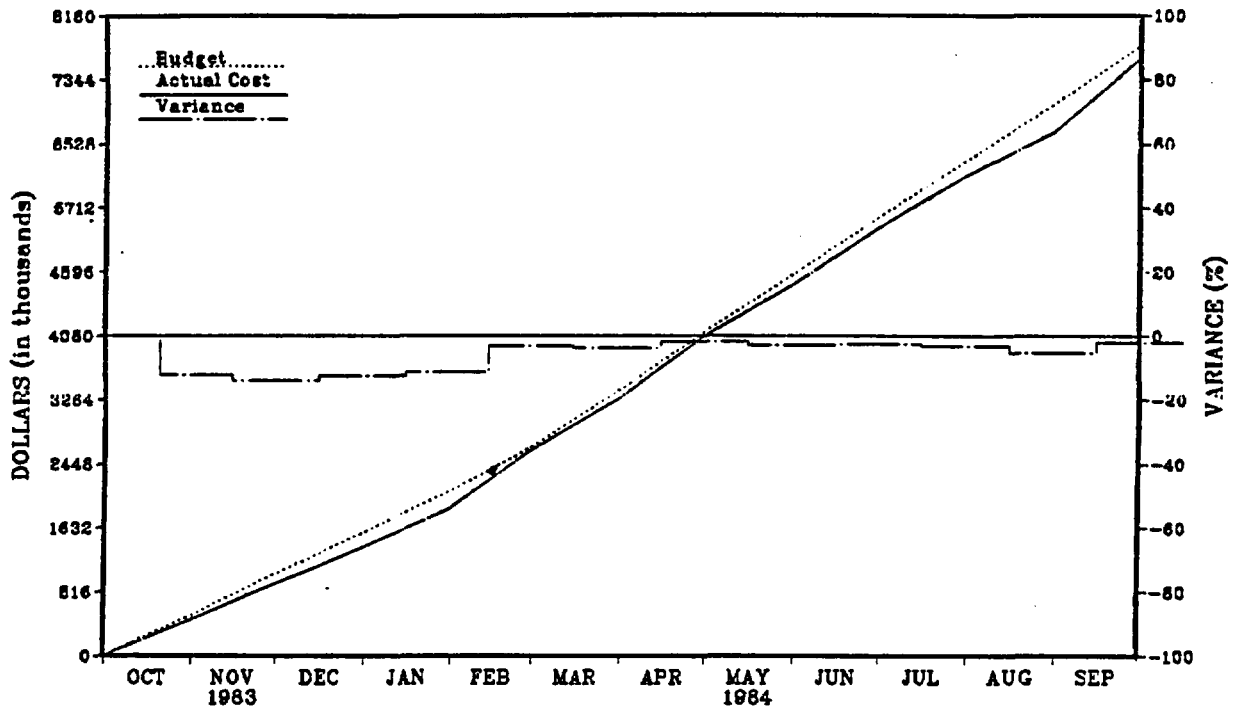
Los Alamos National Laboratory

GOVERNMENT FISCAL YEAR 1984



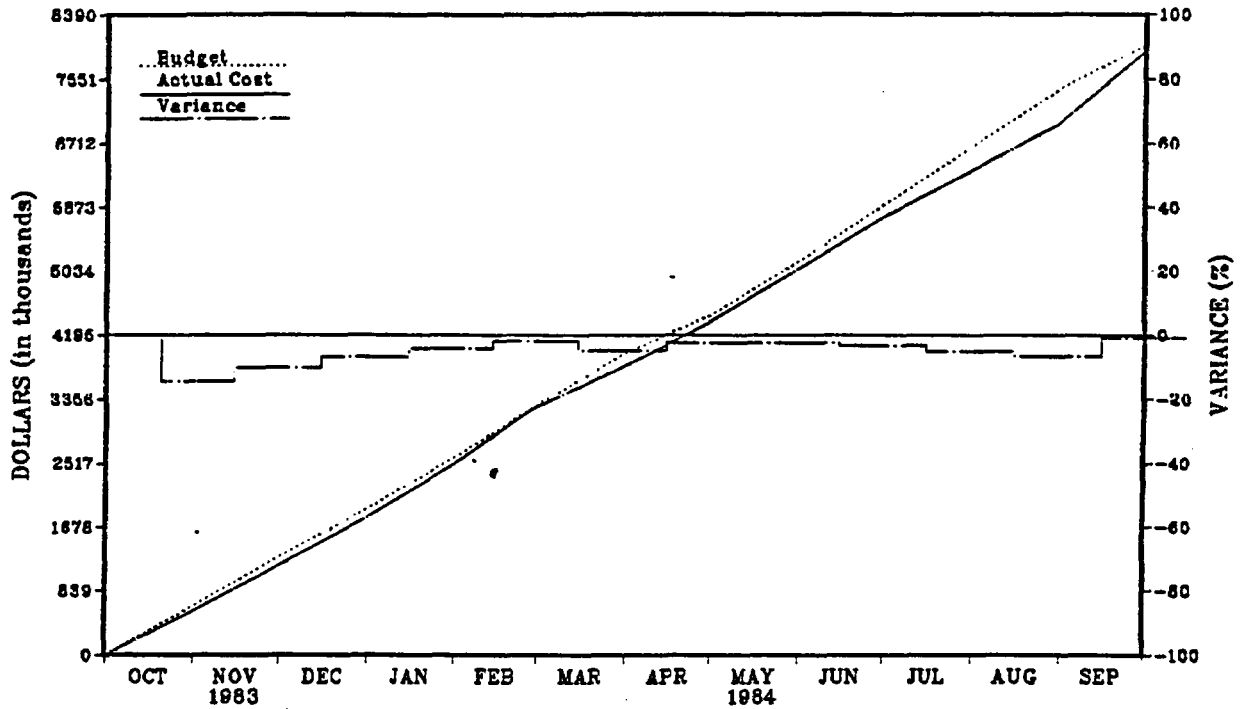
	OCT	NOV 1983	DEC	JAN	FEB	MAR	APR	MAY 1984	JUN	JUL	AUG	SEP
Budget (x1000)	560.	1290.	1971.	2730.	3437.	4103.	4907.	5757.	6560.	7400.	8243.	9090.
Cost (x1000)	568.	1298.	1944.	2703.	3402.	4179.	4923.	5830.	6595.	7393.	8253.	9076.
Variance (x1000)	0.	0.	27.	35.	35.	-16.	-16.	-73.	-27.	7.	-8.	12.
% Variance	0.	0.	-1.	-1.	-1.	0.	0.	1.	0.	0.	0.	0.

U. S. Geological Survey GOVERNMENT FISCAL YEAR 1984



Budget (x1000)	624.	1060.	1503.	2100.	2676.	3402.	4145.	4883.	5608.	6334.	7055.	7777.
Cost (x1000)	459.	911.	1383.	1868.	2585.	3268.	4065.	4732.	5451.	6124.	6666.	7623.
Variance (x1000)	65.	149.	200.	240.	91.	134.	80.	151.	157.	210.	389.	154.
% Variance	-12.	-14.	-13.	-11.	-3.	-4.	-2.	-3.	-3.	-3.	-6.	-2.

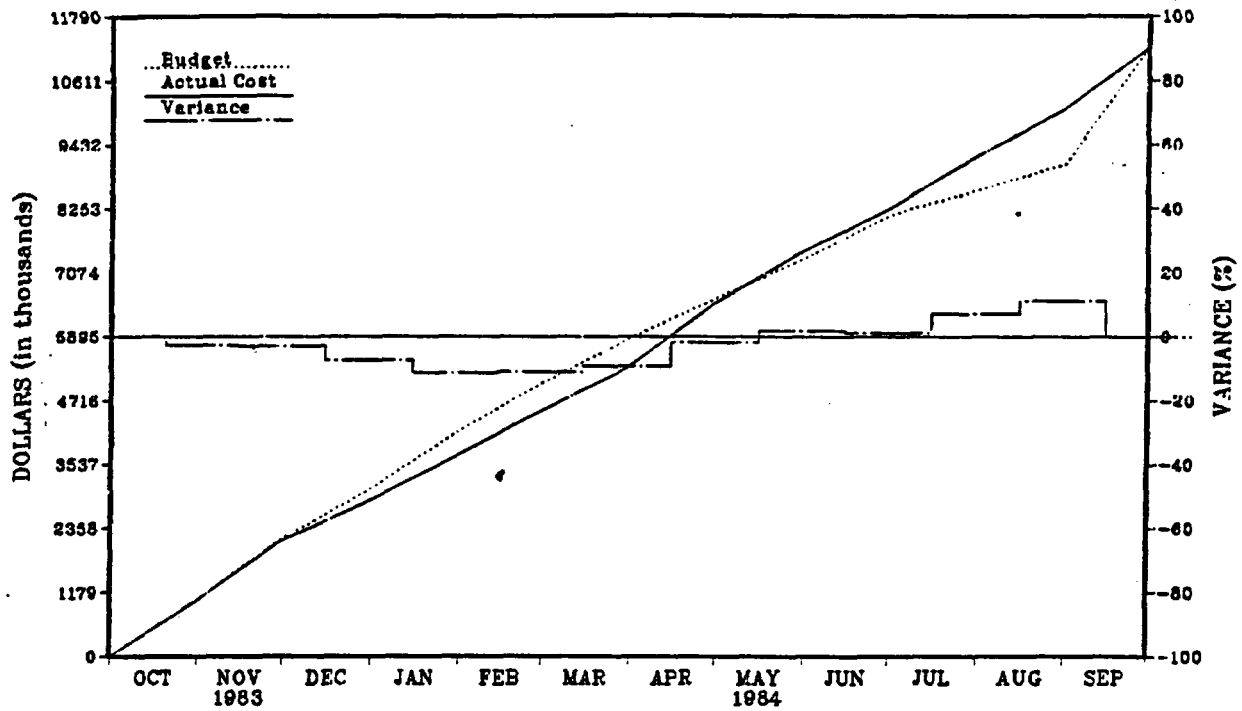
Lawrence Livermore National Laboratory GOVERNMENT FISCAL YEAR 1984



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
	1983							1984				
Budget (x1000)	641.	1290.	1920.	2597.	3204.	3972.	4403.	5172.	5911.	6671.	7438.	7990.
Cost (x1000)	549.	1157.	1785.	2490.	3224.	3778.	4361.	5052.	5724.	6340.	6957.	7921.
Variance (x1000)	92.	133.	135.	107.	60.	194.	102.	120.	187.	331.	481.	77.
% Variance	-14.	-10.	-7.	-4.	-2.	-5.	-2.	-2.	-3.	-5.	-6.	-1.

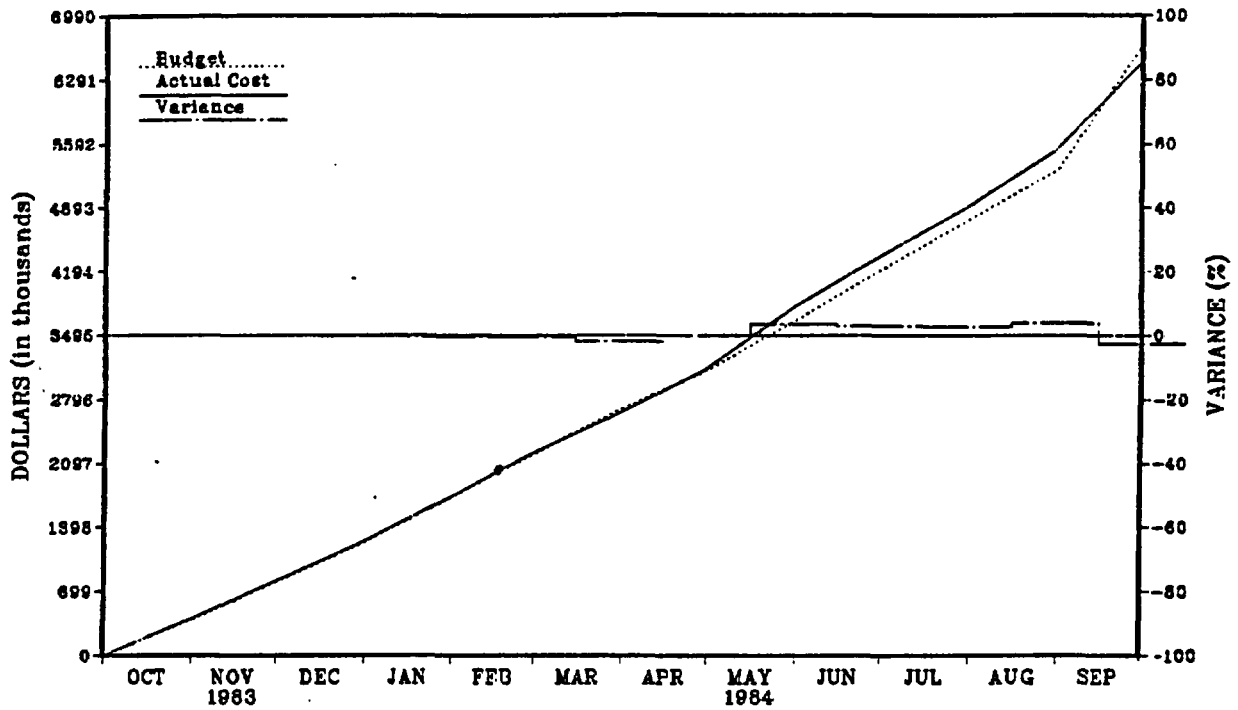
Reeco

GOVERNMENT FISCAL YEAR 1984



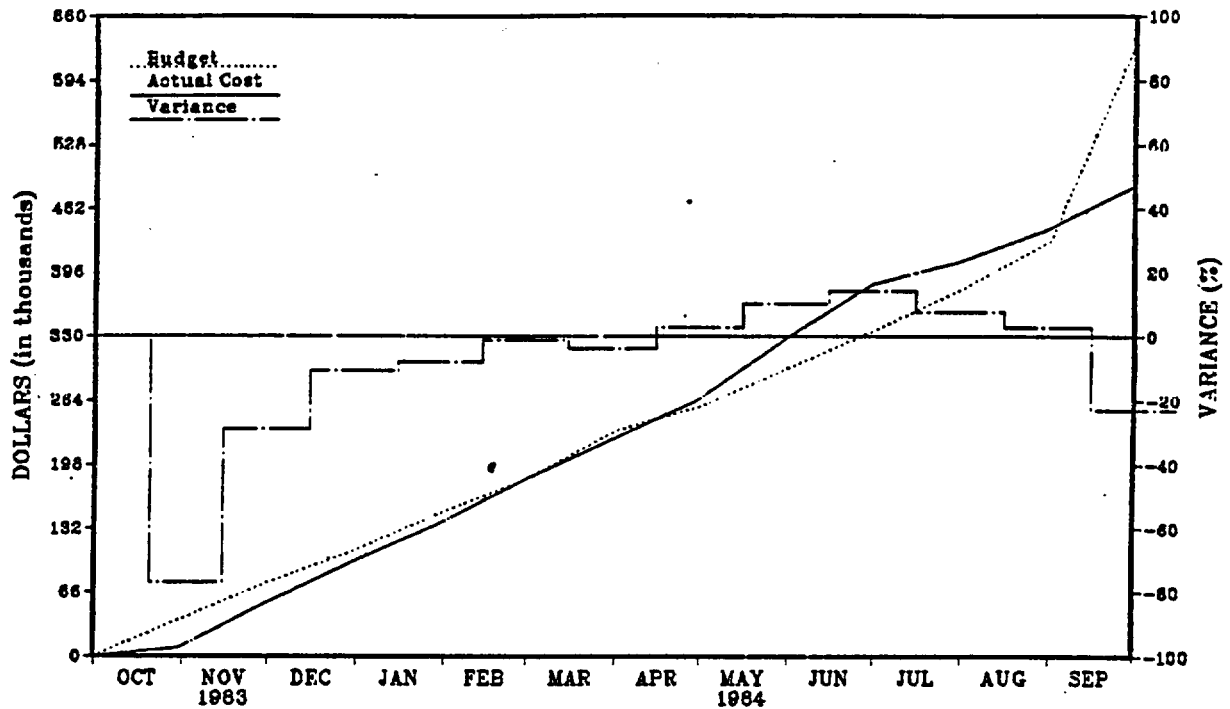
Budget (x1000)	1042.	2102.	3094.	4150.	5043.	5071.	6005.	7348.	8131.	8597.	9003.	11237.
Cost (x1000)	1014.	2115.	2864.	3667.	4485.	5324.	8490.	7470.	8231.	9203.	10062.	11223.
Variance (x1000)	28.	-13.	230.	483.	558.	-253.	-115.	-124.	-100.	-606.	-999.	14.
% Variance	-3.	-3.	-7.	-11.	-11.	-8.	-2.	2.	1.	7.	11.	0.

Science Applications, Inc.
 GOVERNMENT FISCAL YEAR 1984



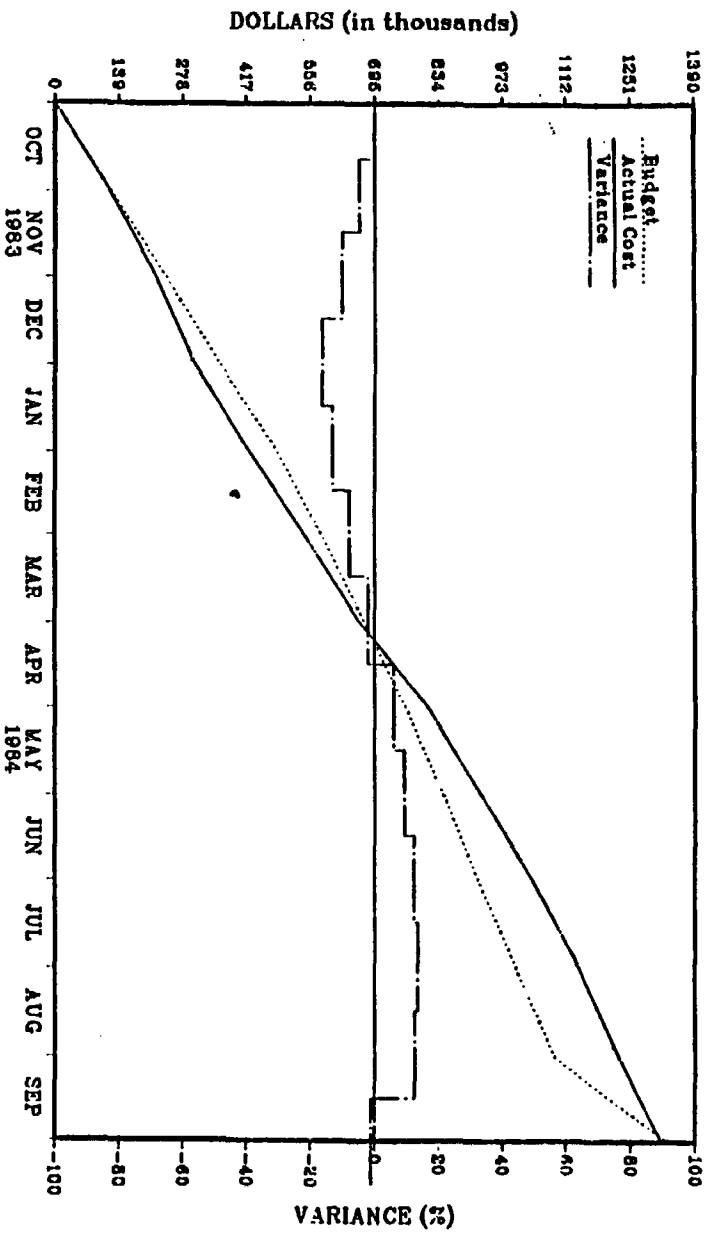
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
	1983							1984				
Budget (x1000)	386.	811.	1234.	1727.	2204.	2701.	3126.	3673.	4219.	4766.	5310.	6600.
Cost (x1000)	386.	811.	1232.	1719.	2188.	2650.	3129.	3810.	4350.	4901.	5519.	6487.
Variance (x1000)	0.	0.	2.	8.	16.	51.	-3.	-137.	-131.	-135.	-209.	173.
% Variance	0.	0.	0.	0.	-1.	-2.	0.	4.	3.	3.	4.	-3.

Holmes and Narver, Inc.
GOVERNMENT FISCAL YEAR 1984



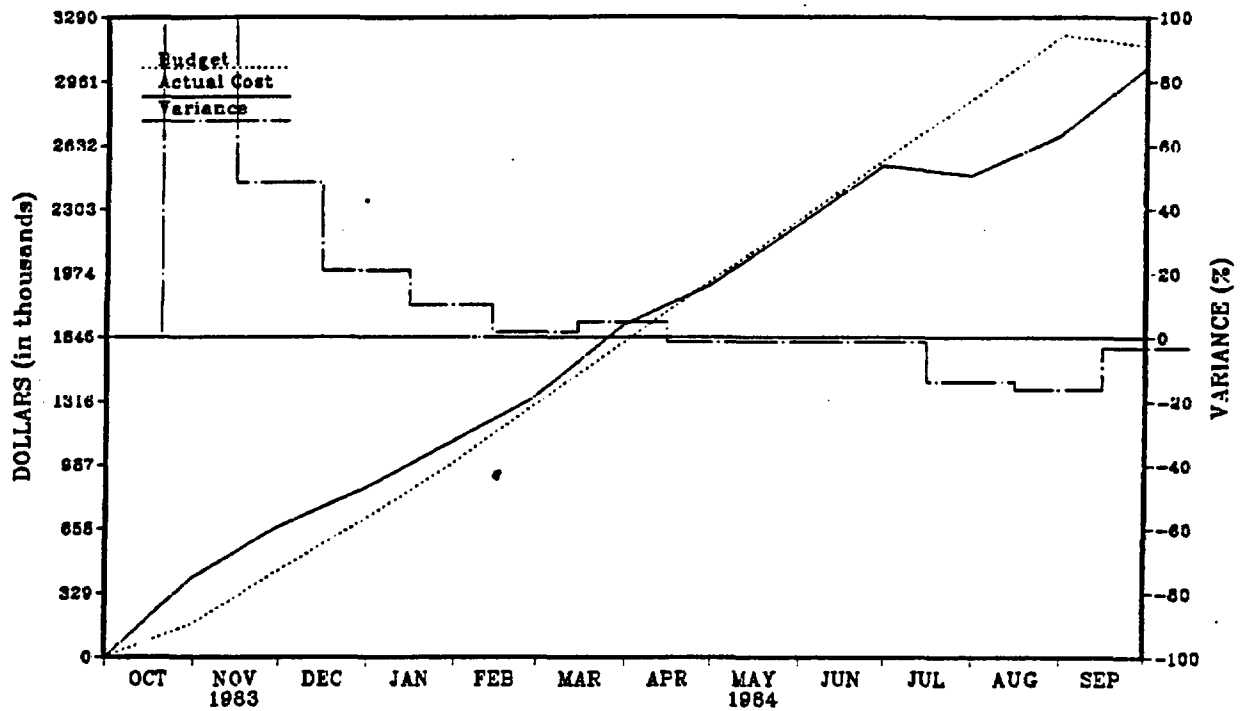
Budget (x1000)	39.	76.	110.	150.	183.	233.	258.	290.	336.	379.	429.	631.
Cost (x1000)	9.	54.	98.	138.	181.	224.	265.	328.	383.	407.	441.	486.
Variance (x1000)	30.	22.	12.	12.	2.	9.	-7.	-30.	-47.	-28.	-12.	145.
% Variance	-77.	-29.	-11.	-8.	-1.	-4.	3.	10.	14.	7.	3.	-23.

Fenix and Scisson, Inc. GOVERNMENT FISCAL YEAR 1984



Month	Budget (x1000)	Actual Cost (x1000)	Variance (x1000)	% Variance
OCT 1983	122.	243.	116.	-5.
NOV 1983	243.	300.	218.	-10.
DEC 1983	300.	402.	301.	-16.
JAN 1984	402.	502.	421.	-13.
FEB 1984	502.	670.	536.	-6.
MAR 1984	670.	764.	662.	-2.
APR 1984	764.	809.	809.	6.
MAY 1984	809.	926.	926.	9.
JUN 1984	926.	1036.	1036.	12.
JUL 1984	1036.	1139.	1139.	13.
AUG 1984	1039.	1223.	1223.	13.
SEP 1984	1223.	1331.	1316.	-1.

Miscellaneous Contractors GOVERNMENT FISCAL YEAR 1984



Budget (x1000)	175.	440.	717.	1003.	1311.	1631.	1942.	2255.	2565.	2877.	3187.	3141.
Cost (x1000)	402.	665.	868.	1108.	1332.	1711.	1913.	2223.	2525.	2478.	2680.	3033.
Variance (x1000)	-227.	-217.	-151.	-103.	-21.	-80.	29.	32.	40.	399.	517.	108.
% Variance	100.	48.	21.	10.	2.	5.	-1.	-1.	-2.	-14.	-16.	-3.

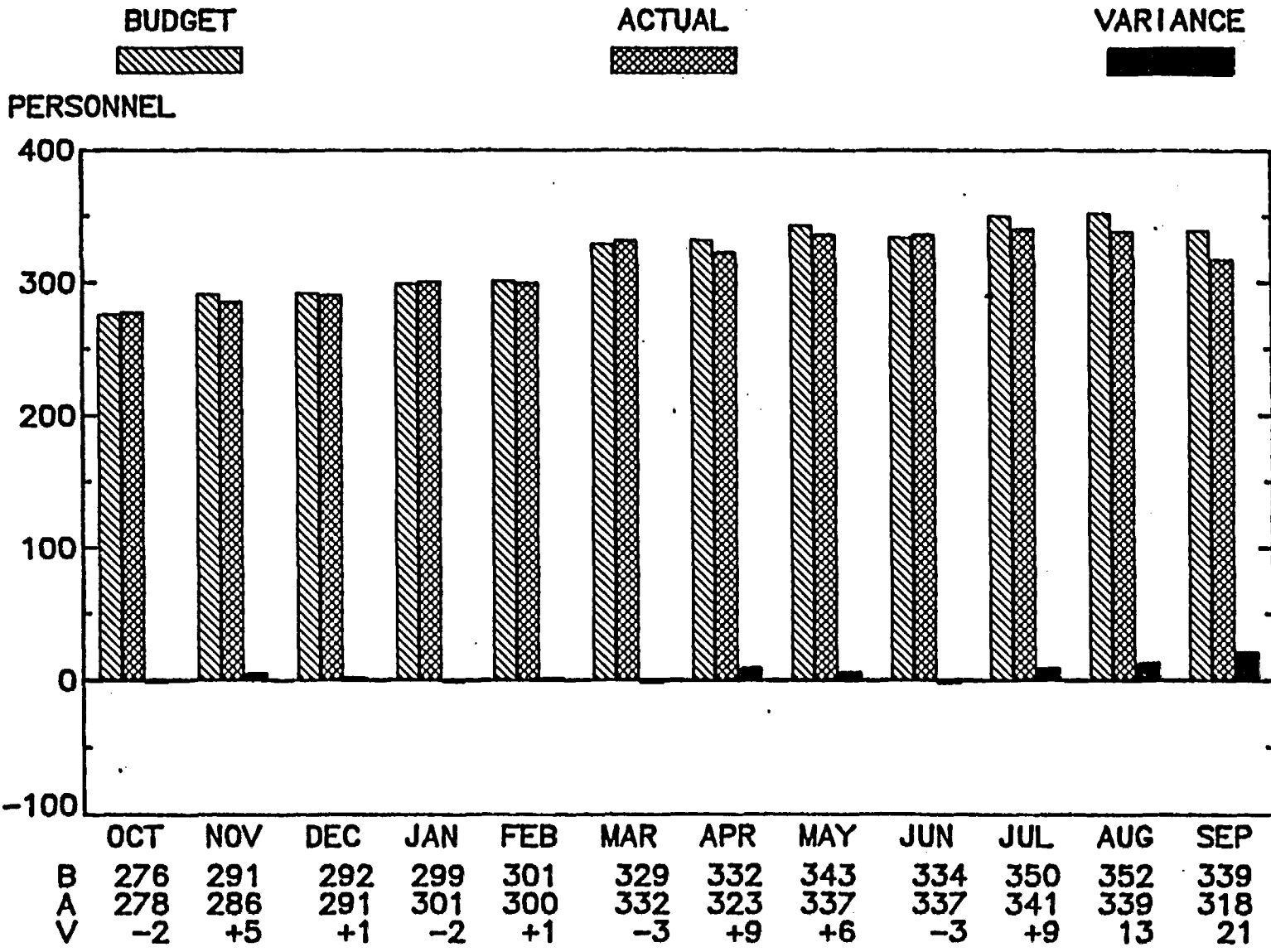
NNWSI LEVEL I MILESTONES

FY 1984

NNWSI NUMBER	WBS	RESP. AGENCY	MILESTONE DESCRIPTION	PLANNED COMPLETION DATE	ACTUAL COMPLETION DATE	REMARKS	REVISED COMPLETION DATE
M150	2112	SNL	Preliminary Performance Assessment for EA	01/15/84	01/15/84		
M151	2111	SNL	Preliminary System Description Document	08/30/84		Behind Schedule	11/21/84
M152	2111	SNL	Users Manual for Data Base System for Participants	08/30/84	09/12/84		
—	22	LLNL	Summary Logic Network for WP Design and Development	01/16/84	01/16/84		
M250	2221	LLNL	Establish Interim Product Specifications	08/30/84		Behind Schedule	10/31/84
M251	223	LLNL	Pre-Closure Analysis of Selected Conceptual Designs	09/28/84		Behind Schedule	11/30/84
M352	2317	LANL	Draft Report Estimating Water Flow and RN Transport Along Flow Path	02/02/84	02/02/84		
M353	2352	USGS	Groundwater Level Data and Preliminary Potentiometric-Surface Maps, Yucca Mountain and Vicinity, Nye County, NV	06/29/84	03/30/84		
M354	2311	LANL	Letter Report Groundwater Chemistry Along Flow Paths	08/30/84		Behind Schedule	10/31/84
M356	2361	LANL	Complete Report on Volcanic Hazards Analysis	09/28/84		Behind Schedule	11/30/84
M355	232	LANL	Progress Report on 3-D Mineralogic Model of Yucca Mountain	08/31/84		Behind Schedule	10/31/84
M357	2364	SNL	Weapons Test Seismic Report	10/30/84			
—	24	SNL	Submit Summary Logic Network for Repository	01/16/84	01/16/84		
M447	2431	SNL	Seal Development Plan for Repository	11/12/84			
M592	252	SAI	Draft EA	02/29/84	02/29/84		
M523	25	WMPO	NNWSI References for EA Complete	08/01/84		Behind Schedule	12/31/84
M521	254	SAI	Draft SCP to HQ	08/15/84		Behind Schedule	07/31/85
M660	2652	LANL	Complete ESTP and Submit to HQ for Final Review and Approval	08/31/84		Behind Schedule	03/29/85
M701	271	LLNL	Termination of Routine Access and LLNL Tour Support to SFT-C	09/30/84		Behind Schedule	11/30/84
M706	271	LLNL	Complete Decision Analysis on Use of Climax Facility	10/15/84			

NNWSI PROJECT STAFFING

- FY 1984 -



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