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CNWRA PROGRAM MANAGER'S PERIODIC REPORT
ON ACTIVITIES OF THE
CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

FOR THE FISCAL REPORTING PERIOD

July 8, 1989 - August 4, 1989

PMPR No. 89-11

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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TITLE: Center for Nuclear Waste
Regulatory Analyses

FIN: D1035-8

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CONTRACT NO: NRC-02-88-005

ESTIMATED BUDGET: \$42,550,000

SITE: 6220 Culebra Road
San Antonio, Texas

PERIOD OF PERFORMANCE: 10/26/87 - 10/26/92

PERIOD OF THIS REPORT: 07/08/89 - 08/04/89

1. SUMMARY

1.1 Narrative Project Status and Technical Progress This Period

Staff efforts were directed primarily in the following areas:

1. Actions that are needed to support further development and refinements in the Program Architecture (PA) and Program Architecture Support System (PASS),
2. Acquisition of staff and consultants (both for permanent positions and to assist in specific short-duration tasks),
3. Continuing development, revision, and implementation of Research Project Plans,
4. Work on specific Element/Subelement activities, including development of the Fast Probabilistic Performance Assessment (FPPA) methodology, evaluation of potential rulemakings, and activities associated with technical positions.

The current status of Center staffing is indicated in the attached tables. The first table indicates the staffing plan, that is, the identification of areas of expertise and experience, and associated FTE that are needed at particular times, as constrained by available resources. The second table provides the names of the individuals currently on the core Center professional staff. The tables reflect the NRC-approved Staffing Plan of June 1989. Rather significant revisions to the Staffing Plan will be made in the coming months to reflect information on long-term programmatic needs recently identified by the NRC. When approved, these changes will be incorporated in this table.

Two major NRC/CNWRA management meetings were conducted this period. These were the NRC Program Management and NRC-RES Management meeting conducted July 24-25, 1989, in San Antonio (results contained in the minutes of that meeting) and the Operations Plan planning meeting conducted August 8-9, 1989, at the NRC White Flint offices. In addition, effective coordination and project control were maintained and augmented through frequent focused telephone conferences among NRC staff and Center staffs in both Washington and

San Antonio. Key among the subjects addressed were: organization and content of the FY1990 Center Operations Plans, requirements for closing out FY1989, Program Architecture development, ongoing and planned Research projects, and various Element-specific activities.

Significant effort continued to be expended within the WSE&I Subelement, with assistance from the Element/Subelement Managers, on activities supporting further development of the Program Architecture (Sections 2, 4 through 6, 8, and 9). Extensive Program Architecture Review Committee (PARC) activities were conducted on Sets 1 through 4 of the Regulatory Requirements to prepare these data (which are under development using the now-current procedures) for orderly transition to the new format and content requirements of the revised Program Architecture process and procedures.

The Center continued to (a) conduct evaluations and assessments of alternatives regarding process, procedures, format, and content of the Program Architecture and the Program Architecture Relational Database and (b) interact with the NRC cognizant Element Manager as the preferred alternatives began to be implemented. These activities are focused on baselining the Program Architecture and PASS (Chapter 2). This work continues as the highest priority of the Center. Closure on these important matters entails the greatest near-term schedule risk for currently assigned tasks. Specific actions taken to date are noted in Chapter 2 of this report.

In addition, the following actions continued, using the current (unrevised) Program Architecture process and procedures:

- * Continued development of Sets 1 through 4 of the Regulatory Requirements.
- * Continued PARC actions on portions of Sets 1 through 4 of the Regulatory Requirements.
- * Continued revision of Program Architecture Technical Operating Procedures, data input templates, and instructional materials.
- * Continued development of new and improvement of existing PASS capabilities.
- * Promulgation of a procedure for the identification of Regulatory Topics and associated Regulatory Requirements.
- * Consideration of and implementation of a change in the items to be covered in the Program Architecture "baseline," treating the "Igneous Activity" rather than the "Adverse Geochemistry" Regulatory Requirement.
- * Discussions and feasibility/need evaluations of implementing the OS/2 technology in the development of the PASS.

The testing of the modified Application System (AS) and Application System Project Management Costing (ASPMC) software continued this period with test data being generated and entered to assist in evaluation of the scheduling, budgeting, and cost reporting modules of the code. A primary focus of AS and ASPMC development continues to be application to the Operations Plans, and subsequent implementation of project planning and control functions within the PASS. Development of work practices and training users also took place this period.

Refinements to the personal computer hardware and software configuration between the NRC and the Center offices in San Antonio, TX and Crystal City, VA continued as IBM mainframe configuration was modified to include updates of various software products and support systems that are used across the Center program. With the multiple components and links present in this system, the overall reliability can, in theory, be no better than about 65%. Options to improve the reliability, thus aiding effective communications

and efficient use of remote computing facilities, are being investigated. Training efforts continued on the AS and ASPMC project management software, and continued for key features of the PASS, PROFS, and the Center's Technical Document Index and records management system.

Coordination continued among the Center and Institute computer facilities and support personnel, and the NRC-IRM staff.

Performance Assessment activities (currently under the WSE&I Element, Chapter 2) included vigorous recruitment efforts. NRC feed-back on the CNWRA recommended approach to transferring and maintaining computer codes and databases resident at computer facilities at Idaho National Engineering Laboratory and Sandia National Laboratories is anticipated to be received early next period. The Center will include the scope of work for related activities in the FY90-91 Operations Plan for Performance Assessment.

Statements of Work were received for the "Stochastic Analyses of Unsaturated Flow and Transport Through Fractured Rock for Large Scale Hydrogeologic Systems" and "Geochemical Analog of Contaminant Transport in Unsaturated Rock" projects. Literature searches and related background work is underway to support development of the Project Plans associated with these two projects.

Major modifications were completed in Building 57 with the case-work and related furnishings for the Thermohydrologics and Waste Package Experiments laboratories being installed this period. Laboratory space continues to be made available in other Institute buildings to support (a) studies that had already begun and (b) tests and analyses which require specialized equipment not located in Building 57.

Activities in the Geochemistry Research Project (Section 3) continued in accordance with the Project Plan. A series of nonisothermal kinetic reaction path and Rayleigh gas fractionation computer simulations of the near field geochemistry of the proposed Yucca Mt. repository site were completed. The results of this work, which focus on determination of the geochemical constraints on the water chemistry in the unsaturated zone, will be presented at the Gordon Research Conference on Inorganic Chemistry next period. Methods and an associated procedure for the purification of zeolite materials were developed and tested during this period. The procedures cited in the literature have been found to be inadequate to obtain the high-purity required; alternatives are being evaluated. The Geochemistry group supported the Integrated Waste Package Experiments by conducting an evaluation of the stability and variability of simulated J-13 groundwaters. Staff attended the International Geological Congress in Washington, D.C., including a workshop on the world-wide nuclear waste management program.

NRC approval of both the Thermohydrologics Project Plan and the Separate Effects Experiment Plan were received this period. The Thermohydrologics Project staff continued their acquisition and examination of information concerning prior DOE- and NRC-sponsored investigations related to the thermohydrological aspects of HLW repositories and assessment of the state of the art of laboratory scale modeling of thermohydrological processes. Arrangements were made to visit the Apache Leap field site and related University of Arizona laboratories. Construction of the Separate Effects Experiments test apparatus was completed, and equipment for these experiments was installed and underwent preliminary testing. Preliminary experiments to evaluate the potential for using liquid crystal beads to optimize flow visualization in the experiments continued.

Development of test apparatus for the Seismic Rock Mechanics Project continued with a projected completion date of late August (Chapter 3). Evaluation of the discrete element code UDEC is nearing completion and arrangements to lease 3DEC for subsequent evaluation are underway. The finite

element code HONDO was made operational. A member of the Project team will also visit the Apache Leap site and laboratories next period. Following a management meeting at the Center July 24-25, 1989, an agreement was reached to expand the scope of this project to include (a) instrumented field measurements to validate the selected computer codes, and (b) instrumented field measurements to study the seismic effect on water table. Appropriate changes will be made to the Project Plan.

A Peer Review Group met July 27, 1989, to evaluate the Integrated Waste Package Experiments Project Plan. A panel of three widely recognized materials scientists reviewed the program and will provide independent comments during the next period. Initial observations of the Group are reported in Chapter 3.

Quality Assurance surveillance of implementation of the key PA development guidance documents TOP-001-02 and TOP-001-03 continued this Period. This continues as 100% review of all inputs to the PA relational database (Section 4). Revisions to the Center Quality Assurance Manual also continued, based on audit results and lessons learned during implementation of Center Technical Operating Procedures. A Quality Assurance Procedure establishing the requirements for laboratory and scientific notebooks was completed and promulgated. No reviews of the DOE Quality Program Plan were conducted this period.

Geological Setting Element (Section 5) activities on development of the Program Architecture continued to be intense this period; focusing on preparation of inputs to the "baselining" of the Program Architecture in September 1989. Results of two workshops conducted last period, plus further in-depth analyses, were used as the basis for Program Architecture inputs on "Adverse Condition--Geochemical Processes" and "Adverse Condition-- Erosion". Activities commenced to accelerate efforts related to the pending change to "Adverse Condition--Igneous Processes". Staff attended the NRC Hydrology-Geochemistry Field Trip to Yucca Mountain and vicinity July 24-27, 1989. A trip report is in preparation.

Efforts continued on a high priority basis toward the acquisition of a geologist/engineering-geologist, geochemist, tectonics/structural geologist, geophysicist, geostatistician, QA specialist with background in the earth sciences, performance assessment specialists, and geohydrologist as part of the core Center staff. These positions will be filled during the coming year. (Note: The proposed NRC-RES research projects for FY90-91 appear to require significant changes in the mix of Center staffing and will require major changes in the recruitment effort.) Numerous resumes were reviewed and additional personal contacts were made this period. Dr. Rachid Ababou has commenced work at the Center and Dr. Ronald Green has accepted a position at the Center; both are geohydrologists.

The EBS Element continued its extensive involvement in Program Architecture (PA) development this Period (Chapter 6). The dominant PA activities were Program Architecture Review Committee (PARC) actions on items submitted by the other Elements and revision of the Regulatory Requirement on "Substantially Complete Containment" to comport with the revised forms and process. The specific status of these activities is reported in Chapters 2, 6, and 8. A meeting on the "Substantially Complete Containment" activity was held July 13-14, 1989, at the White Flint offices. Among the topics addressed were the scope of the first report and the use of geostatistical methods in the study. Professor Andre Journel (consultant to the Center) briefed the team on geostatistical techniques using spacial correlation methods.

Development of the Fast Probabilistic Performance Assessment (FPPA) technique has led to the establishment of a code structure for an EBS Performance Assessment Code (EBSPAC). A review of the parameters and

associated uncertainties relevant to the modeling of thermal conditions continued.

Work continued on finalizing the format and associated contents of the Appendix A tables for the Transportation Risk Study (Chapter 7). It appears that about 5% of the raw data used in the earlier SAND84-7174 report is unusable due to data entry errors at the source. Initial evaluations indicate that the projections made in NUREG-0170 significantly over estimated the shipment of radioactive materials. Test runs with the RADTRAN code continued to familiarize the staff with the code and to perform some preliminary risk assessments. A rough draft of the evaluation of alternative models and codes was completed. Work continued to revise the preliminary draft of Chapter 2 of the TRS regarding transportation regulations.

The SPAE/T Subelement staff was heavily involved in both the PARC and Program Architecture development activities (Section 8). In addition, work commenced on the FY90-91 Operations Plans where Draft Environmental Impact Statement and License Application Review Plans are the primary tasks to be completed. A briefing on "Strategic and Programmatic Issues and Risks Related to Comprehensive Planning for the High-Level Waste Program" (CNWRA 89-004) was presented July 18, 1989.

License application Format and Content Guide (F&CG) development activities continued this period. Comments were provided on the draft "Broad Outline" and work continued on a "crosswalk" between the pertinent portions of 10CFR Part 60, Subparts B and E.

RDCO Element staff worked extensively on preparation of Program Architecture database inputs on the Uncertainties, Elements of Proof, etc. associated with 23 separate Regulatory Requirements (see Section 9 for a detailed list). Acceleration of those items which will be used to support development of Technical Positions during FY90-91 began. Significant Program Architecture Review work was also conducted within this Element.

Work continued to update the document "Listing of Computer Codes Considered to be Potentially Applicable to the Repository Design, Construction, and Operations (RDCO) Program Element". This will fulfill the purposes of (a) a guide and focusing mechanism for selection of compliance determination codes and (b) a preliminary evaluation of the codes DOE may choose to use in design and for demonstrating compliance with the regulations related to RDCO.

Several actions of a management and administrative nature were also undertaken this period. Because none of these are directly or solely attributable to any particular Element/Subelement, they are not forward-referenced to other sections of this report.

1. Continued planning, coordination efforts, and discussions regarding preparation of Operations Plans, based on recent guidance from the NRC.
2. Continued work on a plan for bringing the Center practices for submittal of documents and correspondence into compliance with the provisions of 10CFR2.
3. Initiated revisions of the Center Staffing Plan in accordance with new insights gained in the NRC-NMSS and NRC-RES program areas.
4. Continued work with an IMS coordinating group at the SwRI which includes all Center, SwRI, subcontractor, consultant, and vendor cognizant personnel.
5. Conducted several Conflict of Interest evaluations for prospective permanent, subcontractor, and consultant staff, as well as for summer student employees.

6. Continued planning for Internal Research and Development (IR&D) activities that will be funded out of a portion of the award fees earned by the Center.

1.2 Milestone Status and Significant Accomplishments This Period
The following table summarizes the status of all Element/Subelement milestones related to development of the Program Architecture.

<u>Milestone</u>	<u>Abbreviated Description</u>	<u>Date</u>	<u>Status</u>
E1	Element Activity via TOP-001-02 on Set 1	9/16/88	98%
P7	PARC Review of Set 1 Reg. Requirements	9/26/88	88%
I3	Integrate PARC Set 1 Data	9/27/88	75%
E2	Element Activity via TOP-001-02 on Set 2	9/30/88	95%
P8	PARC Review of Set 2 Reg. Requirements	10/11/88	90%
I4	Integrate PARC Set 2 Data	10/12/88	45%
E3	Element Activity via TOP-001-02 on Set 3	10/28/88	95%
P9	PARC Review of Set 3 Reg. Requirements	11/08/88	85%
I5	Integrate PARC Set 3 Data	11/09/88	20%
E4	Element Activity via TOP-001-02 on Set 4	11/11/88	95%
P10	PARC Review of Set 4 Reg. Requirements	11/21/88	80%
I6	Integrate PARC Set 4 Data	11/21/88	35%
I7	Integrated and "Certified" Data (Sets 1-4)	11/23/88	50%

Major modifications and furnishing Building 57, the Center's principal facility for laboratory study and experimentation, were completed.

Significant developments were made on the Regulatory Requirements "Adverse Condition--Erosion" and "Adverse Condition--Geochemistry" (Chapter 5) and in "Substantially Complete Containment" (Chapter 6). A deliverable related to the Natural Resources Assessment was provided to the NRC.

The final draft of Sections 1.1, 1.2, and 1.3, and a draft of Chapter 2 of the Transportation Risk Study were completed and submitted to NRC (Chapter 7). Work in other areas continued according to the Operations Plan.

Required Center input on the Format and Content Guide was completed and submitted to the NRC.

The RDCO Element continued development of Uncertainties, Uncertainty Questions, etc. for numerous Regulatory Requirements and participation in related PARC activities (Chapter 9). No specific milestones were planned for completion.

1.3 Problems

Lack of technical interactions between the Center and DOE researchers has become crucial. Of immediate concern is the need for the Center to interact with DOE and DOE-contractor researchers regarding the

state-of-the-art in thermohydrologic modeling; a specific requirement for this research project.

A second potential problem area regards the extent of work that must precede the submittal and approval of a specific research Project Plan. Although the current structure and funding of the Overall Research Project Plan accommodates some preliminary work, several of the NRC Project Managers prefer to have more extensive work, such as literature reviews for proposed projects, developed under this plan. Discussions to resolve these differences in approach are planned for next period.

1.4 Forecast for Next Period

Development of the Program Architecture and PASS will continue to be a focus of Center activities next period. Additional Program Architecture development workshops, involving the teaming of NRC and CNWRA staffs will be conducted, as necessary. Completion of development, and final closure and NRC approval of modifications to the process, Technical Operating Procedures, and supporting guidance are required during the next period if the September and December milestones are to be attained. Primary training of Center and support staff in the new procedures will continue.

Development of Operations Plans in all NRC-NMSS work areas will be the highest priority task for all non-research Elements during the next period.

Work will continue in the Geochemistry, Thermohydrologics, Seismic Rock Mechanics, and Integrated Waste Package Experiments Projects in accordance with approved plans. Preparation of the Project Plans for research in the areas of stochastic modeling of fluid flow in the unsaturated zone and geochemical analogs will continue. Peer review comments on the IWPE Project will be received and evaluated.

Implementation of Revision 1 of the Center Quality Assurance Manual, including development of appropriate Administrative, Technical, and Quality procedures, will continue and revisions will be considered (Section 4). Emphasis will continue on the oversight of the Program Architecture development and review activities. Center and SwRI quality assurance professionals will continue with Task 5, as requested by NRC.

The Geologic Setting Element activities will focus on further development of the Program Architecture Relational Database under the revised process, procedures, and data input templates (Chapter 5). Specific work will include the preparation of data and entry of such data on the appropriate input forms for the "Adverse Condition--Geochemistry", "Adverse Condition--Erosion", and "Adverse Condition--Igneous Activity". Acquisition and equipping of facilities in which to perform GS technical work will continue next period. Staff acquisition efforts, including interviews, are anticipated to be intense in the areas noted in Chapter 5. Planning for activities to be conducted in the remainder of FY1989 and FY1990, including Operations Plan preparation, will continue.

Considerable effort will continue to be expended in the EBS Element with the further development of the Program Architecture Relational Database and related PARC activities (Section 6). Recruitment efforts for an electrochemist and another materials scientist will continue with interviews being conducted, as appropriate candidates are identified. Both technical assistance and Program Architecture work related to the Regulatory Requirement "Substantially Complete Containment" will be intense, in accordance with the approved Task 4 plan. Activities will continue in Task 6 regarding EBS performance assessment.

The Transportation Risk Study staff will complete the data tables for Appendix A and will work on Sections 1.4 through 1.6 of the TRS report.

The preliminary evaluation of codes and models will be completed in Period 12, together with a report on the status of risk assessments. Other activities will continue in accordance with the approved Operations Plan.

The SPAE/T Element will continue to focus on supporting development of the Program Architecture by analysis of Subpart B of 10 CFR Part 60 (Sets 2 and 4), and participation in the PARC (Section 8). The "crosswalk" for the license application Format and Content Guide will be completed during the next period.

Activities within the RDCO Element will focus on supporting development of the Program Architecture through activities on the PARC and the development of inputs to the relational database, primarily associated with portions of Set 1 and Set 3 (Section 9). Planning for the transfer of technology from other contractors to the Center will continue next period. Evaluation of codes and models for use in NRC compliance determination methods or by DOE for design and/or compliance demonstration will continue.

1.5 Summary Financial Status

Table 1, below, indicates the financial status of the overall Center program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. These data do not include commitments in the amount of \$392,566. Similar data are presented for each Element/Subelement in the respective sections of this periodic report.

The preponderance of the variance is in the Research programs which were conditionally approved considerably later than originally planned. In addition, under-runs are occurring in the QA Subelement where Task 5 activities have not been as great as anticipated and in SPAE where proposed Task work has been rejected by the NRC and, therefore continues to be defined. Taking into account the commitments noted above, overall spending is \$276,970 (about 3%) under plan. The remaining variances between estimated and actual spending should be remedied in the course of events over the next 3 to 4 periods. No further changes to budget or schedule are recommended at this time.

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$10,396,791	\$10,396,791	\$7,945,672	\$2,451,119	-0-	-0-

CENTER Composite Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	419,423	511,770	576,570	590,933	653,944	672,049	667,536	575,451	567,945	577,778	583,975	567,278	8,615,208
ACTUAL PERIOD COST	364,234	406,981	371,630	418,872	419,505	453,624	451,790	495,768	456,234	568,497	478,950	521,026	7,945,672
VARIANCE, \$	55,189	104,789	204,940	172,061	234,439	218,425	215,746	79,683	111,711	9,281	105,025	46,252	669,536
VARIANCE, %	13.2	20.5	35.5	29.1	35.9	32.5	32.3	13.8	19.7	1.6	18.0	8.2	7.8
ESTIMATED CUMULATIVE COST	3,404,589	3,916,359	4,492,929	4,947,907	5,601,851	6,273,900	6,290,432	6,865,883	7,433,828	7,804,839	8,047,930	8,615,208	
ACTUAL CUMULATIVE COST	2,902,795	3,309,776	3,681,406	4,100,278	4,519,783	4,973,407	5,425,197	5,920,965	6,377,199	6,945,696	7,424,646	7,945,672	
VARIANCE, \$	501,794	606,583	811,523	847,629	1,082,068	1,300,493	865,235	944,918	1,056,629	859,143	623,284	669,536	
VARIANCE, %	14.7	15.5	18.1	17.1	19.3	20.7	13.8	13.8	14.2	11.0	7.7	7.8	

NOTES: 1. All estimated and actual costs exclude award fee.

2. HLW estimates are taken from the May 16, 1989, Interim Spending Plan. TRS and Research estimates are taken from Year 2 Project Plans.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

CENTER CORE STAFF -- HIRING PROFILE

EXPERTISE/EXPERIENCE	1				2				3				4	5	TOTAL REQUIRED	CURRENTLY OPEN (4TH QTR)	TOTAL OPEN
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q					
ADMINISTRATION	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	0
APPLIED MATHEMATICS									1	1	1	1	1	1	1	0	1
BOREHOLE GEOPHYSICS (b)									1	1	1	1	1	1	1	0	1
DATA BASE MANAGEMENT AND DATA PROCESSING	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	0	0
ELECTROCHEMISTRY (b)						1	1	1	1	1	1	1	1	1	1	1	1
ENGINEERING GEOLOGY/GEOLOGICAL ENGINEERING (b)						1	1	1	1	2	2	2	2	2	2	1	2
GEOCHEMISTRY (b)				2	2	2	2	2	2	2	2	2	2	2	2	0	0
GEOHYDROLOGY (b)						1	1	2	2	2	2	2	2	2	2	1	1
GEOLOGY	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	0	1
GEOMORPHOLOGY (b)							1	1	1	1	1	1	1	1	1	1	1
GEOPHYSICS (b)									1	1	1	1	1	1	1	0	1
GEOSTATISTICS (b)							1	1	1	1	1	1	1	1	1	1	1
HEALTH PHYSICS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
INFORMATION MANAGEMENT SYSTEMS	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	0	0
MATERIAL SCIENCES (b)	1	1	1	2	2	3	3	3	3	3	3	3	3	3	3	1	1
MECHANICAL, INCLUDING DESIGN & FABRICATION											1	1	1	2	2	0	2
MINING ENGINEERING				1	1	1	1	1	1	1	1	1	1	1	1	0	0
NUCLEAR ENGINEERING											1	1	2	2	2	0	2
NUMERICAL MODELING (b)							1	1	1	2	2	2	3	3	3	1	3
PERFORMANCE ASSESSMENT (b) (a)						1	1	1	2	2	2	2	2	3	3	1	3
QUALITY ASSURANCE (b)	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	1	2
RADIOCHEMISTRY (b)											1	1	1	1	1	0	1
REGULATORY AND POLICY ANALYSIS (f) (b)	1	1	2	2	2	3	3	3	3	3	3	3	3	3	3	1	1
RELIABILITY				1	1	1	1	1	1	1	1	1	1	1	1	0	0
ROCK MECHANICS (b) (a)							1	1	1	1	1	1	2	2	2	0	1
STRUCTURAL GEOLOGY (b)							1	1	1	1	1	1	1	1	1	1	1
SYSTEMS ENGINEERING				1	1	1	1	1	1	1	1	1	1	1	1	0	0
THERMODYNAMICS											1	1	1	1	1	0	1
TRANSPORTATION				1	1	1	1	1	1	1	1	1	1	1	1	0	0
TOTAL REQUIRED	12	12	13	21	21	28	34	35	39	42	45	45	50	52	52	11	28

(a) Interview scheduled next period.

(b) Resumes being solicited.

(c) Offer made.

(d) Offer pending.

(e) Offer accepted.

(f) Position re-opened.

Staffing Summary

	Professional	Support	Total
Current	25	8	33
Planned This Date	34	8	42
Planned End of FY89	35	8	43

CENTER CORE STAFF -- CURRENT PROFILE

EXPERTISE/EXPERIENCE	
ADMINISTRATION	J. Latz, R. Adler, H. Garcia, W. Patrick, A. Whiting
APPLIED MATHEMATICS	
BOREHOLE GEOPHYSICS	
DATA BASE MANAGEMENT AND DATA PROCESSING	S. McFaddin, M. Pape
ELECTROCHEMISTRY	
ENGINEERING GEOLOGY/GEOLOGICAL ENGINEERING	
GEOCHEMISTRY	W. Murphy, R. Pabalan
GEOHYDROLOGY	R. Ababou, R. Green
GEOLOGY	J. Russell
GEOMORPHOLOGY	
GEOPHYSICS	
GEOSTATISTICS	
HEALTH PHYSICS	J. Hageman
INFORMATION MANAGEMENT SYSTEMS	R. Johnson, R. Marshall
MATERIAL SCIENCES	P. Nair, H. Manaktala
MECHANICAL, INCLUDING DESIGN & FABRICATION	
MINING ENGINEERING	S-M. Hsiung
NUCLEAR ENGINEERING	
NUMERICAL MODELING	
PERFORMANCE ASSESSMENT	
QUALITY ASSURANCE	B. Mabrito
RADIOCHEMISTRY	
REGULATORY AND POLICY ANALYSIS	P. LaPlante, S. Spector
RELIABILITY	J. Wu
ROCK MECHANICS	A. Chowdhury
STRUCTURAL GEOLOGY	
SYSTEMS ENGINEERING	D. T. Romine
THERMODYNAMICS	
TRANSPORTATION	R. Weiner

2. WASTE SYSTEMS ENGINEERING AND INTEGRATION

NRC Program Element Manager: Philip M. Altomare

NRC Program Subelement Manager: Philip M. Altomare

NRC Project Officer for
Program Architecture: Michael P. Lee

CNWRA Subelement Manager: Allen R. Whiting

Key Personnel: R. Adler, R. Johnson, J. Latz, W. Patrick, A. Whiting,
T. Romine

Subcontractors/Consultants: None

2.1 Subelement Objectives

The FY1989 objectives are to (1) continue development and maintenance of the Program Architecture for the NRC-HLW program, (2) develop and sustain the Center's capability to perform systems engineering and integration for the overall program, (3) coordinate and integrate inputs to the Center 5-Year Plan, (4) develop technical capabilities and make necessary preparations to transfer performance assessment activities into the Center and (5) provide technical review of other NRC contractors, DOE and its contractors, other agencies, and affected parties.

2.2 Subelement Technical Status

Activities related to this Subelement continued to be predominantly associated with development and implementation of the intended integrating effect of this Operations Plan. These activities focused on applying the Center's systems engineering and integration concepts to the successful development of the Program Architecture (PA) and the overall NRC-HLW regulatory program.

Throughout this Period, pre-PARC and PARC work on Set 1, Set 2, Set 3, and Set 4 of the Regulatory Requirements continued. Efforts to finalize definitions, terminology and expectations of the process, procedures and products of Program Architecture continued to be aggressively pursued by the Center and the NRC during this period. Meetings, phone conferences, written and telecopied information were all utilized to aid in communication related to open items. Final resolution continues to occur regarding definitions, guidance, and schedule for the refinement of the Program Architecture process, revising of TOPS for further actions of the PARC and Element Managers consistent with the NRC needs and expectations for "baselining" the Program Architecture in the fall of 1989. During this period, the desire was made known to the Center that the NRC would like to have the Center accelerate its activity on Regulatory Requirement analyses related to volcanism. A meeting was held at the CNWRA San Antonio offices on July 20 and 21 and attended by Mr. P. Altomare (NRC) in which it was determined that the CNWRA could reduce its efforts on the "Adverse Condition--Geochemistry" and accelerate effort on the volcanism portion of the "Igneous Activity" Regulatory Requirement analyses with only minor effect on the "baselining" September deliverable of Program Architecture. The effect would only be to substitute "Igneous Activity" for "Adverse Condition--Geochemistry" in the "baselining" exercise and to utilize as much of the "Igneous Activity" analyses as possible by September (through Information Requirements in the Program Architecture Process Diagram, if possible) in concert with "Erosion" and "Substantially

Complete Containment" (through the 22 steps of the PAPD) to provide the September "baseline" deliverable. (Details of the approach and tentative schedule are in the minutes of the July 20-21, 1989 meeting authored by P. Altomare.) Further information on this will be forthcoming from the NRC to make this "official" during next period.

In addition, work continued on development of Program Architecture and PASS with emphasis on the refinement and extension of the relational database; systems requirements and definitions; and development of the hardware, software, and telecommunications specifications necessary to support it. Teleconference discussions were held between the CNWRA and the NRC regarding the implementation and schedule for OS/2 technology described in the Center-submitted plan for "Phased Access to PASS by the NRC" (Reference June 27, 1989 letter from R. Johnson to P. Altomare). The outcome of those discussions will be reflected in the Center Operations Plans for FY90-91.

Increased efforts on scoping, staffing, scheduling, and resource loading and task descriptions of the Operations Plans occurred during this period. Some of these efforts were effected in mid-course when we became aware of certain expectations of NRC Research during the joint NRC Research/CNWRA July 24 and 25, 1989. Details of the meetings are captured in the respective meeting minutes. Re-vamped staffing plans and work scopes were pursued and prepared for presentation to NRC Management at a meeting scheduled for early next period (August 8 and 9, 1989 at White Flint). Element Managers are scheduled to be in attendance at this meeting as well - to finalize expectations regarding what will be in the 90-91 Center Operations Plans.

Continuing this period were training sessions of Center Staff on IMS applications as they are implemented and used in CNWRA operations.

The Technical Document Index and review system continues to be expanded and utilized by Center staff, SwRI, and subcontractors who are providing Element-specific reviews as input.

During this period in the area of Performance Assessment, the pursuit of staff occurred, with two individuals set for interviews next period. Also, preliminary scoping of performance assessment activities desired by the NRC prior to the end of the fiscal year was initiated with Dr. Ruth Weiner acting as the Center's focal point on Performance Assessment.

2.2.1 Narrative Technical Progress This Period

Activities under the Waste Systems Engineering and Integration (WSE&I) Operations Plan for this period included technical work in Task 1 (Develop and Maintain Program Architecture), Task 2 (Develop Technical and Analytical Capability), Task 4 (Evaluate and Develop Performance Assessment Methodology at the Center) and Operations Plan scoping in Tasks 3 and 5.

2.2.1.1 Task 1: Develop and Maintain Program Architecture

Major emphasis this period included attempts at finalizing definitions, guidance, and schedule for the refinement of the Program Architecture process and revising TOPS for further actions of the PARC and Element Managers consistent with the NRC needs and expectations for "baselining" the Program Architecture in the fall of 1989. This included finalizing the prioritization of efforts on Statutes/Regulations and Regulatory Requirements consistent with the December requirement of having all Regulatory and Institutional Uncertainties for 10 CFR Part 60 identified. Also, work continued on development of Program Architecture and PASS with emphasis on the refinement and extension of the relational database; systems

requirements and definitions; and development of the hardware, software, and telecommunications specifications necessary to support it. These efforts were supported by:

1. Continuing to develop Regulatory Requirements, Uncertainty Reduction Methods, etc. for Sets 1, 2, 3, and 4 in developing the relational database of Program Architecture. (A total of 50 Regulatory Requirements are now in the database).

2. Developing, defining, and documenting the terminology and criteria for refining, updating, and expanding the relational database of the Program Architecture through refining the PA process, modifying TOPs and instructions based on the agreements reached in the May 18 & 19 meeting at Crystal City between the NRC and the CNWRA (Reference the minutes of said meeting). This included finalization of Rev. 0 of TOP-001-04 "Selection of Regulatory Topics for Program Architecture."

3. Prioritization of the Statutes/Regulations relative to planned effort consistent with WSE&I deliverables scheduled for September and December 1989.

4. Continuation of activities with identified participants and schedules from the joint NRC/CNWRA team development of the Regulatory Requirement analyses of "Adverse Condition--Geochemistry," "Substantially Complete Containment," and "Erosion," and loading of the data into the Program Architecture Relational Database in support of the March 15 NRC/CNWRA meeting request and the September "baseline" requirement reflected in the April 20 letter from R. Browning to J. Latz. Initial discussions were held at the Center with P. Altomare (NRC) concerning replacing the Center's immediate effort on "Adverse Condition--Geochemistry" with "Volcanism" (Reference meeting minutes of July 20-21, 1989 meeting).

5. Continuing the development of a preliminary draft of the CNWRA Administrative Procedure for Task Control and its relationship to PA.

6. Initiating the development of a specification for the September "baseline" deliverable.

7. Developing additional drafts of the revised TOP-001-02 with associated attachments to reflect the refined PAD Process through Block 13 with the attendant logic diagrams and appropriate DW4 templates to capture the regulatory analysis data consistent with the refined PADP and the revised TOP philosophy agreed to in the May 18 & 19, 1989 meeting.

8. Initiating the development of Regulatory Requirement Topics for the remaining sections of 10 CFR Part 60 as per TOP-001-04.

9. Continuing to improve the communications link of the PASS system to the IBM 4381.

10. Providing Center end-user training on the PASS system on the IBM 4381 on PROFS and E-Mail.

11. Developing additional file maintenance capabilities for PASS and, in particular, developing the system maintenance process for updating the regulations and statutes text.

2.2.1.2 Task 2: Develop Technical and Analytical Capability

No Major Milestones were delivered during this reporting period. The following activities were accomplished:

1. Continued refinement of the database and tracking system for document acquisitions and reviews including continued indexing of the backlog of technical documents in the CNWRA library.

2. Implemented work practices for the preparation of Operations Plans using ASPMC to load resources, schedules and

budgets. Loaded the Work Breakdown Structure, Resources (per the latest staffing plan) and the Cost Elements for both the spending plans and the periodic reports in the ASPMC master file tables.

3. Continued weekly meetings with CCF, IBM, and IMS staff to coordinate CNWRA system development and implementation with NRC-IRM and IBM in Washington on the cluster controller status, network problem resolution, and software configuration control items.

4. Continued training sessions for selected Center staff on IMS applications as they are implemented in the CNWRA.

5. Continued pursuit of candidates for Center staff in Performance Assessment and Systems Engineering needs. Two candidates are scheduled for interview during next period for Performance Assessment staff positions.

6. Continued development on a Procedure for Center Staff to access DIALOG.

2.2.1.3 Task 3: Coordinate and Integrate Input to Center 5-Year Plan

Continued scoping of Year 2 and beyond Operations Plans in this task consistent with the new scope guidance received from the NRC mid-June, 1989.

2.2.1.4 Task 4: Evaluate and Develop Performance Assessment Methodology at the Center

Continued scoping of Year 2 and beyond Operations Plans in this task consistent with the new scope guidance received from the NRC mid-June and discussed thru July. Assessing the impact of information on NRC Research's performance assessment needs which were aired in the July 24 & 25, 1989 meetings.

2.2.1.5 Task 5: Technical Review

Continued scoping of FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC mid-June.

2.2.2 Milestone Status and Significant Accomplishments This Period

2.2.2.1 Task 1: Develop and Maintain Program Architecture

During this period, the following intermediate milestones were pursued. NOTE: With the submittal of the Operations Plans, the following will be revised to more accurately reflect modified milestone definitions, schedules, and completion status.

<u>Milestone</u>	<u>Abbreviated Description</u>	<u>Date</u>	<u>Status</u>
E1	Element Activity via TOP-001-02 on Set 1	9/16/88	98%
P7	PARC Review of Set 1 Reg. Requirements	9/26/88	88%
I3	Integrate PARC Set 1 Data	9/27/88	75%
E2	Element Activity via TOP-001-02 on Set 2	9/30/88	95%
P8	PARC Review of Set 2 Reg. Requirements	10/11/88	90%
I4	Integrate PARC Set 2 Data	10/12/88	45%
E3	Element Activity via TOP-001-02 on Set 3	10/28/88	95%
P9	PARC Review of Set 3 Reg. Requirements	11/08/88	85%

I5	Integrate PARC Set 3 Data	11/09/88	20%
E4	Element Activity via TOP-001-02 on Set 4	11/11/88	95%
P10	PARC Review of Set 4 Reg. Requirements	11/21/88	80%
I6	Integrate PARC Set 4 Data	11/21/88	35%
I7	Integrated and "Certified" Data (Sets 1-4)	11/23/88	50%

2.2.2.2 Task 2: Develop Technical and Analytical Capability

Continued identification, accumulation, and entry of general information reviewed by Element Managers into the Library Management System.

2.2.2.3 Task 3: Coordinate and Integrate Input to Center 5-Year Plan

Continued scoping of FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC mid-June.

2.2.2.4 Task 4: Evaluate and Develop Performance Assessment Methodology at the Center

Continued scoping of FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC mid-June and discussion with the NRC counter parts.

2.2.2.5 Task 5: Technical Review

Continued scoping of FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC mid-June. This task becomes part of Center Operations Plan in 90-91.

2.2.3 Problems

None.

2.2.4 Forecast for Next Period

2.2.4.1 Task 1: Develop and Maintain Program Architecture

Major emphasis next period will involve finalizing Operations Plans for FY90-91 and continued efforts towards finalization of definitions, guidance, and schedules for the refinement of the Program Architecture process and revising TOPS for further actions of the PARC and Element Managers consistent with the NRC needs and expectations for "baselining" the Program Architecture in the fall of 1989. This will include continuing participation in "teaming" workshops and individuals within the NRC on "Erosion," and "Igneous Activity," and "Substantially Complete Containment." Also, work will continue on development of Program Architecture and PASS with emphasis on the refinement and extension of the relational database; systems requirements and definitions; and development of the hardware, software, and telecommunications specifications necessary to support the agreed upon refined PAPD and the modified TOP requirements. Specific activity directed toward this task will include:

1. NRC/CNWRA "teams" working with the Refined Program Architecture Development Process and the Revised Technical Operating Procedures necessary to implement it to meet the "baseline" requirements of the September and December deliverables.

2. Finalizing the NRC/CNWRA concurrence on the prioritization of Center efforts related to the Statutes/Regulations and Regulatory Requirements consistent with the September and December 1989 deliverables and points beyond.

3. Finalizing a schedule and plan, with NRC participation, to conduct analyses of the three Regulatory Requirement topics to varying degrees: "Igneous Activity," "Substantially Complete Containment," and "Erosion," in support of the March 15 and July 20, 1989 requests and consistent with the September "baseline" requirements.

4. Finalization of a schedule for the specification developments of the September and December, 1989 deliverables.

5. Continuing the redesign of the PASS system consistent with the May 18 & 19, 1989 agreements and producing database relationship diagram and flow charts for the operation of the modified system to match the processes. Confirm and/or evaluate software products and options for PASS for user interface and text management, as well as types of workstations, and submit to NRC options for how to best implement the PASS.

6. Continuing to develop Regulatory Requirements, consistent with the refined PAPD and the revised TOP-001-02, to the extent approved, for Sets 1, 2, 3, and 4 through Process Block 15 in support of Program Architecture and in a prioritized manner consistent with CNWRA/NRC decisions made as a function of the May 18 & 19, 1989 meeting.

7. Finalizing Regulatory Requirement Topics for the remaining sections of 10 CFR Part 60 as per TOP-001-04.

8. Providing Center end-user training on the PASS system on the IBM 4381.

9. Work with the NRC as they develop a configuration control plan, and specify and execute computer tests to isolate problems and verify systems are working.

10. Continue to work on numbering schemes for PASS and new data records to handle logical relationships in REOP's, TRC's, etc. Work with task team to prepare for training in new procedures and use of modified DW4 templates.

11. Developing Operations Plans for Fiscal Years 1990-91 for WSE&I.

2.2.4.2 Task 2: Develop Technical and Analytical Capability

The following activities are anticipated:

1. Continued refinement of the database and tracking system for document acquisitions, reviews, and indexing technical documents in the CNWRA library.

2. Continued expansion of liaison with DOE through NRC.

3. Continued pursuit of candidates for Center staff in support of Performance Assessment and System Engineering and Integration needs consistent with the Center Staffing Plan.

4. Train additional staff to use E-Mail and continue using PROFS via the line to White Flint.

5. Implement and train the staff to index correspondence and technical documents and commitment control through the PASS system.

6. Continued loading of technical documents in the index, entering abstracts and reviews for reference and status reporting in PASS, developing and continuing the Correspondence Index for the Center.

7. Providing training, orientation, and support of the group continuing to develop Regulatory Requirements, Elements of Proof, and other relational database fields for the PA and PASS consistent with agreed-to changes in the May 18-19, 1989 meeting.

8. Continuing the development of the ASPMC project management features and their interface to the SwRI accounting system.

9. Continued refinement of the Center LAN/workstation configurations for effective printing and plotting.

10. Continued implementation of additional capability to access NUDOCS using SMARTTERM to download the data.

11. Further implementation of the procedure for Center staff to access DIALOG.

2.2.4.3 Task 3: Coordinate and Integrate Input to Center 5-Year Plan

Continue developing Operations Plan activities in this task consistent with the scope and guidance received from the NRC in late June, and late July.

2.2.4.4 Task 4: Evaluate and Develop Performance Assessment Methodology at the Center

Continue developing Operations Plan activities in this task consistent with the scope and guidance received from the NRC in late June and late July.

2.2.4.5 Task 5: Technical Review

Continue developing Operations Plan activities in this task consistent with the scope and guidance received from the NRC in late June and late July, 1989.

2.3 Element Financial Status

Table 1, below, indicates the financial status of the Element/Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. These data do not include commitments in the amount of \$5,425. Taking into account these commitments, costs are on-target with budgets. No changes to budget or schedule are recommended at this time.

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$1,652,941	\$1,652,941	\$1,329,504	\$323,437	-0-	-0-

WSE&I Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	63,749	40,166	55,030	71,774	79,636	80,988	88,649	81,131	81,472	89,437	85,908	85,170	1,340,876
ACTUAL PERIOD COST	26,223	40,165	14,073	73,637	63,906	74,958	74,351	90,267	89,269	73,254	90,679	82,575	1,329,504
VARIANCE, \$	37,526	1	40,957	(1,863)	15,730	6,030	14,298	(9,136)	(7,797)	16,183	(4,771)	2,595	11,372
VARIANCE, %	58.9	0.0	74.4	-2.6	19.8	7.4	16.1	-11.3	-9.6	18.1	-5.6	3.0	0.8
ESTIMATED CUMULATIVE COST	546,852	587,018	642,048	713,822	793,458	874,446	917,758	998,889	1,080,361	1,169,798	1,255,706	1,340,876	
ACTUAL CUMULATIVE COST	532,926	573,091	587,164	690,245	754,151	829,109	903,460	993,727	1,082,996	1,156,250	1,246,929	1,329,504	
VARIANCE, \$	13,926	13,927	54,884	23,577	39,307	45,337	14,298	5,162	(2,635)	13,548	8,777	11,372	
VARIANCE, %	2.5	2.4	8.5	3.3	5.0	5.2	1.6	0.5	-0.2	1.2	0.7	0.8	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from the May 16, 1989, Interim Spending Plan.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

3. RESEARCH

NRC Program Element Manager: William R. Ott

NRC Project Officer for
Geochemistry Task: George F. Birchard

NRC Project Officer for
Thermohydrology Task: Linda A. Kovach

NRC Project Officer for Integrated
Waste Package Experiments Task: Emmy Booy

NRC Project Officer for Seismic/Rock Mechanics Task: Jacob Philip

CNWRA Element Manager: Wesley C. Patrick (Acting Manager)

Key Personnel: B. Brady, F. Dodge, C. Freitas, S. Hsiung, D. Kana,
F. Lyle, H. Manaktala, F. Masch, W. Murphy, P. Nair,
R. Pabalan, J. Russell, B. Vanzant, A. Chowdhury

Subcontractors/Consultants: Itasca, ABC, Inc., Ohio State University,
University of Arizona, University of Texas-
San Antonio

3.1 Element Objectives

The broad objective of this Element is to develop and recommend a research program that will have optimal effect in identifying, characterizing, and contributing to the eventual resolution of issues and the reduction in the uncertainties and safety concerns associated with the long-term performance of a geologic repository. Specific research objectives for FY1988-FY1989 are to (1) obtain an understanding of geochemical mass transfer processes including sorption and matrix diffusion in both saturated and unsaturated, fractured, and porous tuff, (2) initiate a laboratory-scale study of repository thermohydrologics to provide a basis for evaluating calculational techniques, (3) undertake a laboratory study to evaluate potential corrosion mechanisms and parameters affecting corrosion failure modes for austenitic stainless steels and other DOE candidate materials exposed to conditions hypothesized to be present in a repository in tuff, and (4) investigate the effects of seismological events on both pre- and post-closure repository performances.

3.2 Element Technical Status

3.2.1 Narrative Technical Progress This Period

Major modifications were completed in Building 57 to house the Center's experimental programs. The laboratory casework for the Geochemistry, Thermohydrology, and Waste Package Experiments laboratories was installed in Building 57. Geochemistry equipment, supplies, and materials were acquired and experimental work initiated in the new Geochemistry Laboratory. Installation in Building 57 of equipment for the Thermohydrology Research Project separate effects experiments continued this period. The Center's facilities for experimental studies will be primarily housed in Building 57 to provide integration and efficiency among the Center's research projects. Analytical work (e.g. chemical analyses) will commonly be conducted within appropriate Divisions of SwRI using the equipment of those Divisions.

The status of the Project Plans as identified in the Operations Plan, is shown below.

<u>Project</u>	<u>Title</u>	<u>Revised Plan</u> <u>Completion Date</u>	<u>Approval</u> <u>Status</u>
Res. 1-Overall Program Plan		TBD	revised NRC guidance dated 08/01/89
Res. 2-Geochemistry		01/13/89	approved
Res. 3-Thermohydrology		05/12/89	approved
Res. 4-Seismic/Rock Mechanics		06/30/89	submitted to NRC
Res. 5-Integrated Waste Package		12/30/88	approval pending
Res. 6-Stochastic Analysis of Unsaturated Flow and Transport		SOW received	Project Plan development occurring under Res. 1 Project
Res. 7-Geochemical Analog of Contaminant Transport		SOW received	Project Plan development occurring under Res. 1 Project

3.2.1.1 Research Project 1-Overall Program Plan

The NRC provided revised guidance for the FY 90-91 for the Overall Program Plan in a letter dated August 1, 1989. The Overall Program Plan describes the Center's approach to developing and maintaining a strong research capability at the Center. It outlines a plan to develop focused research projects in support of reducing technical uncertainties arising from regulatory concerns for the licensing of the HLW repository.

A Research Management Meeting was held at the Center on July 24-25, 1989. The meeting covered a wide range of topics including, future research projects, staffing, technology transfer from other contractors, and communications among Center, NRC-RES, and NRC-NMSS staff. The minutes of the meeting are under preparation.

Statements of Work for two new Research Projects have been received and work on preparation of Research Project Plans occurred as a Overall Research Project (Research Project 1) activity in Period 11. R. Ababou initiated development of a Research Project Plan for "Stochastic Analyses of Unsaturated Flow and Transport Through Fractured Rock for Large Scale Hydrogeologic Systems." Dr. Ababou examined pertinent literature documenting NRC-funded research and related research by other investigators. W. Murphy conducted work on development of a Research Project Plan for the project entitled "Geochemical Analog of Contaminant Transport in Unsaturated Rock." Dr. Murphy examined pertinent literature and discussed the "Natural Analog" Project with L. Kovach. Discussions with L. Kovach, and W. Ott indicate a desire to have the preparation of the Research Project Plans for these two projects include extensive, in-depth investigations of research by NRC contractors and other investigators.

3.2.1.2 Research Project 2-Geochemistry

W. Murphy continued geochemical modeling activities by conducting a series of nonisothermal kinetic reaction path calculations and Rayleigh gas fractionation calculations to simulate near field geochemistry at Yucca Mountain, Nevada. Dr. Murphy's modeling was accomplished to assist in determination of the geochemical constraints on the chemistry of the water in the unsaturated zone at Yucca Mountain. The results of this work will be used in a presentation titled "Reaction path modeling of mineral and groundwater chemistry in the vadose zone of Yucca Mountain, Nevada", which will be made at the Gordon Research Conference on Inorganic Chemistry during Period 12. Dr. Murphy's paper entitled "Dislocations and Feldspar Dissolution," which was presented at the International Geochemical

Congress in September, 1988, was published in the European Journal of Mineralogy. He also reviewed a manuscript on geochemical mass transfer at the request of the editors of Geochimica Acta. During Period 11, W. Murphy gave a presentation on Yucca Mountain geology, hydrology, and geochemistry to the Corrosion Peer Review Panel and gave tours of the Center's laboratories in Building 57 for the research management review meeting participants.

W. Murphy attended the International Geological Congress convention in Washington, D.C. where he participated in a workshop on a review of nuclear waste programs throughout the world. R. Pabalan participated in the NRC Hydrology-Geochemistry Field Trip to Yucca Mountain and vicinity on July 24-27, 1989. The trip included participants from NRC, USGS, DOE, and Inyo County.

Methods for purification of zeolite materials described in the Center's draft Technical Operating Procedure-005 (TOP-005) entitled, "Procedure for Zeolite Ion Exchange Experiments," were tested. The method for removing carbonate minerals using saturated ammonium chloride solutions, while cited in the literature as useful for purifying zeolites, was found to be inadequate in dissolving carbonate minerals. Alternative methods, such as using sodium acetate buffer solutions, are being evaluated for possible use in TOP-005. Additional purification methods such as dissolution of organic materials and manganese and iron oxides are also being evaluated.

A study of the Center's Draft Technical Operating Procedure for Preparing Simulated and Modified J-13 Waters was conducted to determine the stability of simulated J-13 waters and the possible sources of errors and uncertainties in the procedure. Simulated J-13 waters were prepared following the steps given in the procedure, and the solution compositions were analyzed using plasma emission spectroscopy, ion chromatography, and pH and ion selective electrodes. A memorandum report to P. Nair (Element Manager, Engineered Barrier System) is being prepared.

General laboratory procedures were conducted, including calibration of ion selective electrodes and analytical balances. Volumetric glassware are currently being cleaned in acid baths and are being calibrated and labeled. A water purification system for the Center's laboratories was installed in Building 57. This system delivers ultrapure water of 18 megaohm resistivity for the Center's needs in geochemistry and integrated waste package experiments.

3.2.1.3 Research Project 4-Thermohydrology

Work was performed in Task 1, "Assessment of the State of Knowledge of Thermohydrology in Unsaturated Media," during the reporting period. Task 1 activities included identification, acquisition and familiarization with the content of publications and reports containing information on thermohydrologic and related phenomena, including heat and fluid flow visualization and measurement. Arrangements were made to visit during Period 12, the laboratory facilities and the Apache Leap field investigations site of the University of Arizona. Task 2 activities involved the design and preparation for the execution of separate effects experiments which will identify physical parameters that characterize thermohydrologic flow phenomena. NRC formal approval was received for the Thermohydrology Research Project Plan and for the experimental plan given in the Separate Effects Experimental Design Letter Report.

Construction of the separate effects experimental apparatus (glass-sided container to contain glass bead experiments) was completed. Equipment to be utilized in thermohydrological experiments for control of heat and fluid flow were initially installed and tested in Building 57. Experiments were also continued from Period 10 on the concentrations of

liquid crystal beads and lighting techniques to optimize flow visualization using liquid crystal beads in certain temperature ranges.

3.2.1.4 Research Project 4-Seismic/Rock Mechanics Studies

A meeting of the seismic/rock mechanics researchers of the Center (A. Chowdhury, S. Hsiung) and SwRI (D. Kana, B. Vanzant) was held at the Center on July 10, 1989, to review the status of the seismic/rock mechanics experimental apparatus that is being constructed at the Machine Shop and the Dynamics Laboratory at SwRI. It was projected that the preparation of the apparatus parts will be completed by the third week of August, 1989, and the assembly of the apparatus parts will begin subsequently. By the second week of September, 1989, the apparatus should be operational and the calibration will start.

A conference call meeting of the seismic/rock mechanics researchers of the Center (A. Chowdhury, S. Hsiung), SwRI (D. Kana, B. Vanzant) and Itasca (B. Brady) was held on July 17, 1989 to review: (i) the status of the qualification of distinct element codes UDEC and 3DEC, (ii) the concept of seismic-geohydrologic head analogue studies, (iii) the collection of jointed tuff rock specimens, and (iv) the construction of seismic/rock mechanics experimental apparatus. The qualification study on the UDEC code, based on the four example problems with available analytical solutions, is in the process of completion. These four example problems are: (1) Joint Slip Model, (2) Dynamic Sources in a Jointed Medium, (3) Excavation Near-Field Problems (Effect of Planes of Weakness), and (4) S-wave Transmission at a Joint Subject to Slip. The first and the second problems were analyzed using UDEC at Itasca. The UDEC analyses for the third and fourth problems were carried out at the Center. The results show a reasonable agreement as compared to the associated analytical solutions for all the four example problems. Work on qualification studies of 3DEC code has been started at Itasca. Arrangement for leasing 3DEC by the Center from Itasca is underway. The finite element code HONDO was made operational on a micro-computer by Itasca. Severe limitations of input and output need to be resolved before it can be used effectively. Negotiation is underway concerning leasing the discrete element code DECICE from ECL Petroleum Technologies, Denver, Colorado.

Several analogues may be proposed between natural earthquakes and controlled or measurable dynamic settings suitable for field/experimental study to investigate the seismic effect on water table. These include laboratory simulations, small high explosive blasts, and mining induced rockbursts. It was determined that Apache Leap at Arizona will be the location for obtaining jointed tuff specimens for seismic/rock mechanics experimental studies. B. Vanzant of seismic/rock mechanics research project team along with two members of thermohydrology research team (F. Dodge and F. Masch) will make a preliminary survey trip to Apache Leap on August 16-18, 1989. This will include meeting with Jaak Daemen and Todd Rasmussen and visiting the rock mechanics experimental facilities of the University of Arizona. B. Vanzant will preview the Apache Leap site location for obtaining rock specimens to be used for seismic/rock mechanics experimental studies and get information necessary to plan extraction and shipment of large size jointed rock specimens during the next trip. During this trip, B. Vanzant will collect some tuff specimens from surface and will transport them to SwRI for possible use in preliminary work such as testing the operation of the constructed apparatus. After this preliminary trip to Apache Leap field, a detailed trip report will be prepared and submitted to NRC. The Technical Operating Procedure for obtaining jointed tuff rock specimens from field is under internal review.

A NRC-CNWRA Research Management meeting was held at the Center on July 24-25, 1989. It was agreed at the meeting that the Center will submit a revised project plan for seismic/rock mechanics research Project to include two additional tasks: (i) Instrumented field measurements to validate the selected computer codes, and (ii) Instrumented field measurements to study the seismic effect on water table. The preparation of the revised project plan will be started after NRC formal approval is received by the Center.

During this reporting period, the result of Task 1 of seismic/rock mechanics research Project which has been delivered to NRC as report CNWRA 89-001 was utilized to identify the need for NRC NMSS to provide guidance to DOE concerning the basis for selection of a design seismic motion criterion for the design of underground repository structures, systems and components.

3.2.1.5 Research Project 5-Integrated Waste Package Experiments

The IWPE Project Plan was presented in detail to the Peer Review Group at CNWRA on July 27, 1989. The Peer Review Group consists of: Dr. M. Streicher, Dr. S. Yukawa, and Mr. O. Siebert. The NRC staff present as observers at the Peer Review were Dr. M. Silberberg and Mr. R. Weller, along with two NRC consultants, viz. Prof. P. Shewmon of the Ohio State University and member of the Advisory Committee on Reactor Safety and Dr. J. Weeks of the Brookhaven National Laboratory. The Peer Review Group was provided with detailed presentations in the areas of electrochemical testing, slow strain rate testing, hydrogen adsorption studies, low temperature sensitization, and dealloying. A summary presentation of the statistical methods used in the IWPE project was also presented. Recognizing the uncertainties associated with test environments, test methods, and the need for obtaining reproducible and quantifiable data, CNWRA's statistical approach is based on sequential testing. Here the notion is to run a select number of tests using the technical experience of the researcher and existing data and building the next set of statistically valid tests based on the results of the earlier tests. This approach will direct resources in a cost effective manner and provide a sound basis for the development of the planned long-term tests. The presentation staff included, P. Nair, F. Lyle, H. Manaktala, R. Mason, and B. Wilde (Ohio State). The members of the Peer Review Group are expected to provide their individual evaluations by August 31, 1989 to the Center IWPE Project Manager. Summarized below are some of the comments/observations discussed at the Peer Review meeting.

- o For the materials in the test matrix, the Center should concentrate more on Incoloy-825 and Hastelloy C-22, out of the family of austenitic alloys for the HLW canisters, as much less is known about their anticipated performance in the repository environment. Late stage "surprises" could create serious difficulties in the materials selection for the HLW canister.
- o Particular attention should be given to the thermal stability of austenitic alloys, particularly Incoloy-825 which may precipitate unstable titanium carbide second-phase particles in the heat affected zone (HAZ) during welding.
- o Standard specifications for the Constant Extension Rate Test (CERT) and the electrochemical tests are quite open, and should be narrowed in terms of specimen preparation, surface finish, testing environment, strain rate, specimen size, etc. to assure

reproducibility and usefulness of the data for the intended purpose. [This will involve modifying or specifying additional requirements while using "standard" testing procedures. General impression was that there has been a tendency among the researchers, in the canister materials research programs, to "force-fit" existing "standard" testing procedures when modified or new procedures may have been necessary].

- o Suggestion was made to hold a series of "technical workshops" narrowly focused on specific testing methods to debate the merits and appropriateness of using a particular method in generating data that would be helpful in evaluating a particular material for HLW canisters.
- o Topics suggested for the first few "technical workshops" were: CERT, techniques/methodology for extrapolating short-term lab data to much longer-periods of interest for modeling and eventually in evaluating the DOE licensing application for the HLW repository, electrochemical testing procedures, and simulation of radiation environment. [The main emphasis would be to try to come to some agreement among the "technical experts in the field" on "standardized" methods that would be used by a vast majority (if not everyone) responsible for generating new data for evaluating candidate HLW canister materials. This may involve developing new standard testing procedures].
- o It was suggested that technical experts from industry, academia, independent consultants, DOE labs, NRC, and CNWRA should participate in these "technical workshops". [The technical workshops may be sponsored/hosted by the CNWRA].
- o A more effective dialog with DOE labs performing research was suggested, which would among other things entail CNWRA obtaining information from the DOE labs, in a timely fashion, about the details of the testing procedures and review the appropriateness of those procedures in generating the required data.
- o Concern was expressed about limited information on the host environment for the HLW canister, making the task of environmental selection for materials testing more difficult.

3.2.2 Milestone Status and Significant Accomplishments This Period

Outfitting of the Building 57 research facility was completed.

3.2.3 Problems

Review of DOE-supported research pertinent to the HLW geologic repository in thermohydrology and related technical areas was used to determine interactions with DOE contractors which will be necessary to obtain information on DOE research programs of thermohydrological phenomena. Recommendations were given to NRC's Repository Licensing and Quality Assurance Project Directorate on Appendix 7 meeting with DOE contractors necessary for acquisition of information required by the Center to accomplish determination of the state of the art for thermohydrological studies. Approval of the proposed Center-DOE Contractor informational meetings is necessary to accomplish Thermohydrology Task 1 deliverables for assessing the state of art

of thermohydrologic research, including that research conducted by DOE contractors, e.g. Lawrence Berkeley Laboratory.

Discussions with L. Kovach, and W. Ott indicate a desire to have the preparation of the Research Project Plans for "Stochastic Analyses of Unsaturated Flow and Transport Through Fractured Rock for Large Scale Hydrogeologic Systems" and "Geochemical Analog of Contaminant Transport in Unsaturated Rock" include extensive, in-depth investigations of previous and current research by NRC contractors and other investigators. Implementation of such large magnitude reviews of previous investigations extends the duration of Research Project Plan development which is currently funded in the Overall Research Project. Extension of Project Plan development is not supported in the current funding within the Overall Project Plan which anticipated that extensive reviews of previous literature would, if necessary, be accomplished as an initial task of each research project.

3.2.4 Forecast for Next period

The Peer Review comments for the IWPE project are due at the Center by August 31, 1989; follow-up activities on the subject will be initiated. The procedures for the development of synthetic J-13 water will be documented.

3.3 Element Financial Status

Table 1, below, indicates the financial status of the Element/Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. There are outstanding subcontractor commitments totalling \$170,672 related to these projects. Under-runs result primarily from delayed approvals of these projects. No changes to budget or schedule are recommended at this time.

Overall

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$309,370	\$309,370	\$73,401	\$235,969	-0-	-0-

Outstanding Subcontractor Commitments - \$30,593

Geochemistry

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$379,617	\$379,617	\$263,050	\$116,567	-0-	-0-

Outstanding Subcontractor Commitments - \$15,727

Thermohydrology

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$300,000	\$300,000	\$183,039	\$116,961	-0-	-0-

Outstanding Subcontractor Commitments - \$6,074

Seismic Rock Mechanics

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$575,270	\$575,270	\$500,496	\$74,774	-0-	-0-

Outstanding Subcontractor Commitments - \$53,572

Integrated Waste Package

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$616,119	\$616,119	\$382,526	\$233,593	-0-	-0-

Outstanding Subcontractor Commitments - \$64,706

OVERALL Research Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	14,074	6,381	14,880	16,061	13,464	14,556	15,736	6,056	7,473	7,473	7,237	7,797	158,336
ACTUAL PERIOD COST	2,043	10,003	1,501	6,552	4,056	3,129	8,900	13,886	3,400	3,265	5,879	10,006	73,401
VARIANCE, \$	12,031	(3,622)	13,379	9,509	9,408	11,427	6,836	(7,830)	4,073	4,208	1,358	(2,209)	84,935
VARIANCE, %	85.5	-56.8	89.9	59.2	69.9	78.5	43.4	-129.3	54.5	56.3	18.8	-28.3	53.6
ESTIMATED CUMULATIVE COST	41,222	47,603	62,483	78,544	92,008	106,564	122,300	128,356	135,829	143,302	150,539	158,336	
ACTUAL CUMULATIVE COST	2,824	12,827	14,328	20,880	24,936	28,065	36,965	50,851	54,251	57,516	63,395	73,401	
VARIANCE, \$	38,398	34,776	48,155	57,664	67,072	78,499	85,335	77,505	81,578	85,786	87,144	84,935	
VARIANCE, %	93.1	73.1	77.1	73.4	72.9	73.7	69.8	60.4	60.1	59.9	57.9	53.6	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from Year 2 Project Plan submitted on 12/15/88.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect MRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

GEOCHEM Research Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	48,621	22,875	40,318	15,887	30,975	48,441	33,685	29,761	32,527	25,358	25,358	27,719	453,195
ACTUAL PERIOD COST	8,006	44,057	23,131	13,759	30,837	12,895	13,638	22,935	30,285	15,946	15,265	20,741	263,050
VARIANCE, \$	40,615	(21,182)	17,187	2,128	138	35,546	20,047	6,826	2,242	9,412	10,093	6,978	190,145
VARIANCE, %	83.5	-92.6	42.6	13.4	0.4	73.4	59.5	22.9	6.9	37.1	39.8	25.2	42.0
ESTIMATED CUMULATIVE COST	120,291	143,166	183,484	199,371	230,346	278,787	312,472	342,233	374,760	400,118	425,476	453,195	
ACTUAL CUMULATIVE COST	19,561	63,618	86,749	100,508	131,345	144,240	157,878	180,813	211,098	227,044	242,309	263,050	
VARIANCE, \$	100,730	79,548	96,735	98,863	99,001	134,547	154,594	161,420	163,662	173,074	183,167	190,145	
VARIANCE, %	83.7	55.6	52.7	49.6	43.0	48.3	49.5	47.2	43.7	43.3	43.0	42.0	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from Year 2 Project Plan submitted on 01/12/89.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

THERMO Research Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	0	38,962	46,887	40,670	40,670	40,670	50,293	47,859	25,198	39,355	40,425	37,747	241,969
ACTUAL PERIOD COST	0	32,485	8,961	11,900	17,754	9,600	2,581	19,813	21,339	10,055	15,828	32,715	183,040
VARIANCE, \$	0	6,477	37,926	28,770	22,916	31,070	47,712	28,046	3,859	29,300	24,597	5,032	58,929
VARIANCE, %	0	16.6	80.9	70.7	56.3	76.4	94.9	58.6	15.3	74.5	60.8	13.3	24.4
ESTIMATED CUMULATIVE COST	0	38,962	85,849	126,519	167,189	207,859	258,152	306,011	331,209	163,797	204,222	241,969	
ACTUAL CUMULATIVE COST	0	32,485	41,446	53,355	71,109	80,709	83,290	103,103	124,442	134,497	150,325	183,040	
VARIANCE, \$	0	6,477	44,403	73,164	96,080	127,150	174,862	202,908	206,767	29,300	53,897	58,929	
VARIANCE, %	0	16.6	51.7	57.8	57.5	61.2	67.7	66.3	62.4	17.9	26.4	24.4	

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NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from Year 2 Project Plan submitted on 05/12/89.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

SEISMIC Research Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	76,260	49,207	57,429	55,621	55,323	50,323	52,323	53,175	48,805	51,066	39,726	37,719	511,625
ACTUAL PERIOD COST	33,857	34,198	26,314	43,906	27,680	62,364	12,312	25,133	28,643	43,774	34,249	32,066	500,495
VARIANCE, \$	42,403	15,009	31,115	11,715	27,643	(12,041)	40,011	28,042	20,162	7,292	5,477	5,653	11,130
VARIANCE, %	55.6	30.5	54.2	21.1	50.0	-23.9	76.5	52.7	41.3	14.3	13.8	15.0	2.2
ESTIMATED CUMULATIVE COST	301,792	350,999	408,428	464,049	519,372	569,695	622,018	675,193	723,998	775,064	473,906	511,625	
ACTUAL CUMULATIVE COST	129,856	164,054	190,368	234,274	261,954	324,318	336,630	361,763	390,406	434,180	468,429	500,495	
VARIANCE, \$	171,936	186,945	218,060	229,775	257,418	245,377	285,388	313,430	333,592	340,884	5,477	11,130	
VARIANCE, %	57.0	53.3	53.4	49.5	49.6	43.1	45.9	46.4	46.1	44.0	1.2	2.2	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from Year 2 Project Plan submitted on 06/29/89.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

IWPE Research Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	21,901	30,185	30,185	30,112	34,490	34,059	35,952	36,542	37,723	35,952	37,723	35,952	436,852
ACTUAL PERIOD COST	17,845	(8,279)	17,799	29,862	19,439	15,114	36,780	61,055	29,403	38,518	25,983	54,245	382,527
VARIANCE, \$	4,056	38,464	12,386	250	15,051	18,945	(828)	(24,513)	8,320	(2,566)	11,740	(18,293)	54,325
VARIANCE, %	18.5	127.4	41.0	0.8	43.6	55.6	-2.3	-67.1	22.1	-7.1	31.1	-50.9	12.4
ESTIMATED CUMULATIVE COST	57,977	88,162	118,347	148,459	182,949	217,008	252,960	289,502	327,225	363,177	400,900	436,852	
ACTUAL CUMULATIVE COST	62,608	54,329	72,128	101,990	121,429	136,543	173,323	234,378	263,781	302,299	328,282	382,527	
VARIANCE, \$	(4,631)	33,833	46,219	46,469	61,520	80,465	79,637	55,124	63,444	60,878	72,618	54,325	
VARIANCE, %	-8.0	38.4	39.1	31.3	33.6	37.1	31.5	19.0	19.4	16.8	18.1	12.4	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from Year 2 Project Plan submitted on 12/29/88.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

4. QUALITY ASSURANCE

NRC Program Element Manager: Mark S. Delligatti

NRC Program Subelement Manager: Mark S. Delligatti

NRC Project Officer for External QA Task: James E. Kennedy

CNWRA Subelement Manager: Bruce E. Mabrito

Key Personnel: Bruce E. Mabrito, Robert E. Engelhardt,
Thomas C. Trbovich, Robert D. Brient, Michael R. Gonzalez

Subcontractors/Consultant: William M. Bland, Jr., P.E., John H. Doyle

4.1 Subelement Objectives

Objectives pursued in FY1989 are to (1) support development of the Program Architecture for the NRC-HLW program, (2) develop and sustain the Center's technical and analytical capabilities in the technology of quality assurance, (3) provide appropriate inputs to the Center 5-Year Plan, (4) develop and implement the Center Quality Assurance Manual and (5) provide information assessments, and audits of the programs of other NRC contractors, DOE and its contractors, other agencies, and affected parties, based on NRC direction.

4.2 Subelement Technical Status

The QA Subelement Operations Plan includes specific tasks associated with each objective noted above which are integrated into the overall Center program. In support of the Program Architecture WSE&I deliverables, the Quality Assurance Subelement monitors the quality of other Element work.

4.2.1 Narrative Technical Progress This Period

4.2.1.1 Task 1: Support Development and Maintenance of Program Architecture

During this reporting period, the Center Director of Quality Assurance (the QA Subelement Manager) continued to participate in major Center Program Architecture (PA) discussions and assisted in the application of quality assurance and quality control principles to the Program Architecture development. The Center QA Department continued to receive new products from the Program Architecture Review Committee (PARC) on computer diskettes, and the QA Department performed a 100-percent review of each submittal. The QA Director participated in those reviews and continued to provide input to those Technical Operating Procedures which direct Program Architecture actions.

4.2.1.2 Task 2: Develop Technical and Analytical Capabilities

The Director of Center QA continued to work as Secretary to the Center Conflict of Interest Management Committee in obtaining the documentation required by Center Administrative Procedure AP-001, and documenting the COI Management Committee actions.

The QA Subelement Manager read the pertinent professional, trade, and programmatic publications and documentation that were circulated this period.

4.2.1.3 Task 3: Provide Input to 5-Year Plan No activity.

4.2.1.4 Task 4: Develop and Implement Center QA Program
During Period 11, implementation of the Center QA Manual continued and a QA audit was initiated on the remaining four active sections of the Center QA Manual and on specified Element project plan tasks. Center Technical Operating Procedures (TOPs) were generated and issued during the period dealing with Program Architecture work within the Center. Work was completed on Quality Assurance Procedure (QAP)-001 to describe the requirements for laboratory and scientific notebooks and the procedure will be utilized by the Center's technical personnel performing project plan tasks. QAP-001 was distributed under the Center's controlled document program.

4.2.1.5 Task 5: Develop External Program Information/
Audits

Preparation for this task continued in Period 11, as requested by the NRC, however due to postponements, only preparatory efforts were accomplished and no Center representative participated in DOE QAPP reviews or Audit Observation Team work during the period. At the direction of Mr. James Kennedy, the Center QA Department made preparations for additional reviews of Department of Energy Quality Assurance Program Plans and for Audit Observation Team participation. Center participation in NRC Audit Observation Teams will definitely be required during Periods 12 and 13 and planning for such work took place during Period 11.

4.2.2 Milestone Status and Significant Accomplishments This
Period

4.2.2.1 Task 1: Support Development and Maintenance of
Program Architecture

No specific milestones were scheduled. The Center QA Director has held meetings with the WSE&I personnel to monitor the development of TOP-001-02 and to be cognizant of the progress of the revision of this important Program Architecture document.

4.2.2.2 Task 2: Develop Technical and Analytical
Capabilities

There were an additional six persons cleared through the Center's COI Management Committee during this reporting period, including SwRI staff and consultants.

4.2.2.3 Task 3: Provide Input to 5-Year Plan
No activity.

4.2.2.4 Task 4: Develop and Implement Center QA Program
During Period 11, work continued on Technical Operating Procedures of the Center, noting changes for Revision 2 to the Center Quality Assurance Manual, and Quality Assurance Indoctrination and Training for Center staff members. QAP-001 was completed and controlled distribution was made. Technical Operating Procedures in the process of development will make reference to QAP-001 as applicable.

4.2.2.5 Task 5: Develop External Program Information/
Audits

Period 11 work included Quality Assurance preparation of NRC Audit Observation Team task work related to the HLW site characterization program. Mr. James Kennedy instituted a bi-weekly conference call involving the Center QA Department and key personnel of the NRC NMSS QA staff during this period. This teleconferencing allows participants to become advised and aware of important issues regarding the NRC HLW program and to become cognizant of schedule changes which heavily impact Center QA activities and commitments.

4.2.3 Problems
None.

4.2.4 Forecast for Next Period

4.2.4.1 Task 1: Support Development and Maintenance of Program Architecture

Quality Assurance at the Center will be focused on documenting the continuing development and maintenance of the Program Architecture. QA reviews being performed by the Program Architecture Review Committee will continue to be documented. The revised TOPs will be reviewed for QA implications and be approved when judged to be in compliance with QA requirements. New TOPs and QAPs will receive appropriate QA input before they are published by the Center. The quality control work of checking each product from the PARC will continue and personnel from the SwRI Quality Assurance Department will be utilized in that process if required.

4.2.4.2 Task 2: Develop Technical and Analytical Capabilities

Information and insights gained from the Center's representatives to the NRC Audit Observation Teams will be integrated into the day-to-day activities of the Center QA Director. Work will continue with the Center's Conflict of Interest Management Committee.

4.2.4.3 Task 3: Provide Input to 5-Year Plan

None planned.

4.2.4.4 Task 4: Develop and Implement Center QA Program

The Center will refine the Decision Support System which is detailed in the CQAM. The CQAM will be modified to reflect the "lessons learned" in the area of Program Architecture and other Center activities.

4.2.4.5 Task 5: Develop External Program Information/Audits

Close coordination will be maintained with Mr. Kennedy and his NRC personnel in preparation for additional work assignments of reviewing DOE Quality Assurance Program Plans and Audit Observation Team work. The Center will provide Quality Assurance reviews of the DOE QA Program Plans for those organizations identified by the NRC as they are received. NRC Audit Observation Team participation by Center representatives will take place in Periods 12 and 13.

4.3 Subelement Financial Status

Table 1, below, indicates the financial status of the Element/Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. The observed under-run results from delay in the DOE audit schedule. This situation is expected to be corrected as a result of higher work load in the coming periods. Any monies remaining at the end of FY89 are anticipated to be carried over to complete the planned work during FY90. No changes to budget or schedule are recommended at this time.

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$541,160	\$541,160	\$383,968	\$157,192	-0-	-0-

QA Subelement Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	25,670	26,218	42,027	50,965	62,239	54,268	50,644	53,229	24,825	23,809	27,686	27,973	457,204
ACTUAL PERIOD COST	12,249	26,219	29,578	15,800	17,060	23,858	23,334	23,737	32,387	19,015	19,543	16,915	383,969
VARIANCE, \$	13,421	(1)	12,449	35,165	45,179	30,410	27,310	29,492	(7,562)	4,794	8,143	11,058	73,235
VARIANCE, %	52.3	0.0	29.6	69.0	72.6	56.0	53.9	55.4	-30.5	20.1	29.4	39.5	16.0
ESTIMATED CUMULATIVE COST	186,164	212,382	254,409	305,374	367,613	421,881	299,682	352,911	377,736	401,545	429,231	457,204	
ACTUAL CUMULATIVE COST	136,523	162,742	192,320	208,120	225,180	249,038	272,372	296,109	328,496	347,511	367,054	383,969	
VARIANCE, \$	49,641	49,640	62,089	97,254	142,433	172,843	27,310	56,802	49,240	54,034	62,177	73,235	
VARIANCE, %	26.7	23.4	24.4	31.8	38.7	41.0	9.1	16.1	13.0	13.5	14.5	16.0	

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NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from the May 16, 1989,
Interim Spending Plan.

3. Cumulative variances include FY 1988 year to date
cost experience.

4. Period 1 actuals reflect MRC-approved adjustments of
management and technical support costs.

5. Totals reflect costs since inception of Contract.

5. GEOLOGIC SETTING

NRC Program Element Manager: David Brooks

NRC Project Officer for Task 1: John Trapp

NRC Project Officer for Tasks 2 and 4: Tin Mo

NRC Project Officer for Subtask 4.1: William Ford

NRC Project Officer for Task 3: Jeff Pohle

CNWR Element Manager: John L. Russell

Key Personnel: M. Board, A. Brown, R. Hart, M. Logsdon, L. Lorig,
J. Russell, W. Murphy, R. Pabalan, M. Miklas, R. Ababou

Subcontractors/consultants: Itasca, ABC, Inc.

5.1 Element Objectives

The objectives are to (1) support development of the Program Architecture for the NRC-HLW program, (2) develop and sustain the Center's technical and analytical capabilities in technical areas relevant to the geologic setting, (3) provide appropriate inputs to the Center 5-Year Plan, and (4) support ongoing investigations related to the geologic settings of potential repository sites and activities in the area of compliance determination.

5.2 Element Technical Status

Activities related to this Element were in: Task 1- development of the Program Architecture, Task 2- development of the Center's technical and analytical capabilities, Task 4- support to technical reports/positions and rulemaking activities, and Task 5- support of SCP review. Work on development of the Program Architecture (Task 1) was a major activity of the Geologic Setting Program Element. Activity in Task 2 included supporting Geologic Setting investigations by major efforts in recruitment and by development of laboratory facilities in Building 57 which will be used in technical work.

J. Russell, W. Murphy, R. Pabalan, R. Blake, and B. Everett of the Center staff, and M. Miklas of the SwRI staff performed work at the Center on the Geologic Setting Program Element during Period 11. M. Miklas primarily performed work on Tasks 1. B. Everett's work activities were in Tasks 1 and 2. W. Murphy and R. Pabalan conducted work for the Geologic Setting Program Element primarily in Tasks 1 and 2.

J. Russell performed work for the Research Program Element in support of recruitment of professional staff and management of Research projects. He also managed the Thermohydrology Research Project and Geochemistry Research Project and conducted certain technical activities for these projects. W. Murphy and R. Pabalan primarily worked on the Geochemistry Research Project. R. Ababou became familiar with the activities of the Center, particularly the activities in the Geologic Setting Program Element, and initiated development of a Research Project Plan for "Stochastic Analyses of Unsaturated Flow and Transport Through Fractured Rock for Large-Scale Hydrogeologic Systems." W. Murphy examined literature pertinent to the development of a Research Project Plan for "Geochemical Analog of Contaminant Transport in Unsaturated Rock."

5.2.1 Narrative Technical Progress This Period

5.2.1.1. Task 1: Support Development and Maintenance of Program Architecture

Work on development of the Program Architecture was primarily on the Regulatory Requirements designated "Adverse Condition--Geochemical Processes" and "Adverse Condition--Extreme Erosion" which were selected to be used as examples for input of required information onto DisplayWrite 4 (DW4) templates which were developed to correspond to the revised Technical Operating Procedure for Program Architecture development. Analyses of the Regulatory Requirements for the two examples and entry of data in DW4 format on Technical Operating Procedure-approved templates were performed during the Period. Work on the "Adverse Condition--Extreme Erosion" Regulatory Requirement included revision of the Regulatory Elements of Proofs, entry of data onto appropriate templates for the Technical Review Components, and continuation of work on defining the Compliance Determination Methods. Activities for the "Adverse Condition--Geochemical Processes" Regulatory Requirement included definition of Technical Review Components and Compliance Determination Methods. Work was accomplished on determination of the logic for 10 CFR Section 60.122(c) Regulatory Requirements. Mike Miklas reviewed newly-generated and revised portions of the Technical Operating Procedures for Program Architecture development.

The decision was made to develop Program Architecture input for the "Adverse Condition--Igneous Processes" Regulatory Requirement to support NRC immediate concern with the volcanic activity component of tectonic processes. Acceleration of the development of input for this Regulatory Requirement necessitates delaying development of additional input for the "Geochemical Processes" example.

M. Miklas, J. Erwin, B. Everett, W. Murphy, R. Pabalan, and J. Russell comprise the SwRI/Center Staff team which provided the Geologic Setting Program Element input into Program Architecture development throughout Period 11. Dr. Jimell Erwin, a Chemical Engineer on the SwRI staff, assisted in development of Program Architecture logic and data for the "Adverse Condition--Geochemical Processes" Regulatory Requirement. The Center's Washington Office staff conducted work as part of Geologic Setting Program Element activities during Period 11 on development of aspects of the Program Architecture assigned to the Geologic Setting Program. The Washington Office staff also participated in PARC review of materials developed by the Geologic Setting Program Element.

5.2.1.2 Task 2: Develop Technical and Analytical Capabilities

Identification and acquisition of literature (including maps and unpublished reports) related to ongoing investigations, technical issues, compliance assessment methodologies, and other information pertinent to the HLW program were conducted during the reporting period. Professional publications which are pertinent to the geologic setting aspect of HLW geologic repositories were ordered for the Center and logged into the Center's Technical Document Library.

The Center had established, as a high priority, the acquisition of a geologist/engineering geologist, tectonics/structural geologist, geophysicist, geomorphologist, radiochemist, two geochemists, geostatistician, QA specialist with a background in the earth sciences, two performance assessment specialists with backgrounds in geochemistry and/or hydrology, and a geohydrologist as full-time employees. These individuals will primarily be tasked to the GS, QA, Performance Assessment, WSE&I (Program Architecture development), and the Research Elements. John Russell reviewed resumes obtained from a large number of geoscientists who forwarded employment

inquiries to the Center. A large number of telephone calls was also made to solicit applications by appropriate individuals. Resumes and a computer listing of individuals registered in the Geological Society of America employment service were obtained by the Center. Excellent prospects for the Center's job openings were selected by review of the resumes and formal employment applications were solicited from the individuals. Additionally, announcements of employment opportunities were placed in regional newspapers and professional journals, including the American Association of Petroleum Geologists Explorer and Geotimes.

As a result of recruitment activities Dr. Rachid Ababou accepted employment at the Center and began work during Period 11. He received his PhD in hydrology from MIT where he worked with Dr. Gelhar. Dr. Ababou has been on a postdoctoral fellowship at Princeton University. Dr. Ronald Green will begin work at the Center during Period 12. He received a PhD in Hydrology from the University of Arizona in 1985 and has subsequently worked as a hydrogeologist in a private firm. Dr. Green has a MS in Geophysics from the University of Utah, and BS Degrees in Geology and in Industrial Engineering.

W. Murphy attended the International Geological Congress (IGC) in Washington, D.C. where he participated in a workshop which reviewed nuclear waste repository programs throughout the world. While at the IGC, Dr. Murphy advertised the Center's employment opportunities and conducted informal interviews of geoscientists interested in the job positions. W. Murphy also contacted individuals, particularly volcanologists, who may provide consulting services to the Center.

R. Pabalan participated in the NRC Hydrology-Geochemistry Field Trip to Yucca Mountain and vicinity on July 24-27. The field trip participants included individuals from the NRC Hydrologic Transport Section, U.S. Geological Survey, DOE, and Inyo County. A trip report is in preparation.

Installation of casework in the Center's laboratory facilities in Building 57 was completed, and laboratory equipment and supplies have been moved into the facilities. The facilities are adequate to support laboratory experimentation and analyses which will occur in technical assistance activities for NRC. Laboratory experimentation activities for the Geochemistry and Thermohydrology Research Projects were conducted in Building 57 during the Period.

The Center's Washington Office represented the Center at the Yucca Mountain Site Team weekly meetings at Rockville. Attendance and reporting of activities at these meetings, handled by staff from our Washington Office, were conducted as Geologic Setting Program Element activities.

5.2.1.3 Task 3: Support Development of Center 5-Year Plan
No work was performed in this area.

5.2.1.4 Task 4: Support to Technical Reports/Positions
and Rulemaking Activities

J. Russell arranged with Robert Wright, Itasca, and ABC, Inc., the availability of technical support for the Center's activities for development of the Natural Resources Technical Position. References pertinent to DOE's approach to Natural Resources Assessment at Yucca Mountain were determined by examination of the SCP. J. Russell determined the status of U.S. Geological Survey Open-File Report 88-373, satisfying a deliverable of technical direction to the Center to provide technical assistance to NRC supporting development of the Natural Resources Technical Position.

5.2.1.5 Task 5: Review SCP and SCP Modifications
No activity occurred for Task 5 in Period 11.

5.2.2 Milestone Status and Significant Accomplishments This Period

5.2.2.1 Task 1: Support Development and Maintenance of Program Architecture

Significant development of Program Architect input for the 10 CFR Section 60.122 "Adverse Conditions--Geochemical Processes, Sorption" and "Extreme Erosion" was accomplished.

5.2.2.2 Task 2: Develop Technical and Analytical Capabilities

The Center's experimental facilities in Building 57 were fully equipped with laboratory casework. Dr. Rachid Ababou, a geohydrologist with excellent technical qualifications and pertinent professional experience, began employment at the Center. Dr. Ronald Green, also a geohydrologist with excellent technical qualifications and pertinent professional experience, will begin employment at the Center during Period 12.

5.2.2.3 Task 3: Support Development of Center 5-Year Plan
No milestones were scheduled.

5.2.2.4 Task 4: Support to Technical Reports/Positions and Rulemaking Activities

J. Russell determined the status of U.S. Geological Survey Open-File Report 88-373, satisfying a deliverable of technical direction to the Center to provide technical assistance to NRC supporting development of the Natural Resources Technical Position.

5.2.2.5 Task 5: Review SCP and SCP Modifications
None.

5.2.3 Problems
None.

5.2.4 Forecast for Next Period

5.2.4.1 Task 1: Support Development and Maintenance of Program Architecture

Program Architecture modification, development and maintenance will be conducted with appropriate consideration of guidance from the WSE&I Subelement and the NRC. Program Architecture development will consist of continuation of analyses and input of data for "Adverse Condition--Igneous Processes" and "Adverse Condition--Erosion."

5.2.4.2 Task 2: Develop Technical and Analytical Capabilities

A major activity for Task 2 during Period 12 of Year 2 will include continuation of recruitment of highly qualified Center staff with the specializations noted in Section 5.2.1.2. It is anticipated that the best candidates for these positions will be brought to the Center on recruiting/interview trips in the next Period.

5.2.4.3 Task 3: Support Development of Center 5-Year Plan
No activity presently planned for Period 12.

5.2.4.4 Task 4: Support to Technical Reports/Positions and Rulemaking Activities

It is anticipated that a major activity of Period 12 will be assisting in developing the technical and regulatory bases for the NRC's proposed Natural Resources Technical Position.

5.2.4.4 Task 5: Review SCP and SCP Modifications

It is anticipated that Geologic Setting Program Element activities associated with supporting NRC's review of the SCP will continue in Period 12, upon request by NRC. The SCP review activities may include involvement at technical meetings between the NRC and DOE where the NRC's technical review of the SCP is discussed.

5.3 Element Financial Status

Table 1, below, indicates the financial status of the Element/Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. These data do not include commitments in the amount of \$76,272. Taking into account these commitments, Element costs are on-target for the remainder of the year (currently about \$30,000 above planned). No changes to budget or schedule are recommended at this time.

Total	Funds			Adjustment	
Negotiated	Allotted			to Complete	Revised
Subelement	by NRC	Funds	Funds	Subelement	Subelement
<u>Ceiling</u>	<u>to date</u>	<u>Costed</u>	<u>Uncosted</u>	<u>(+ or -)</u>	<u>Ceiling</u>
\$1,459,903	\$1,459,903	\$1,071,803	\$388,100	-0-	-0-

GS Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	31,435	70,910	56,930	66,382	124,335	124,825	115,991	63,922	62,660	61,931	58,633	58,265	1,119,219
ACTUAL PERIOD COST	73,081	70,910	68,214	69,555	59,949	58,979	84,144	69,083	31,968	75,014	51,136	62,641	1,071,803
VARIANCE, \$	(41,646)	0	(11,284)	(3,173)	64,386	65,846	31,847	(5,161)	30,692	(13,083)	7,497	(4,376)	47,416
VARIANCE, %	-132.5	0.0	-19.8	-4.8	51.8	52.8	27.5	-8.1	49.0	-21.1	12.8	-7.5	4.2
ESTIMATED CUMULATIVE COST	475,315	546,225	603,155	669,537	793,872	918,697	813,808	877,730	940,390	1,002,321	1,060,954	1,119,219	
ACTUAL CUMULATIVE COST	385,482	456,392	524,606	578,889	638,838	697,817	781,961	851,044	883,012	958,026	1,009,162	1,071,803	
VARIANCE, \$	89,833	89,833	78,549	90,648	155,034	220,880	31,847	26,686	57,378	44,295	51,792	47,416	
VARIANCE, %	18.9	16.4	13.0	13.5	19.5	24.0	3.9	3.0	6.1	4.4	4.9	4.2	

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NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from the May 16, 1989, Interim Spending Plan.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

6. ENGINEERED BARRIER SYSTEM

NRC Program Element Manager: Jerome R. Pearring

NRC Project Officer for Tasks 1-4: Kien C. Chang

CNWSA Element Manager: Prasad K. Nair

Key Personnel: R. Adler, B. Brady, H Manaktala, P. Nair, W. Patrick,
A. Whiting, Y. Wu

Subcontractors/Consultants: Systems Support, Inc.

6.1 Element Objectives

Objectives pursued in FY1989 are to (1) support development of the Program Architecture for the NRC-HLW program, (2) develop and sustain the Center's technical and analytical capabilities in technical areas relevant to engineered barriers, (3) provide appropriate inputs to the Center 5-Year Plan, (4) develop technical reviews of technical documents related to the EBS, (5) conduct technical review of DOE's Site Characterization Plan and associated documents, and (6) develop methodologies for evaluating DOE compliance with regulatory requirements in the area of engineered barriers.

6.2 Element Technical Status

During this reporting period, efforts included the selection and review of literature in the area of materials for the EBS, and the conduct of PARC reviews of the various regulatory analysis packages assigned by the WSE&I subelement. EBS Operations Plan guidance for FY 90-91 were reviewed with the NRC staff and scoping work was initiated.

6.2.1 Narrative Technical Progress This Period

6.2.1.1 Task 1: Support Development and Maintenance of Program Architecture

Three regulatory requirements (E-3, E-4, & E-5) associated with the engineered barrier system and its performance have been developed, and the status of each is given below.

E-3 -- No activity this period

E-4 -- This RR is being revised to conform with the new forms and process diagram. This effort is in support of the identified Uncertainty in the regulation on "Substantially Complete Containment." This is also the subject of an ongoing rulemaking effort. The Program Architecture process steps undertaken for E-4 are 1, 2, 4b, 10, 15a, 13-22. Process steps 1, 2, 4b, and 10 have been completed. Uncertainty Reduction Methods by DOE and NRC on "Substantially Complete Containment" have been identified and documented.

E-5 -- No activity this period.

Program Architecture Review (PARC) actions were undertaken this Period. A complete list of regulatory requirements for which the packages of forms are available and the status of PARC review are provided in the Attachment to this Chapter.

6.2.1.2 Task 2: Develop Technical and Analytical Capabilities

Literature review of waste package materials

continued this period. The paper to be presented on the FPPA methodology at the FOCUS 89 meeting to be held in Las Vegas in September 18-21, 1989 is under preparation.

P. Nair participated in a program review of NMSS supported projects at the National Institute of Standards and Technology, Gaithersburg on July 20, 1989. A trip report is under preparation.

6.2.1.3 Task 3: Provide Input to the Center 5-Year Plan
No work performed this period.

6.2.1.4 Task 4: Develop Technical Reviews

A meeting on "Proposed Rulemaking Related to Substantially Complete Containment" were held on July 13-14, 1989 at the NRC White Flint Offices. The purposes of this meeting were to discuss the scope of the Uncertainty Evaluation Report and discuss/define support activities for Prof. Andre Journel, a consultant to the project. The technical background needed for the interpretation of the Regulatory Requirement of "Substantially Complete Containment" in 10 CFR Section 60.113 was discussed. Prof. Journel presented a briefing on geostatistical techniques using spatial correlation methods. A detailed meeting report was prepared and submitted to the NRC.

6.2.1.5 Task 5: Technical Review of DOE SCP Documents
No activities this period.

6.2.1.6 Task 6: Develop Compliance Assessment Methodology

A meeting was held on July 12 between Y. Wu and G. Fuller of SSI to discuss the criteria in selecting a thermal analysis code and several test cases. It was agreed that the selected thermal analysis code should cover the entire spectrum of analysis capabilities required for tuff environment; the number of test cases need not be large but should cover all significant parameters.

An Engineered Barrier System Performance Assessment Code (EBSPAC) code structure has been established. In this structure, the EBSPAC code has a driver to allow for the interactions between the FPPA code, the process modules (thermal, corrosion, .. etc.), and a data base. A review was initiated to identify the various parameters in modelling thermal conditions and assessing strategies for representing the associated uncertainties. Progress was made in the compliance determination code development area by running test examples.

6.2.2 Milestone Status and Significant Accomplishments This Period

6.2.2.1 Task 1: Support Development and Maintenance of Program Architecture

Several Regulatory Requirements were assigned to the EBS Element for PARC review. EBS staff has updated PARC reviews of several of these Regulatory Requirements that were earlier considered by the PARC committee as requiring revisions (see attachment). Detailed revision of Regulatory Requirement E-4 continued this period.

6.2.2.2 Task 2: Develop Technical and Analytical Capabilities

The technical paper on the FPPA methodology is under preparation for the FOCUS 89 meeting.

6.2.2.3 Task 3: Provide Input to the Center 5-year Plan
None planned.

6.2.2.4 Task 4: Develop Technical Reviews

Work on the "Substantially Complete Containment" activity continued. A Task 4.2 review meeting was held at the NRC offices.

6.2.2.5 Task 5: Technical Review of DOE SCP Documents
None planned.

6.2.2.6 Task 6: Develop Compliance Assessment Methodology
Activities in modelling, debugging and code structure developments continued this reporting period.

6.2.3 Problems
None.

6.2.4 Forecast for Next Period
Significant effort will be directed toward preparing the FY 90-91 Operations plan for this Program Element.

6.2.4.1 Task 1: Support Development and Maintenance of Program Architecture
Participation in PARC reviews of Regulatory Requirements assigned to the EBS Element by the WSE&I Subelement will continue. Development of E-4 based on the revised Program Architecture procedures and support of the analyses to carry the "Substantially Complete Containment" assessment through the twenty-two process steps will continue.

6.2.4.2 Task 2: Develop Technical and Analytical Capabilities
Continue review of literature and information on materials-related programs.

6.2.4.3 Task 3: Provide Input to the Center 5-Year Plan
None.

6.2.4.4 Task 4: Develop Technical Reviews
Continue the approved work for the feasibility study for resolution of the uncertainty associated with "Substantially Complete Containment."

6.2.4.5 Task 5: Technical Review of DOE SCP Documents
Continue to provide support to the NRC on the review of the SCP, as requested.

6.2.4.6 Task 6: Develop Compliance Assessment
Develop a detailed plan for the EBSPAC compliance methodology for FY 90-91.

6.3 Element Financial Status

Table 1, below, indicates the financial status of the Element/Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. These data do not include commitments in the amount of \$90,665. Spending is on target (approximately \$50,000 greater than planned) for the established budgets. No changes to budget or schedule are recommended at this time.

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$1,405,466	\$1,405,466	\$1,022,033	\$383,433	-0-	-0-

ATTACHMENT
ENGINEERED BARRIER SYSTEM

<u>I.D.</u>	<u>Date</u>	<u>PARC Status</u>
E-1		NO ACTIVITY IN THIS PERIOD
E-2		NO ACTIVITY IN THIS PERIOD
E-8		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME
E-34		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME
E-38	3/14/89	PARC and Returned to Analyst for Revision; (Element Manager--J. Hageman, Analysts--V. Muller, H. Kwun, and J. Hageman, PARC members--P. Nair, R. Wilbur, E. Tschoepe, and S. Spector)
	6/14/89	PARC'd
	7/21/89	Returned to PARC Committee for Review.
E-39		NO ACTIVITY THIS PERIOD-IN MAINFRAME.
E-40	7/21/89	PARCed and Returned to Element Manager.
E-41		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.
E-42		NO ACTIVITY THIS PERIOD-IN MAINFRAME.
E-43		NO ACTIVITY THIS PERIOD-IN MAINFRAME.
E-44		NO ACTIVITY IN THIS PERIOD.
E-45	3/1/89	Received Package for PARC.
	3/17/89	Pre-PARC Review by E.Tschoepe & R.L. Wilbur (Element Manager--John Hageman, Analysts--T. Brandshaug (Itasca). & J. P. Hageman, Tentative PARC members--P. K. Nair, R. L. Wilbur, E. Tschoepe, & S. Spector or N. K. Brown)
	6/7/89	PARC & Returned to Analyst for Revision.
	7/5/89	Final PARC and sent to QA.
	7/28/89	PARCed and in Mainframe.
E-47		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.
E-45		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.
E-47		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.
E-48		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.
E-49		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.
E-51a		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.
E-52		NO ACTIVITY IN THIS PERIOD-IN MAINFRAME.

EBS Element Status Cost Report, Year 2

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ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	51,006	79,232	55,908	42,707	54,609	59,241	54,087	55,036	58,151	49,916	51,395	39,787	1,062,659
ACTUAL PERIOD COST	73,085	79,231	81,711	46,010	111,552	54,068	55,682	32,619	36,414	51,104	48,625	43,302	1,022,033
VARIANCE, \$	(22,079)	1	(25,803)	(3,303)	(56,943)	5,173	(1,595)	22,417	21,737	(1,188)	2,770	(3,515)	40,626
VARIANCE, %	-43.3	0.0	-46.2	-7.7	-104.3	8.7	-2.9	40.7	37.4	-2.4	5.4	-8.8	3.8
ESTIMATED CUMULATIVE COST	496,276	575,508	631,416	674,123	728,732	787,973	808,374	863,410	921,561	971,477	1,022,872	1,062,659	
ACTUAL CUMULATIVE COST	394,885	474,116	555,827	588,667	700,219	754,287	809,969	842,588	879,002	930,106	978,731	1,022,033	
VARIANCE, \$	101,391	101,392	75,589	85,456	28,513	33,686	(1,595)	20,822	42,559	41,371	44,141	40,626	
VARIANCE, %	20.4	17.6	12.0	12.7	3.9	4.3	-0.2	2.4	4.6	4.3	4.3	3.8	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from the May 16, 1989, Interim Spending Plan.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

7. TRANSPORTATION RISK STUDY

NRC Program Element Manager: John Cook

NRC Program Subelement Manager: Russell R. Rentschler

CNWRA Subelement Manager: John P. Hageman

Key Personnel: R. Weiner (P.I.), P. LaPlante, E. Oelkers (SwRI),
J. Buckingham (SwRI)

Subcontractor/consultant: None identified

7.1 Subelement Objectives

The overall objectives of the Transportation Risk Study (TRS) are to (1) update the currently available information on the subject, (2) provide a supplement to and update of NUREG-0170, which will cover the transportation of all radioactive materials by all transportation modes, (3) review and assess the available computational methodologies related to probabilistic risk assessment, (4) assess the risk of transporting radioactive materials, and (5) provide a Final Report which will project the acquired data and transportation statistics through the year 2005. The current emphasis of the study is to collect and implement information as set forth by the Operation Plan.

7.2 Subelement Technical Status

7.2.1 Narrative Technical Progress During This Period

7.2.1.1 Task 1: Completion of Overview and Scoping

It has been requested that appropriate revisions to the TRS Operations Plan be due at the same time as the FY90/91 Center Operations Plan. A delay in the submission date until January 1990 for the FY90/91 TRS Operations Plan has been requested, since the FY90 Operations Plan is to remain essentially unchanged and time is needed for the NRC and the Center to better formulate the scope of work for FY91 and FY92. NRC and Center-internal review comments have been incorporated into the draft of Chapter 1 and Appendix A text. The revised text and responses to comments were submitted to NRC. R. Weiner continues to serve as a Program Committee Member for Transportation and Risk Assessment for the International High-Level Radioactive Waste Management Conference to be held in Las Vegas, NV, April 8-12, 1990. The information and resources regarding transportation in the Center Library continues to be augmented and updated on a regular basis.

7.2.1.2 Task 2: Evaluation and Assessment of Data, Models, and Codes - Recommendations and Uncertainty and Sensitivity Analysis

7.2.1.2.1 Subtask 2.1: Evaluation of Data and Databases

R. Weiner, F. Bennett and E. Oelkers are finalizing the tabular format for Appendix A and tables from SAND84-7174 ("Transportation of Radioactive Materials in the United States" April, 1985, Sandia National Laboratory). About 5% of the SAND84-7174 raw data appears to be unusable because of data entry errors. Evaluation of the DOE integrated data base (IDB), the DOE shipment mobility/accountability collection (SMAC), and SMAC as it was used as a source for SAND84-7174 is continuing. J. Buckingham has recalculated the shipment, package and curie totals to incorporate more significant figures (i.e. greater precision), and the revised numbers are being used to generate both tables for the TRS and a database for input to RADTRAN. Comparison of 1982 data with 1982 projections (which were

interpolated from the 1975 to 1985 projections contained in NUREG-0170) indicates that the projections were well above the data.

Recommendations for using the existing radioactive materials transportation databases in the TRS are being formulated. Further literature has been obtained on radioactive materials transportation associated with medical uses, and computer codes are continuing to be documented.

P. LaPlante, F. Bennett and R. Weiner have made about twenty RADTRAN runs, both to familiarize the Center with the operation of RADTRAN via TRANSNET and to obtain some preliminary risk assessments. They are continuing formulation of scenarios for RADTRAN runs. An inherent problem in RADTRAN in the calculation of accident dose may have been discovered and will be further evaluated next period. J. Buckingham is now able to communicate electronically with the group via PROFS.

7.2.1.2.2 Subtask 2.2: Evaluation of Models and Codes

E. Oelkers has completed a rough draft of the comparative evaluation of transportation models and codes. R. Weiner is in the process of editing this comparison for a presentation and publication.

7.2.1.2.3 Subtask 2.3: Uncertainty and Sensitivity Analysis

Evaluation of RADTRAN with several verification exercises has been initiated.

7.2.1.3 Task 3: Analysis of Regulations Governing Radioactive Materials Transportation

R. Weiner and P. LaPlante completed the preliminary draft of Chapter 2 of the TRS (the analysis of transportation regulations). The draft underwent initial Subelement Manager review and comments have been incorporated. The draft has been submitted to NRC for comment.

7.2.1.4 Task 4: Discussion and Analysis of Transportation Alternatives

Scoping and organization of Chapter 6 of the TRS has been initiated.

7.2.1.5 Task 5: Analyses of Radiological Effects of Radioactive Materials Transportation

7.2.1.5.1 Subtask 5.1: Radiological Effects and Risk Analysis of Normal Transportation

R. Weiner continues the overview of preparation of the "Radiological Effects" section of the TRS (Chapter 3).

7.2.1.5.2 Subtask 5.2: Radiological Effects and Risk Analysis of Transportation Accidents

No action this period.

7.2.1.5.3 Subtask 5.3: Security and Safeguards Considerations

Review of regulations on transportation of "Special Nuclear Material" has begun.

7.2.1.5.4 Subtask 5.4: Radiation Dose and Risk Analysis

Construction of scenarios for representative shipments continues (see preceding discussion of RADTRAN).

7.2.1.6 Task 6: Analysis of Non-Radiological Impacts of Radioactive Materials Transportation, and Consideration of Human Factors.
No action to date. Consideration of Human Factors is unfunded.

7.2.2 Milestone Status and Significant Accomplishments This Period

7.2.2.1 Task 1: Completion of Overview and Scoping
NRC comments on the Final Draft of Sections 1.1, 1.2, and 1.3 were incorporated and the resulting draft was submitted to NRC.

7.2.2.2 Task 2: Evaluation and Assessment of Data, Models, and Codes - Recommendations and Uncertainty and Sensitivity Analysis

7.2.2.2.1 Subtask 2.1: Evaluation of Data and Databases
No milestones scheduled.

7.2.2.2.2 Subtask 2.2: Evaluation of Models and Codes
No milestones scheduled.

7.2.2.2.3 Subtask 2.3: Uncertainty and Sensitivity Analysis
No milestones scheduled.

7.2.2.3 Task 3: Analysis of Regulations Governing Radioactive Materials Transportation
Draft of Chapter 2 was submitted to NRC.

7.2.2.4 Task 4: Discussion and Analysis of Transportation Alternatives
No milestones scheduled.

7.2.2.5 Task 5: Analysis of Radiological Effects of Radioactive Materials Transportation
No milestones scheduled.

7.2.2.5.1 Subtask 5.1: Radiological Effects and Risk Analysis of Normal Transportation
No milestones scheduled.

7.2.2.5.2 Subtask 5.2: Radiological Effects and Risk Analysis of Transportation Accidents
No milestones scheduled.

7.2.2.5.3 Subtask 5.3: Security and Safeguards Considerations
No milestones scheduled.

7.2.2.5.4 Subtask 5.4: Radiation Dose and Risk Analysis
No milestones scheduled.

7.2.2.6 Task 6: Analysis of Non-Radiological Impacts of Radioactive Materials Transportation, and Consideration of Human Factors.
No milestones scheduled.

7.2.3 Problems
None.

7.2.4 Forecast for next period.

7.2.4.1 Task 1: Completion of Overview and Scoping
Work on Sections 1.4 through 1.6 will continue and Section 1.6.1 will be completed.

7.2.4.2 Task 2: Evaluation and Assessment of Data, Models, and Codes - Recommendations and Uncertainty and Sensitivity Analysis

7.2.4.2.1 Subtask 2.1: Evaluation of Data and Databases

Data tables for Appendix A will be submitted during the forthcoming period. An informal presentation on the database and code evaluation and current status of the risk assessment is planned for the next period. Plans for using existing databases and documentation of computer codes will be completed during Period 12.

7.2.4.2.2 Subtask 2.2: Evaluation of Models and Codes

R. Weiner and J. Buckingham will continue RADTRAN access through TRANSNET during the coming periods. Development of the recommended plan for using the existing RAM transportation databases in the TRS documentation of computer codes and models suitable for the transportation risk analysis will continue. The intermediate milestone for the preliminary evaluation of the codes and models (Milestone 3) will be delayed until Period 12 and a report on the risk assessment status will also be included.

7.2.4.2.3 Subtask 2.3: Uncertainty and Sensitivity Analysis

J. Buckingham will continue the sensitivity analysis during the coming periods. R. Weiner and P. LaPlante will continue the RADTRAN analysis of representative shipments.

7.2.4.3 Task 3: Analysis of Regulations Governing Radioactive Materials Transportation

No activity scheduled until comments are received from NRC.

7.2.4.4 Task 4: Discussion and Analysis of Transportation Alternatives

No actions planned.

7.2.4.5 Task 5: Analysis of Radiological Effects of Radioactive Materials Transportation

7.2.4.5.1 Subtask 5.1: Radiological Effects and Risk Analysis of Normal Transportation

R. Weiner will continue to write the overview of Radiological Effects.

7.2.4.5.2 Subtask 5.2: Radiological Effects and Risk Analysis of Transportation Accidents

No actions planned.

7.2.4.5.3 Subtask 5.3: Security and Safeguards Considerations

The regulatory aspects of Security and Safeguards of the TRS will be reviewed in the upcoming periods.

7.2.4.5.4 Subtask 5.4: Radiation Dose and Risk Analysis

No actions planned.

7.2.4.6 Task 6: Analysis of Non-Radiological Impacts of Radioactive Materials Transportation, and Consideration of Human Factors

Work on Non-Radiological Impacts of transporting radioactive material will begin during the next period.

7.3 Subelement Financial Status

Table 1, below, indicates the financial status of the Element/Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both dollar and percentage bases. These data do not include commitments in the amount of \$300. Budgets are on target. No changes to budget or schedule are recommended at this time.

Total Negotiated Subelement <u>Ceiling</u>	Funds Allotted by NRC <u>to date</u>	Funds <u>Costed</u>	Funds <u>Uncosted</u>	Adjustment to Complete Subelement <u>(+ or -)</u>	Revised Subelement <u>Ceiling</u>
\$474,438	\$474,438	\$353,866	\$120,572	-0-	-0-

TRS Subelement Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	15,925	6,587	20,865	12,648	14,974	19,808	21,741	19,836	21,987	22,467	25,701	28,953	378,716
ACTUAL PERIOD COST	17,695	10,597	19,931	16,988	8,856	16,238	23,497	29,086	17,313	10,598	16,279	23,173	353,866
VARIANCE, \$	(1,770)	(4,010)	934	(4,340)	6,118	3,570	(1,756)	(9,250)	4,674	11,869	9,422	5,780	24,850
VARIANCE, %	-11.1	-60.9	4.5	-34.3	40.9	18.0	-8.1	-46.6	21.3	52.8	36.7	20.0	6.6
ESTIMATED CUMULATIVE COST	163,149	169,736	190,601	203,249	218,223	238,031	259,772	279,608	301,595	324,062	349,763	378,716	
ACTUAL CUMULATIVE COST	161,310	171,907	191,838	208,826	217,682	233,920	257,417	286,503	303,816	314,414	330,693	353,866	
VARIANCE, \$	1,839	(2,171)	(1,237)	(5,577)	541	4,111	2,355	(6,895)	(2,221)	9,648	19,070	24,850	
VARIANCE, %	1.1	-1.3	-0.6	-2.7	0.2	1.7	0.9	-2.5	-0.7	3.0	5.5	6.6	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from the Year 2 Project Plan submitted on 04/04/89 (Revision 1).

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

8. SPECIAL PROJECTS AND ANALYTICAL EVALUATIONS, INCLUDING TRANSPORTATION

NRC Program Element Manager: Mark S. Delligatti

NRC Program Subelement Manager: Mark S. Delligatti

CNWRA Subelement Manager: John P. Hageman

Key Personnel: R. Adler, J. Hageman, S. Spector, R. Weiner,
P. LaPlante, A. Greenberg (Consultant)

Subcontractors/Consultants: None identified.

8.1 Subelement Objectives

The FY 1989 objectives are to (1) support development of the Program Architecture for the NRC-HLW program, (2) develop and sustain the Center's technical and analytical capabilities in technical areas relevant to special study areas that will include legal, socioeconomic, institutional, environmental, and policy analyses, (3) develop Strategic Plan inputs and the Center 5-Year Plan based on the NRC-HLW Program Architecture and inputs from the other Elements/Subelements of the Center program, (4) monitor and assess the potential impacts of nuclear related Federal legislation and other relevant national technical/policy developments, and (5) provide policy options to streamline the HLW repository licensing process. Concentration on these objectives has continued in accordance with priorities indicated by the NRC.

8.2 Subelement Technical Status

The Subelement activities have been distributed over the five tasks as detailed in the following paragraphs.

8.2.1 Narrative Technical Progress This Period

8.2.1.1. Task 1: Support Development of Program Architecture

S. Spector participated in PARC review of RR-52 (B-3). Development of other RRs is continuing.

8.2.1.2 Task 2: Develop and Sustain Technical and Analytical Capability

R. Adler, S. Spector, R. Weiner and J. Hageman held discussions with the NRC Program Element Manager and reviewed various drafts of components of the FY90/91 Operations Plan. S. Spector, R. Weiner and J. Hageman worked on documentation for the Draft Environmental Impact Statement (DEIS) Review Plan and LARP tasks. P. LaPlante installed modems and configured PS/2s to use software. R. Weiner attended a planning meeting (July 14) for HLW International Conference.

8.2.1.3 Task 3: Develop 5-Year Center Plan and Strategic Plan

A briefing on Strategic Programmatic Issues was held July, 18, 1989. The written report had previously been delivered, and NRC comments will be provided to the Center in writing.

8.2.1.4 Task 4: Monitor Nuclear Waste Related Federal Legislation and Assess Impact on Regulatory Policy

One Pertinent Information Summary was prepared and distributed internally on July 12, 1989. A review of the Federal Registers was made. Updates to regulation changes were provided to staff.

8.2.1.5 Task 5: Provide Policy Options to Streamline the Licensing Process
J. Hageman and R. Weiner met with NRC personnel several times regarding the Format & Content Guide (F&CG). She also met with A. Greenberg to work on a "crosswalk" between 10 CFR 60.21 and 10 CFR 60 Subpart E.

8.2.2 Milestone Status and Significant Accomplishments this Period

8.2.2.1 Task 1: Support Development of Program Architecture
None this period.

8.2.2.2 Task 2: Develop and Sustain Technical and Analytical Capability
Washington Office computers now have modem capability as both backup to the SwRI mainframe, and for access to other systems.

8.2.2.3 Task 3: Develop 5-Year Center Plan and Strategic Plan
A briefing on Strategic Issues by A. Greenberg and R. Adler held July 8.

8.2.2.4 Task 4: Monitor Nuclear Waste Related Federal Regulations
One Pertinent Information Summary was issued.

8.2.2.5 Task 5: Provide Policy Options to Streamline the Licensing Process
Required Center input to the Format and Content Guide was provided to NRC July 28, 1989.

8.2.3 Problems

A number of problems relating to the structure of an NRC/CNWRA team arose during work on the Format and Content Guide outline. These have served as a learning experience and are anticipated to result in an improved structure for future teaming efforts, such as the License Application Review Plan Task.

8.2.4 Forecast for Next Period

8.2.4.1 Task 1: Support Development of Program Architecture
Continue Program Architecture and PARC activities.

8.2.4.2 Task 2: Develop and Sustain Technical and Analytical Capability
Complete FY90/91 Operations Plan.

8.2.4.3 Task 3: Develop 5-Year Center Plan and Strategic Plan
Continued development of criteria for use in conducting analyses of strategic programmatic risks.

8.2.4.4 Task 4: Monitor Nuclear Waste Related Federal Regulations
A briefing on the unapproved Environmental/Socioeconomic task will take place August 9, 1989.

8.2.4.5 Task 5: Provide Policy Options to Streamline the Licensing Process
Complete regulatory "crosswalk" for Format and Content Guide.

8.3 Subelement Financial Status

Table 1, below, indicates the financial status of the Element/

Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2 displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. These data do not include commitments in the amount of \$2,710. The observed variances result primarily from tasking the staff to Program Architecture development activities outside of this Subelement. The variance is expected to decrease over the next several periods as specific task assignments such as the FCRG development are undertaken. No changes to budget or schedule are recommended at this time.

Total	Funds			Adjustment	
Negotiated	Allotted			to Complete	Revised
Subelement	by NRC	Funds	Funds	Subelement	Subelement
<u>Ceiling</u>	<u>to date</u>	<u>Costed</u>	<u>Uncosted</u>	<u>(+ or -)</u>	<u>Ceiling</u>
\$1,499,841	\$1,499,841	\$1,210,645	\$289,196	-0-	-0-

ATTACHMENT
SPECIAL PROJECTS AND ANALYTICAL EVALUATIONS, INCLUDING TRANSPORTATION

<u>I.D.</u>	<u>PARC Date</u>	<u>Status</u>
B-1	6/15/89	Final PARC: PARC members --P.K. Nair, R.L. Wilbur, E. Tschoepe & S. Spector. 6/29/89 Input to Mainframe.
B-2	12/20/88	RR was Input to Mainframe.
B-3	8/09/89	Redone and Resubmitted to PARC.
B-4	6/29/89	PARCed and in Mainframe.
B-5	6/22/89	Final PARC and sent to QA. PARC members --P. K. Nair, R. L. Wilbur, E. Tschoepe & S. Spector. 6/22/89 In Mainframe.
B-6	7/19/89	PARCed and sent to QA and placed in Mainframe.
E-7		NO ACTIVITY IN THIS PERIOD.
E-8	4/01/89	PARCed and Placed in Mainframe.
B-7		Combined with B7, B8, B9, B10, B11 to make new Regulatory Requirement.
B-8		Combined with B7, B8, B9, B10, B11 to make new Regulatory Requirement.
B-9		Combined with B7, B8, B9, B10, B11 to make new Regulatory Requirement.
B-10		Combined with B7, B8, B9, B10, B11 to make new Regulatory Requirement.
B-11		Combined with B7, B8, B9, B10, B11 to make new Regulatory Requirement.
B-13		STET.
B-14	7/11/89	PARCed and sent to QA placed in Mainframe.
B-15	7/11/89	PARCed and sent to QA placed in Mainframe.
B-17	7/18/89	PARCed and sent to QA placed in Mainframe.
B-18	8/10/89	Sent to PARC.
B-19	8/03/89	Sent to PARC and on to QA.
B-20	8/11/89	Sent to Pre-PARC.
B-21	6/19/89	PARCed and sent to QA and placed in Mainframe.
B-22		Under Revision.
B-23	8/08/89	Submitted for Pre-PARC.

SPAE/T Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	40,598	16,604	60,952	74,753	87,791	89,195	91,019	91,350	123,485	123,557	125,662	128,671	1,372,381
ACTUAL PERIOD COST	28,385	16,603	13,272	43,145	35,813	60,244	70,073	80,300	101,403	110,097	80,486	79,649	1,210,645
VARIANCE, \$	12,213	1	47,680	31,608	51,978	28,951	20,946	11,050	22,082	13,460	45,176	49,022	161,736
VARIANCE, %	30.1	0.0	78.2	42.3	59.2	32.5	23.0	12.1	17.9	10.9	36.0	38.1	11.8
ESTIMATED CUMULATIVE COST	512,600	529,204	590,156	664,909	752,700	841,895	779,656	871,006	994,491	1,118,048	1,243,710	1,372,381	
ACTUAL CUMULATIVE COST	507,644	524,247	537,519	592,580	628,393	688,637	758,710	839,010	940,413	1,050,510	1,130,996	1,210,645	
VARIANCE, \$	4,956	4,957	52,637	72,329	124,307	153,258	20,946	31,996	54,078	67,538	112,714	161,736	
VARIANCE, %	1.0	0.9	8.9	10.9	16.5	18.2	2.7	3.7	5.4	6.0	9.1	11.8	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from the May 16, 1989, Interim Spending Plan.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

9. REPOSITORY DESIGN, CONSTRUCTION, AND OPERATIONS

NRC Program Element Manager: Jerome R. Pearring

NRC Project Officer for Tasks 1-4: John Buckley

CNWRA Element Manager: Asadul H. Chowdhury

Key Personnel: A. Chowdhury, S. Hsiung, L. Lorig, T. Brandshaug,
J. Daemen

Subcontractors/consultants: Itasca

9.1 Element Objectives

The objectives pursued in FY1989 are to (1) support development of the Program Architecture for the NRC-HLW program, (2) develop and sustain the Center's technical and analytical capabilities in technical areas relevant to the design, construction, and operations of both surface and underground facilities that are associated with a high-level nuclear waste repository, (3) provide appropriate inputs to planning activities and to the Center 5-Year Plan, (4) support the NRC in evaluating the DOE demonstration of compliance with regulatory requirements in the area of repository design, construction, and operations, and (5) perform a technical review of selected sections of DOE's Site Characterization Plan and associated documents.

9.2 Element Technical Status

Activities related to this Element for this period are predominantly in: Task 1- support development of the Program Architecture, Task 2 - development of the Center's technical and analytical capabilities, Task 4 - develop compliance assessment methodology, and the preparation of the draft Operations Plan for FY90 and FY91 relevant to the RDCO Element. This Element also provided input for technical position preparation activities associated with repository design, retrievability, and short-term data extrapolation to long-term results for repository seals and near-field rock properties.

A. Chowdhury, J. Hageman, S. Hsiung, and J. Bayouth of the Center staff, M. Muller and J. O'Brien of the SwRI staff, T. Brandshaug and M. Board of Itasca, and R. Field, a consultant performed work on the RDCO Program Element during Period 11. J. Hageman, J. Bayouth, M. Muller, J. O'Brien, T. Brandshaug and R. Field performed work on Task 1. M. Board assisted in activities associated with short-term data extrapolation to long-term results. S. Hsiung conducted work in Tasks 1, 2, 4 and draft Operations Plan for FY90 and FY91; he also worked on Seismic Rock Mechanics Research Program Element. A. Chowdhury performed work on Tasks 1, 2, and 4, and draft Operations Plan for FY90 and FY91, and worked on the Seismic Rock Mechanics Research Project. He also performed work in support of recruitment of professional staff.

9.2.1 Narrative Technical Progress This Period

9.2.1.1 Task 1: Support Development and Maintenance of Program Architecture

In support of the Program Architecture development, efforts were continued by this Element. This effort included CNWRA staff, Itasca, a consultant, and Southwest Research Institute personnel participation in the analyses of Regulatory Requirements based on the parsed texts from the various regulations in the Program Architecture Support System

(PASS) database. The primary focus was the requirements of 10 CFR Part 60, Subpart E.

The development and maintenance of Program Architecture relevant to the RDCO Element involve twenty three Regulatory Requirements: RR1(E-36), RR2(E-2), RR3 (E-50), RR4(E-1), RR34(E-34), RR35(E-35), RR37(E-37), RR80(E-44), RR81(E-45), RR82(E-46), RR83(E-47), RR84(E-48), RR85(E-49), RR86(E-51A), RR87(E-52), RR88(E-38), RR89(E-39), RR90(E-40), RR91(E-41), RR92(E-42), RR93(E-43), RR94(E-51B), and RR96(E-51C). Work is being performed by the Program Architecture Review Committee (PARC) to review for finalization of the completed Regulatory Requirements. Because of the work load for the preparation of the draft Operations Plan for FY90 and FY91 and technical position preparation activities, during this period, only a few were reworked to address PARC comments. The status of Program Architecture activities of 10 CFR Part 60, Subpart E relevant to the RDCO Element is provided in the attachment to this chapter. This is based on the Center's Technical Operating Procedure TOP-001-02 Rev. 0.

Personnel involved in regulatory analysis during this period included: A. Chowdhury, J. Hageman, S. Hsiung, J. Bayouth (CNWRA), and T. Brandshaug (Itasca). They were assisted by M. Muller, and J. O'Brien (SwRI), and R. Field (Consultant).

The development of the Program Architecture on the Regulatory Requirement designated "Thermal Load" has been selected during this period to be used as an example for input of required information into DW4 templates which were developed to correspond to the Center's revised Technical Operating Procedure TOP-001-02 Rev. 1.

During this reporting period, A. Chowdhury performed his function as one of the five analysts for purposes of Regulatory Topic Selection for Program Architecture for 10 CFR Part 60, Subparts A, C, D, F, G and H. A total of 20 Regulatory Requirements were identified: RR3001 through RR3020.

9.2.1.2 Task 2: Develop Technical and Analytical Capability

Identification and acquisition of technical literature related to RDCO activities were carried out during this period. Indexing and documenting newly received documents were carried out on an ongoing basis.

During this reporting period, the work for the preparation of the draft Operations Plan for FY90 and FY91 was carried under this task. This included discussions between the Center and NRC Program Element Manager and NRC technical guidance personnel. The preparation of the draft Operations Plan for FY90 and FY91 included the use of the research results of Phase 1 of Seismic Rock Mechanics Research Project and the technical uncertainties identified in Program Architecture.

A. Chowdhury performed work in support of recruitment of professional staff in the areas of rock mechanics/mining engineering, and performance assessment.

9.2.1.3 Task 3: Support Development of Center 5-year Plan

No work performed in this area.

9.2.1.4 Task 4: Develop Compliance Determination Methodology

The technical position preparation activities associated with repository design, retrievability, and short-term data extrapolation to long-term results for repository seals and near-field rock properties were performed under this task. During this period, the results of Task 1 of Seismic Rock Mechanics Research Project were utilized to identify the need to provide guidance to DOE concerning the basis for the determination of seismic input motion for the design of underground repository structures, systems and components.

9.2.1.5 Task 5: Technical Review of DOE SCP
No work performed this period.

9.2.2 Milestone Status and Significant Accomplishments This Period.

9.2.2.1 Task 1: Support Development and Maintenance of Program Architecture
No milestones were scheduled.

9.2.2.2 Task 2: Develop Technical and Analytical Capability
No milestones were scheduled.

9.2.2.3 Task 3: Support Development of Center 5-Year Plan
No milestones were scheduled.

9.2.2.4 Task 4: Develop Compliance Determination Methodology
No milestones were scheduled.

9.2.2.5 Task 5: Technical Review of DOE SCP
No milestones were scheduled.

9.2.3 Problems
None.

9.2.4 Forecast for Next Period
The preparation of the draft Operations Plan for FY90 and FY91 relevant to the RDCO Element and Seismic Rock Mechanics Research Project will continue during the next period. The forecast for the five tasks of RDCO is given below.

9.2.4.1 Task 1: Support Development and Maintenance of Program Architecture
For FY90, the Program Architecture activities for RDCO Element will be limited to Regulatory Requirements that will be used to identify technical uncertainties to develop a technical position on thermal load and technical positions on retrievability and short-term to long-term data extrapolation. These Program Architecture activities will be carried out using the Center's revised Technical Operating Procedure TOP-001-02 Rev. 1.
To prepare for FY90 Program Architecture activities on a limited number of Regulatory Requirements, the Program Architecture activities for the next reporting period (Period 12) will be limited to completion of unfinished steps of some of the 23 regulatory requirements of RDCO Element. During reporting Period 13 of FY89, T. Brandshaug of Itasca and several personnel of the Center will be trained to work on Program Architecture using Center's revised Technical Operating Procedure TOP-001-02 Rev. 1.

9.2.4.2 Task 2: Develop Technical and Analytical Capability
Identification and acquisition of technical literature related to RDCO activities will continue. Planning activities associated with transfer of technology from existing NRC contractors, such as Itasca, to the Center will be carried out during the next period. The draft Operations Plan for FY90 and FY91 will be prepared under this task.

9.2.4.3 Task 3: Support Development of Center 5-Year Plan and Other Plans
No activities planned.

9.2.4.4 Task 4: Develop Compliance Determination Methodology
Activities will concentrate on the need for the development of analytical evaluation capabilities, including codes and models for NRC Compliance Determination Methods, and for technical position preparation activities associated with repository design, retrievability and short-term data extrapolation to long-term results for repository seals and near-field rock properties.

9.2.4.5 Task 5: Technical Review of
DOE SCP
No activities planned.

9.3 Element Financial Status

Table 1, below, indicates the financial status of the Element/ Subelement program in the context of "ceiling" and "allotted" funds established by the NRC. Table 2, displays planned and actual costs to date on both a per period and cumulative basis. In addition, variances are shown on both a dollar and percentage basis. These data do not include commitments in the amount of \$46,022. Spending is on target. No changes to budget or schedule are recommended at this time.

Total	Funds			Adjustment	
Negotiated	Allotted			to Complete	Revised
Subelement	by NRC	Funds	Funds	Subelement	Subelement
<u>Ceiling</u>	<u>to date</u>	<u>Costed</u>	<u>Uncosted</u>	<u>(+ or -)</u>	<u>Ceiling</u>
\$1,182,666	\$1,182,666	\$938,154	\$244,512	-0-	-0-

ATTACHMENT
REPOSITORY DESIGN, CONSTRUCTION, AND OPERATIONS

<u>ID</u>	<u>STATUS</u>
RR1(E-36)	This regulatory requirement has been PARCed and QA approved through step 14 of the Program Architecture process using Center's Technical Operating Procedure TOP-001-02 Rev. 0.
RR2(E-2)	PARCed and QA approved through step 14.
RR3(E-50)	This regulatory requirement has been selected for the identification of technical uncertainty to develop first technical position on repository design.
RR4(E-1)	Completed 11 Regulatory Uncertainties, and Regulatory Uncertainty Methods. To be submitted to PARC next period.
RR34(E-34)	PARCed through step 5.
RR35(E-35)	On hold for new format i.e. Center's revised Technical Operating Procedure TOP-001-02 Rev. 1.
RR37(E-37)	On hold for new format.
RR80(E-44)	On hold for new format.
RR81(E-45)	PARCed and QA approved through step 14.
RR82(E-46)	On hold for new format.
RR83(E-47)	PARCed and QA approved through step 5.
RR84(E-48)	PARCed and QA approved through step 5.
RR85(E-49)	On hold for new format.
RR86(E-51A)	PARCed and QA approved through step 5.
RR87(E-52)	PARCed and QA approved through step 7.
RR88(E-38)	On hold for new format.
RR89(E-39)	PARCed and QA approved through step 5.
RR90(E-40)	On hold for new format.
RR91(E-41)	On hold for new format.
RR92(E-42)	On hold for new format.
RR93(E-43)	On hold for new format.
RR94(E-51B)	On hold for new format.
RR96(E-51C)	On hold for new format.

RDCO Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	TOTAL
ESTIMATED PERIOD COST	30,184	68,158	67,983	60,859	55,438	55,675	57,416	37,554	43,639	47,457	58,521	51,525	936,994
ACTUAL PERIOD COST	62,653	68,156	66,576	47,627	22,483	62,128	46,495	27,850	34,412	117,852	75,000	62,999	938,154
VARIANCE, \$	(32,469)	2	1,407	13,232	32,955	(6,453)	10,921	9,704	9,227	(70,395)	(16,479)	(11,474)	(1,160)
VARIANCE, %	-107.6	0.0	2.1	21.7	59.4	-11.6	19.0	25.8	21.1	-148.3	-28.2	-22.3	-0.1
ESTIMATED CUMULATIVE COST	357,769	425,927	493,910	554,769	610,207	665,882	698,298	735,852	779,491	826,948	885,469	936,994	
ACTUAL CUMULATIVE COST	319,502	387,658	454,234	488,935	511,418	573,546	620,041	647,891	682,303	800,155	875,155	938,154	
VARIANCE, \$	38,267	38,269	39,676	65,834	98,789	92,336	78,257	87,961	97,188	26,793	10,314	(1,160)	
VARIANCE, %	10.7	9.0	8.0	11.9	16.2	13.9	11.2	12.0	12.5	3.2	1.2	-0.1	

NOTES: 1. All estimated and actual costs exclude award fee.

2. Estimates are taken from the May 16, 1989, Interim Spending Plan.

3. Cumulative variances include FY 1988 year to date cost experience.

4. Period 1 actuals reflect NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.