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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
August 5, 1989 - September 1, 1989
PMPR No. 89-12

September 15, 1989

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CNWRA PROGRAM MANAGER'S PERIODIC REPORT
ON ACTIVITIES OF THE
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: 08/05/89 - 09/01/89

1. SUMMARY

1.1 Narrative Project Status and Technical Progress This Period

Staff efforts were directed primarily in the following areas:

1. Preparation of the Division of High Level Waste Operations Plans for FY90-91 and the Overall Research Plan for FY90-91,
2. Actions that are needed to support further development and refinements in the Program Architecture (PA) and Program Architecture Support System (PASS),
3. Acquisition of staff and consultants (both for permanent positions and to assist in specific short-duration tasks),
4. Continuing development, revision, and implementation of Research Project Plans, and
5. 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. Such needed changes will be provided first in the FY90-91 Operations Plans and later in the update to the Center Staffing Plan. When approved, these changes will be incorporated in this table.

A major NRC/CNWRA management meeting regarding Operations Plans preparation, form, and content was 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 FY90 Center Operations Plans, requirements for closing out FY89, Program Architecture development, ongoing and planned Research projects, and various Element-specific activities.

Major 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). The most significant accomplishment this period was completion of the first draft of the revised Technical Operating Procedure on the development of Program Architecture (TOP-001-02). This TOP, together with its supporting attachments, provides detailed guidance on the conduct of regulatory analyses and the development of the Program Architecture relational database that will contain the results of those analyses. Program Architecture Review Committee (PARC) activities continued for 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). With the exception of Operation Plan preparation, this work continued 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:

- * Development of specific examples that will be used to prove out the Program Architecture (the Erosion and Substantially Complete Containment regulatory requirements).
- * 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.
- * Revision and redistribution of the procedure for the identification of Regulatory Topics and associated Regulatory Requirements.
- * Discussions and feasibility/need evaluations of implementing the OS/2 technology in the development of the PASS.

Implementation of the modified Application System (AS) and Application System Project Management Costing (ASPMC) software was fully underway this period with Operations Plan schedule and budget data being generated, entered, and integrated for each of eight Program Elements (as such data became available from the Element Managers). Further development and modification of work practices, and implementation of additional user training also took place, as needs were identified.

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 at a low-priority (addressing critical needs, only), as dictated by staff demands to support Operations Plan and Program Architecture development activities.

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 was received and will be taken into consideration as the Performance Assessment Operations Plan is developed.

Research Project Plans were under development in response to Statements of Work 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 continued to support development of the Project Plans associated with these two projects. Revision of the Overall Research Project Plan for FY90-91 was underway this period.

Activities in the Geochemistry Research Project (Section 3) continued in accordance with the Project Plan. Work continued on modification of the EQ3/EQ6 code to include nonisothermal kinetic reaction path and Rayleigh gas fractionation. The results of recently completed work in this area were presented at the Gordon Research Conference on Inorganic Chemistry. Evaluation continued regarding methods for purifying zeolite samples. A method using sodium acetate buffer solutions was determined to be satisfactory in dissolving carbonate minerals. An interlaboratory-comparison of zeolite chemical analyses was initiated.

Installation and evaluation of test apparatus for the Thermohydrologics Project continued this period (see Chapter 3). Early testing indicates that thermocouple psychrometers will provide better measurements of moisture content than will capacitance hygrometers. Experiments using real-time radiography to evaluate techniques for saturation/desaturation have highlighted the need to use multiport injection/withdrawal methods. The Apache Leap field site and related University of Arizona laboratories were visited this period and samples of tuff were obtained for evaluation. Samples were used to evaluate the potential for using water-jet cutting to remove blocks for transport to the San Antonio research facilities. This technique looks promising at this time.

Development of test apparatus for the Seismic Rock Mechanics Project was completed and preliminary testing was begun (Chapter 3). Evaluation of the discrete element code UDEC continued and arrangements to lease 3DEC are in place. A Project team member visited the Apache Leap site and laboratories, as described above.

Results of the Peer Review of the Integrated Waste Package Experiments Project Plan, which was conducted July 27, 1989, were received throughout this period and began to be evaluated. A panel of three widely recognized materials scientists conducted this review of the program and provided independent comments. IWPE test apparatus began to be moved to the recently completed Building 57 research facility.

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. The Director of Quality Assurance made a presentation to the Texas Quality Conference on the Center's QA program.

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. The focus was on (a) refinement of Technical Review Components and development of Compliance Determination Methods and Information Requirements for the regulatory requirement dealing with "Adverse Condition--Erosion" and completion of the Regulatory Requirements, Regulatory Uncertainties, and logic diagram for "Adverse Condition--Igneous Processes".

Efforts continued on a high priority basis toward the acquisition of a geologist/engineering-geologist, three geochemists, tectonics/structural geologist, geophysicist, geostatistician, QA specialist with background in the earth sciences, performance assessment specialists, and two more geohydrologists 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. Ronald Green, a hydrogeologist, has commenced work at the Center.

A magnetic copy of the Site Engineering Properties Data Base (SEPDB) was obtained and installed on an Institute computer for use in support of Center activities. Technical assistance work was also conducted on the Natural Resources Technical Position.

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 latter item is now complete through process block 15a. The specific status of these activities is reported in Chapters 2, 6, and 8.

As part of the Center's work on the analysis of "substantially complete containment", staff participated in and made two technical presentations at a DOE/NRC interface meeting on this subject. A two-day working session involving NRC, Center, and consultant staff was conducted regarding the treatment of uncertainty in the analysis of waste package performance. A paper on technical considerations for addressing substantially complete containment was completed and submitted for presentation at the First Annual International High-Level Radioactive Waste Management Conference, which will be held next April in Las Vegas.

Development of the code structure to integrate the Fast Probabilistic Performance Assessment (FPPA) code and the process modules of CONVO was completed, providing part of the overall code structure for the EBS Performance Assessment Code (EBSPAC). An importance-sampling scheme was developed and is being evaluated using a corrosion model. A paper on the FPPA methodology was developed for presentation at the FOCUS '89 conference in Las Vegas in September.

Work continued on the Transportation Risk Study in accordance with the Operations Plan (Chapter 7).

The SPAE/T Subelement staff was heavily involved in both the PARC and Program Architecture development activities (Section 8).

Comments were provided on the final Format and Content Guide "table of contents" and the crosswalk between the pertinent portions of 10 CFR Part 60.21 and Subpart E were completed. Work continued on the crosswalk between the "table of contents," and 10 CFR Part 60, with an anticipated completion next period.

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 continued. This includes work related to technical positions on repository design, retrievability, and extrapolation of data from short- to long-term applications. Significant Program Architecture Review work was also conducted within this Element.

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 10 CFR Part 2.
3. Revised the principal table 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	90%
I3	Integrate PARC Set 1 Data	9/27/88	80%
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	40%
I7	Integrated and "Certified" Data (Sets 1-4)	11/23/88	52%

Thermohydrologics and IWPE equipment and apparatus began to be set up in the recently completed Building 57 research facility.

The Center supported the NRC in the USGS Observation Audit.

Significant developments were made on the Regulatory Requirement "Adverse Condition--Erosion" (Chapter 5). A copy of the SEPDB was obtained and made available on the Institute computer facilities.

Significant developments were made on the Regulatory Requirement "Substantially Complete Containment" (Chapter 6), with development through process block 15a being completed. The code structure to integrate the FPPA code and the CONVO process modules was completed as part of the overall EBSPAC development effort. An importance-sampling scheme was developed and is being evaluated using a corrosion model.

Comments on the final Format and Content Guide "table of contents" and a crosswalk between 10 CFR Part 60.21 and 10 CFR Part 60 Subpart E were 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 scheduled this period.

1.3 Problems

None.

1.4 Forecast for Next Period

Development of the Program Architecture and PASS will return to Priority 1 status, following completion of the Operations Plans next period. Additional Program Architecture development workshops, involving the teaming of NRC and CNWRA staffs will be conducted, as necessary. NRC review and comment on the draft TOP-001-02 is expected to be completed, allowing final closure to be reached on the modifications to the process, Technical Operating Procedures, and supporting guidance for Program Architecture Development. 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. Completion of the Overall Research Plan for FY90-91 will be the highest priority research activity (Note: due to differences in who works on this Plan versus who works on the other Research Projects, this assignment of priority is not expected to affect the conduct of any of the other research that is currently underway).

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. Evaluation and response to the Peer review comments on the IWPE Project will be completed.

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 work, 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--Erosion", and "Adverse Condition--Igneous Activity". Technical assistance on the Natural Resources Technical Position will also continue, in accordance with the revised work plan. 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.

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, including presentation of a paper on probabilistic methods in performance assessment at the FOCUS '89 meeting in Las Vegas.

The Transportation Risk Study staff will continue work 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" from the license application Format and Content Guide "table of contents" to the provisions of 10 CFR Part 60 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). Training concerning the revised Program Architecture procedure will be conducted for the RDCO staff from the Center, SwRI, and Itasca. Planning for the transfer of technology from other contractors to the Center will continue next period.

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 \$373,232. 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 \$345,727 (about 5%) under plan. 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>
\$10,484,147	\$10,484,147	\$8,494,693	\$1,989,454	-0-	-0-

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

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) (a)						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) (a)	1	1	1	2	2	3	3	3	3	3	3	3	3	3	3	1	1
METALLURGY, 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) (a)							1	1	1	2	2	2	3	3	3	1	3
PERFORMANCE ASSESSMENT (b) (c) (d)						1	1	1	2	2	2	2	2	3	3	1	3
QUALITY ASSURANCE (b) (a)	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	1	2
RADIOCHEMISTRY (b)										1	1	1	1	1	1	0	1
REGULATORY AND POLICY ANALYSIS (f) (b) (a) (d)	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) (a) (d)							1	1	1	1	1	1	1	1	1	1	1
SYSTEMS ENGINEERING (b)				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

- (P) Interview scheduled next period.
- () assumes being solicited.
- () 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 Composite Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	598,444	9,213,652
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	549,021	8,494,693
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	49,423	718,959
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	8.3	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	9,213,652	
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	8,494,693	
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	718,959	
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	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.

6. Period 12 Overall Research cumulative costs include the transfer of Research (3102) amounts. Ref: Mace ltr 01/18/89.

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, limited 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. A major step toward resolution occurred when a draft of TOP-001-02 Rev. 1 titled "Program Architecture Relational Database Content and Development Instructions" was submitted to the NRC for review and comment during this period (reference letter from A. Whiting to P. Altomare dated September 2, 1989).

Last 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 "baseline" deliverable. (Details of the approach and tentative schedule are in the minutes of the July 20-21, 1989 meeting authored by P. Altomare.) Official confirmation of this was received by the Center during this period (reference letter from P. Altomare to A. Whiting dated August 15, 1989). Activities are being pursued consistent with this request.

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. A report reflecting justification information for the approach was completed and sent to the NRC this period (reference letter report to J. Funches from R. Johnson on August 22, 1989).

Major efforts on scoping, staffing, scheduling and resource loading, and task descriptions of the Operations Plans occurred during this period. Some of these efforts were affected in mid-course when we became aware of certain funding levels during the joint NRC/CNWRA August 8 and 9, 1989 meeting at White Flint. Details of the meetings are captured in the respective minutes. Re-vamped staffing plans and work scopes are being pursued and prepared for presentation in the draft Operations Plans for FY90-91 Center Operations scheduled to be submitted early next period.

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 being interviewed and a job offer being extended to one. Also, continuation of scoping of performance assessment activities tasks desired by the NRC prior to the end of the fiscal year was pursued with Dr. Ruth Weiner acting as the Center's focal point on Performance Assessment and input from R. Green (new CNWRA staff member - a geohydrologist with performance assessment experience). (Reference letter from John Latz to Mary Mace dated August 22, 1989.)

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 1, 2, 3, 4, and 5.

2.2.1.1 Task 1: Develop and Maintain Program Architecture

Major emphasis this period included continuing attempts to capture final 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 the following:

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 52 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 and 19 meeting at Crystal City between the NRC and the CNWRA (Reference the minutes of said meeting).

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. These activities are consistent with the guidance received from NRC concerning replacing the Center's immediate effort on "Adverse Condition--Geochemistry" with "Volcanism" (Reference meeting minutes of July 20-21, 1989 meeting and letter from P. Altomare to A. Whiting dated August 15, 1989).

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

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

7. Developing and submitting to NRC for review a complete draft of the revised TOP-001-02 with associated attachments to reflect the refined PAD Process through Block 22 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 and 19, 1989 meeting (reference letter from A. Whiting to P. Altomare dated September 2, 1989).

8. Continuing 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. Discussed the possibility of NRC document control sending the CNWRA the RIDS header information on diskettes to load into TDI. This is being coordinated with HLW.

2. Exercised 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. Two candidates were interviewed this period for Performance Assessment staff positions and an offer was made to one.

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 FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC in mid-June 1989.

2.2.1.4 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 discussed thru July. The need to integrate NRC Research performance assessment needs was made known in the July 24 and 25, 1989 meetings on the overall Performance Assessment activities.

2.2.1.5 Task 5: Technical Review

Continued development of FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC in 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	90%

I3	Integrate PARC Set 1 Data	9/27/88	80%
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	40%
I7	Integrated and "Certified" Data (Sets 1-4)	11/23/88	52%

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 and continued development of the WSE&I Element Operations Plans for FY90-91.

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

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

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

Continued development of FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC in mid-June and discussion with the NRC counter parts. This task becomes a separate element activity in FY90-91.

2.2.2.5 Task 5: Technical Review

Continued development of FY90-91 Operations Plans in this task consistent with the new scope guidance received from the NRC in 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 of individuals within the NRC on "Erosion," "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 Procedure (TOP-001-02 Rev. 1) 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 and 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. Continuing to provide 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 regulatory analysts and task team members for training in new procedures and use of modified DW4 templates.

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.

12. Complete development of Operations Plans for WSE&I for FY90-91 using AS and ASPMC.

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

Finalize development of 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

Finalize development of 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

Finalize development of 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 \$6,287. 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 Ceiling	Funds Allotted by NRC to date	Funds Costed	Funds Uncosted	Adjustment to Complete Subelement (+ or -)	Revised Subelement Ceiling
\$1,652,941	\$1,652,941	\$1,434,416	\$218,525	-0-	-0-

WSE&I Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	109,585	1,450,461
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	104,912	1,434,416
VARIANCE, \$	37,526	1	40,957	(1,863)	15,730	6,030	14,298	(9,136)	(7,797)	16,183	(4,771)	2,595	4,673	16,045
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	4.3	1.1
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	1,450,461	
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	1,434,416	
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	16,045	
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	1.1	

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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.

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, W. Murphy, P. Nair,
R. Pabalan, J. Russell, B. Vanzant, A. Chowdhury
R. Ababou, R. Green

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 FY88-FY89 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

Currently Building 57 houses three of the Center's experimental programs. The laboratory casework and other installation activities for the Geochemistry, Thermohydrology, and Waste Package Experiments laboratories were completed in Building 57. Geochemistry equipment, supplies, and materials were acquired and experimental work continued in the new Geochemistry Laboratory. Experimental setup and determination of optimum experimental procedures for the Thermohydrology Research Project separate effects experiments continued this period. Part of the laboratory experimental setup for the Integrated Waste Package Experiments was moved from Building 90 to Building 57. 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. Research Project Plans for "Stochastic Analysis of Unsaturated Flow and Transport Through Fractured Rock for Large-Scale Hydrogeologic Systems" and "Geochemical Analog of Contaminant Transport in Unsaturated Rock" research projects were under development in response to statements of work delivered to the Center from NRC.

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

<u>Project</u>	<u>Title</u>	<u>Revised Plan Completion Date</u>	<u>Approval Status</u>
Res. 1-Overall Program Plan		09/11/89	Submitted to NRC
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

Based on the NRC guidance in the letter dated August 1, 1989, the Center has prepared and submitted a FY 90-91 Overall Program Plan for Research. The plan incorporates the effort required for the development of the project plans for the anticipated new starts for FY 90. 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.

Research Project Plans for "Stochastic Analysis of Unsaturated Flow and Transport Through Fractured Rock for Large-Scale Hydrogeologic Systems" and "Geochemical Analog of Contaminant Transport in Unsaturated Rock" research projects were in the process of preparation in response to statements of work delivered to the Center from NRC. R. Ababou and W. Murphy, respectively, are the designated leaders in preparation of these two research project plans. A major activity of Dr. Murphy during Period 12 was identification, review, and preparation of background information to support the "Geochemical Analog of Contaminant Transport in Unsaturated Rock" Research Project Plan. He also interviewed candidates for Center staff positions in performance assessment. He and R. Pabalan prepared job descriptions for three Center staff positions in geochemistry including one position in isotope geochemistry. R. Green, R. Ababou, W. Murphy and R. Pabalan contributed to the development of the revised Overall Research Project Plan which was submitted to NRC in early Period 13. They provided input on anticipated travel plans and allocation of Center geoscientist's time among present and planned research projects. A major activity of R. Ababou during Period 12 was the identification, review, and preparation of background information to support the "Stochastic Analysis of Unsaturated Flow and Transport Through Fractured Rock for Large-Scale Hydrogeologic Systems" Research Project Plan.

3.2.1.2 Research Project 2-Geochemistry

W. Murphy presented an invited talk titled "Reaction path modeling of mineral and groundwater chemistry in the vadose zone at Yucca Mountain, Nevada" at the Gordon Research Conference on Inorganic Geochemistry. W. Murphy's participation in the conference was during August 14-18. W. Murphy continued activities associated with the modification of the EQ3/6 codes to incorporate nonisothermal kinetics and Rayleigh gas fractionation calculation capabilities into the codes.

R. Pabalan completed a study of the Technical Operating Procedure for Preparing Simulated and Modified J-13 Waters. W. Murphy reviewed the resultant report and subsequently contributed to the report. Procedures for purifying zeolite samples were tested for possible inclusion in Technical Operating Procedure 005 which is titled, "Procedure for Zeolite Ion Exchange Experiments). A final version of Technical Operating Procedure 005 was reviewed and approved by Center management. Copies of the procedure were sent to NRC. A method using sodium acetate buffer solutions was determined satisfactory in dissolving carbonate minerals. A procedure to remove iron oxides using a citrate-bicarbonate-dithionite solution was also tested. Zeolite samples for chemical analyses were prepared. The zeolite samples will be sent to three different laboratories, including SwRI Division 01 (Chemistry and Chemical Engineering) for interlaboratory comparison of results. Standard Reference Materials (feldspar minerals) will be included among the samples submitted for analyses.

3.2.1.3 Research Project 4-Thermohydrology

In Period 12 the digital multimeter and the channel switching unit from Hewlett Packard were received and configuration of the GPIB interface for conducting measurements with thermocouple psychrometers (PSY) and resistance temperature devices (RTD) was initiated. An order to Solomat for the capacitance hygrometers was cancelled because the capacitance hygrometers were determined to perform in a manner inferior to the PSY and because relative humidity measurements would be applicable only at saturation levels less than 65 to 70 percent. A resistivity probe was constructed and is currently being investigated for use in the regions of higher saturation.

Experiments using glass beads to test saturation/desaturation techniques and to investigate such phenomena as the static distribution of water in the media were conducted. This was accomplished using a backpressure saturation and a vacuum withdrawal technique. It was not apparent that this technique is overwhelmingly successful using a single port. It is anticipated that provisions for distributing the saturation/withdrawal pressures throughout the media using a linear port extension may prove successful. The success of the saturation/desaturation procedure was evaluated using real-time x-ray radiography. This gives insight into the static distribution of water within the media and allows evaluation of the use of x-ray radiography as a tool, i.e., to determine if there is sufficient sensitivity to detect saturation differences within the media.

A small plexiglass box (roughly 6 inch square with an adjustable width) having a heat exchanger top and bottom was completed to more adequately control flow visualization experiments using thermochromatic liquid crystal (TLC) microbeads. The techniques for preparing the media with the TLC mixture are adequate to perform controlled visualization experiments. It is anticipated that a publication documenting these preparation techniques, the observed physical processes, and their significance in porous media will result from these efforts.

Blocks of Apache Leap (brown unit) welded tuff collected from near Superior, Arizona have been cut at SwRI from irregular

specimens using a water jet cutting method. The success in cutting the samples and previous experience by SwRI in water jet cutting of rock indicates the technique may be applicable for cutting specimens in the field to facilitate removal with minimal disruption and alteration of the rock. A block of Apache Leap welded tuff was cut to allow tests of thermal conductivity of the tuff for comparison with the thermal conductivity of glass bead samples used for separate effects experiments.

The equipment and materials acquired for the thermohydrological experiments are described below:

Equipment:

Hewlett Packard 3458A Digital Multimeter (System)
Hewlett Packard 3488A Switchbox with 24 channels
IBM Model 50 PS2 with National Inst. MC-GPIB card
6 high temperature thermocouple psychrometers
2 Neslab- Exacal model EX-251HT high temperature baths
Brainaird Kilman pressure panel (9 accumulators)
1 4" flexible wall permeameter
1 triaxial cell (doubles as flex wall permeameter)
2 pore pressure transducers with readout
2 bladder accumulators
de-aired water tank
small direct drive vacuum pump
electronic topload balance (30 kg)
1/2" glass experimental apparatus 36x36x3 in.
2 custom built aluminum heat exchangers for the apparatus
1 small unit with heat exchangers top and bottom for visual experiments

List of Specialized Supplies

1 liter R30C15W liquid crystal microbeads (15 micron)
1/4 liter R29C4W liquid crystal microbeads (15 micron)
250lbs. 40 micron glass beads
250lbs. 80 micron glass beads
250lbs. 160 micron glass beads
10lbs. 200 micron glass beads
10lbs. 400 micron glass beads
10lbs. 800 micron glass beads

F. Dodge and M. Lewis conducted a trip to the University of Arizona in Tucson where they examined the laboratory facilities utilized in NRC sponsored research. They also traveled to the University of Arizona field test site at Apache Leap near Superior, Arizona. T. Rasmussen described the University of Arizona investigations and served as the visit coordinator.

3.2.1.4 Research Project 4-Seismic/Rock Mechanics Studies

The major activities related to seismic/rock mechanics research project that took place during this reporting period include: (i) visit of NRC-RES by A. Chowdhury, (ii) a conference call meeting of the research group and invited participants, (iii) a preliminary survey trip to Apache Leap Site in Arizona, (iv) presentation of a paper "An Assessment of Dynamic Response Prediction for a High-Level Nuclear Waste Underground Repository" at the 10th SMiRT conference in Anaheim, California, (v) construction of seismic/rock mechanics experimental apparatus, and (vi) qualification study of computer codes.

A. Chowdhury visited with M. Silberberg and J. Philip at NRC-RES on August 9, 1989. This meeting included the review of NRC's comments on seismic/rock mechanics research Task 1 Report, Critical Assessment of Seismic and Geomechanics Literature Related to a High-Level Nuclear Waste Underground Repository (CNWRA 89-001), and the discussion on the ongoing and future research activities of Seismic/Rock Mechanics Research Project. The pertinent points discussed included:

- o Submission of revised project plan for seismic/rock mechanics research project to include two additional tasks: (a) instrumented analog field studies for dynamic effects on underground openings, and (b) seismic effects on the groundwater, and an extension of the project duration through FY94
- o Laboratory experimental program to include both dry and wet specimens
- o Development of contacts with the international seismic/rock mechanics researchers, specially Japanese researchers
- o Possible future research topics: (a) time and process based three-dimensional failure criterion for near field tuff rock structure, and (b) stochastic determination of mechanical properties of rocks and distribution of rock joints and fractures in Yucca Mountain tuff
- o Submission of quarterly technical report to NRC for seismic/rock mechanics research project
- o Visit to the Center by J. Philip in September 1989.

A conference call meeting of the seismic/rock mechanics researchers of the Center (A. Chowdhury, S. Hsiung, P. Nair), SwRI (D. Kana, B. Vanzant) and Itasca (B. Brady) was held on August 11, 1989. Invited participants in the meeting were R. Ababou (Geohydrology and Stochastic Analysis - CNWRA) and M. Lewis (Geology - SwRI). This meeting reviewed the activities outlined in items (i) and (iii) through (vi). This included technical discussions on instrumented field studies for dynamic effects on underground openings, seismic effects on groundwater, and laboratory experimental testing of saturated tuff. R. Ababou contributed to the technical discussion on seismic effects on groundwater and stochastic modeling of rock parameters.

B. Vanzant of seismic/rock mechanics research project team along with F. Dodge and M. Lewis of thermohydrology research team made a preliminary survey trip to Apache Leap on August 16-18, 1989. The purpose of B. Vanzant's trip was to obtain the necessary information required to plan and implement a specimens acquisition effort for experimental work of seismic/rock mechanics research project. This trip also included meetings with Jaak Daemen and Todd Rasmussen and visiting the rock mechanics and thermohydrology experimental facilities of the University of Arizona, Tucson. Todd Rasmussen conducted a tour of a previous rock extraction site at Apache Leap and explained the technique that the University of Arizona has used to obtain jointed/fractured tuff specimens for laboratory experimentation. The University of Arizona jointed/fractured rock extraction technique will be compared with other available techniques to select the technique to be used for extraction of tuff specimens for seismic/rock mechanics research project. Two loose block samples approximately one cubic foot in size, each containing fractures, were acquired from Apache Leap site during this trip. These blocks

will be used for preliminary activities such as sizing the blocks to appropriate specimen dimensions and checking the experimental set up. A trip report is under preparation for submission to NRC.

A paper based on the seismic/rock mechanics research project was presented by D. Kana at the 10th Structural Mechanics in Reactor Technology Conference that was held in Anaheim, California, August 13-20, 1989. The paper was well received by the audience at the conference. The attendance of this conference by D. Kana was useful to make a preliminary assessment of the extent to which seismic/rock mechanics research is being carried out by international researchers. An attempt by the Center is underway to establish contact with the international seismic/rock mechanics researchers. A trip report is being prepared for submission to NRC and a set of conference proceedings has been acquired for the CNWRA library.

The preparation of the experimental apparatus parts at the SwRI Machine Shop has been completed during this reporting period. These parts are being assembled at the Dynamics Laboratory at SwRI. A demonstration experimental run will be made during the third week of September when J. Philip will visit the Center.

The qualification study on the UDEC and 3DEC codes are continuing. This includes investigation of the potential impact of joint model parameters on the ability of the UDEC code to model the response of a plane of weakness subjected to near-field excavation compared to the analytical predictions. Two example problems: (1) Joint Slip Model, and (2) Dynamic Sources in a Jointed Medium have been analyzed using the three-dimensional distinct element code 3DEC. These analysis results are in the process of being reviewed and compared to the associated analytical solutions.

A computer diskette and hard copy of the summaries and reviewer comments of relevant papers, articles, etc. reviewed by the Center for Task 1 of the seismic/rock mechanics research project have been sent to J. Philip on August 11, 1989. During this reporting period, NRC formal approval has been received to prepare the revised project plan that will include additional tasks and modifications of tasks as suggested by NRC. Preparation of this revised project plan is underway.

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 reviews were completed with each of the reviewers providing their comments to the IWPE Project Manager. The comments are being evaluated. A summary with a recommendation on the IWPE Plan will be prepared and submitted to the NRC IWPE Project Officer.

3.2.2 Milestone Status and Significant Accomplishments This Period

Experimental setup work has been initiated for three projects in the Building 57 research facility.

Chemical analyses of 304L SS, 316L SS, and IN 825 materials were completed. Alloys 304 L SS and 316L SS are entirely within the applicable specifications. Incoloy 825 meets all composition limit requirements of the specification (ASTM B 424), except that the Mo concentration is reported to be 3.56%, while the upper limit for Mo in B424 is 3.5%. However, B424 allows a variation of 0.10% at the high end of the range for Mo, so the alloy meets the specification. Chemical analysis on the C-22 material is underway.

3.2.3 Problems

None

3.2.4 Forecast for Next period

The Peer Review comments on the IWPE project will be summarized and recommendations developed. The procedures for the development of synthetic J-13 water will be reviewed by the Center technical staff for implementation.

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 \$170,169 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>
\$396,726	\$396,726	\$320,155	\$76,571	-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>
\$352,378	\$352,378	\$282,876	\$69,502	-0-	-0-

Outstanding Subcontractor Commitments - \$13,051

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>
\$266,584	\$266,584	\$219,741	\$46,843	-0-	-0-

Outstanding Subcontractor Commitments - \$3,658

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>
\$675,270	\$675,270	\$530,572	\$144,698	-0-	-0-

Outstanding Subcontractor Commitments - \$53,778

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>
\$576,774	\$576,774	\$402,987	\$173,787	-0-	-0-

Outstanding Subcontractor Commitments - \$69,089

OVERALL Research Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	8,978	312,496
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	13,568	320,155
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)	(4,590)	(7,659)
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	-51.1	-2.5
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	312,496	
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	320,155	
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	(7,659)	
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	-2.5	

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 NRC-approved adjustments of management and technical support costs.

5. Totals reflect costs since inception of Contract.

6. Period 12 cumulative costs include the transfer of Research (3102) amounts. Ref: Mace ltr 01/18/89. (Estimated \$145,182 - Actual \$233,186 F/Y 88).

GEOCHEM Research Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	25,358	478,553
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	19,826	282,876
VARIANCE, \$	40,615	(21,182)	17,187	2,128	138	35,546	20,047	6,826	2,242	9,412	10,093	6,978	5,532	195,677
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	21.8	40.9
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	478,553	
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	282,876	
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	195,677	
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	40.9	

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	12	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	41,368	283,337
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	36,702	219,742
VARIANCE, \$	0	6,477	37,926	28,770	22,916	31,070	47,712	28,046	3,859	29,300	24,597	5,032	4,666	63,595
VARIANCE, %	0	16.6	80.9	70.7	56.3	76.4	94.9	58.6	15.3	74.5	60.8	13.3	11.3	22.4
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	283,337	
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	219,742	
VARIANCE, \$	0	6,477	44,403	73,164	96,080	127,150	174,862	202,908	206,767	29,300	53,897	58,929	63,595	
VARIANCE, %	0	16.6	51.7	57.8	57.5	61.2	67.7	66.3	62.4	17.9	26.4	24.4	22.4	

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	12	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	37,719	549,344
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	30,077	530,572
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	7,642	18,772
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	20.3	3.4
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	549,344	
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	530,572	
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	18,772	
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	3.4	

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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 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	12	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	38,903	475,755
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	20,461	402,988
VARIANCE, \$	4,056	38,464	12,386	250	15,051	18,945	(828)	(24,513)	8,320	(2,566)	11,740	(18,293)	18,442	72,767
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	47.4	15.3
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	475,755	
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	402,988	
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	72,767	
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	15.3	

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.

5. Totals reflect costs since inception of Contract.

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. This included review of portions of the "Comment Draft" Technical Operating Procedure-001-02 which has been rewritten to incorporate significant changes in the process and content of the Program Architecture based on comments from the NRC and the Center. The comment draft version of TOP-001-02 will be sent out next period for review and those Center staff providing input to the Program Architecture database will receive controlled copies of the document. Due to work on the Center's Operations Plans, the QA Group did not receive new Program Architecture products to review from the Program Architecture Review Committee (PARC). The QA Group will continue to check 100% of the PARC output and provide input to those Technical Operating Procedures which direct Program Architecture actions next period.

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. Center QA has reviewed the

most recent COI packets for completeness before presentation to the COI Management Committee and has requested more information in one case. The COI Management Committee will meet next period to consider the submitted information on not less than seven individuals who may be cleared for work with the Center.

The QA Subelement Manager read the pertinent professional, trade, and programmatic publications and documentation that were circulated through the Center this period in addition to American Society for Quality Control publications.

B. Mabrito made a presentation to the sixth annual Texas Quality Conference August 19, 1989. The Austin, Texas conference had specified no paper be submitted, and that the presentation be from audio/visual aids only. The subject of the hour-long talk was Southwest Research Institute, the Center for Nuclear Waste Regulatory Analyses, and an overview of the quality assurance program being implemented at the Center. Attendees to the presentation represented quality professionals from across the state of Texas in the fields of petroleum production, chemical processes, aerospace, and general manufacturing and fabrication.

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 12, implementation of the Center QA Manual continued and a QA audit on the remaining four active sections of the Center QA Manual proceeded utilizing specific Element project plan tasks. Center Technical Operating Procedures (TOPs) continued to be generated and issued during the this period. Quality Assurance Procedure (QAP)-001, describing the requirements for laboratory and scientific notebooks, was distributed and is now being utilized by the Center's technical personnel performing project plan tasks in the geochemical discipline.

4.2.1.5 Task 5: Develop External Program Information/Audits

This task continued in Period 12, as directed by the NRC, with the U.S. Geological Survey Audit Observation Team work accomplished from August 14-22, 1989 at two separate USGS locations. Robert D. Brient represented the Center on the NRC Audit Observation Team and provided the follow up report as required by the Task Operations Plan which was processed through the Center. At the direction of Mr. James Kennedy, the Center QA Group 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 be required during Period 13 and planning for such work took place during Period 12.

4.2.2 Milestone Status and Significant Accomplishments This Period

4.2.2.1 Task 1: Support Development and Maintenance of Program Architecture

The Center QA Director continued to hold meetings with the WSE&I personnel to monitor the progress and development of the revision to TOP-001-02, which is an important Program Architecture document. Considerable effort during Period 12 was devoted to addressing Program Architecture in the Center Operations Plan, to ensure that QA resources will be available to apply to the development of the systems analysis approach to the regulatory requirement process within the Center.

4.2.2.2 Task 2: Develop Technical and Analytical Capabilities

There were more personnel cleared through the

Center COI Management Committee during this reporting period, including the Center's Advisory Board members. At the close of Period 12, there was a total of 113 individuals who had been cleared through the Center COI Management Committee with the objective evidence of such actions in a Center Administrative location.

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 12, 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. As scheduled, an audit of the Center continued through this Period with Robert E. Engelhardt of the SwRI QA Department performing the Lead Auditor activities. The audit concentrated on project activities of the Center, covering the section topics of the Center Quality Assurance Manual which were not addressed in the first Center audit. The audit report will be issued to Center Management in Period 13.

Various receiving inspections were performed by Center QA during the Period to verify materials shipped met the purchase order requirements. Guidance was provided on use of a qualified vendor to perform analysis of metal samples.

4.2.2.5 Task 5: Develop External Program Information/
Audits

Period 12 activities included work on the USGS Audit Observation Team (R. Brient) and the follow up report. During this Period preparations were made for the Sandia National Laboratories Audit Observation Team work which will occur in Period 13 where R. E. Engelhardt will represent the Center. Mr. James Kennedy continued the bi-weekly NRC staff conference calls involving Center QA personnel and key NRC NMSS QA staff during the 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 focus 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 Program. 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. Applicants for the Center quality assurance position will be interviewed during Period 13. The Center QA and programmatic controls will be applied to products of the Center throughout the Period.

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 Period 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	\$407,680	\$133,480	-0-	-0-

QA Subelement Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	26,580	483,784
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	23,711	407,680
VARIANCE, \$	13,421	(1)	12,449	35,165	45,179	30,410	27,310	29,492	(7,562)	4,794	8,143	11,058	2,869	76,104
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	10.8	15.7
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	483,784	
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	407,680	
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	76,104	
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	15.7	

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.

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

CNWRA 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
R. Green

Subcontractors/consultants: Itasca Consulting Group, Inc., Adrian Brown
Consultants, 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 the development of regulatory guidance documents such as technical positions and rules, (5) provide technical assistance in the form of reviews and analyses, and (6) support SCP and Study Plan reviews.

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, and Task 4- support to technical reports/positions and rulemaking activities. 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.

J. Russell, W. Murphy, R. Pabalan, R. Green, R. Ababou and B. Everett of the Center staff, and M. Miklas and J. Erwin of the SwRI staff performed work at the Center on the Geologic Setting Program Element during Period 12. M. Miklas primarily performed work on Task 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. Green and R. Ababou became familiar with the activities of the Center, particularly the activities related to hydrology and geohydrology 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," and initiated preparation of the project plan manuscript.

A magnetic tape copy of the Scientific and Engineering Properties Data Base (SEPDB) which is maintained by Sandia National Laboratories for the Yucca Mountain project was obtained via NRC and installed on SwRI's Division 06 VAX computer. The Center can manipulate the SEPDB using INGRES software, which is available through a "CPU license" agreement with SwRI. R. Ababou investigated computational and graphics facilities, hardware, and software required to support the Center's activities.

The major work during the period was the development of the Geologic Setting Program Element components of the Center's FY90 and FY91 Operations Plans. J. Russell traveled to Rockville, Maryland for meetings with NRC on the Operation Plans which were conducted August 8 and 9, 1989. Preparation of the Center's Operation Plans involved training and familiarization with a computer-based project management system which was used in scheduling anticipated Geologic Setting Program Element activities and determining availability of resources (including personnel) to accomplish activities.

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--Extreme Erosion" and "Adverse Condition--Igneous Processes" 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, and entry of data onto appropriate templates for the Technical Review Components, and continuation of work on defining the Compliance Determination Methods and Information Requirements. C. Purcell traveled to San Antonio where he worked with M. Miklas and J. Russell on the "Adverse Condition-- Extreme Erosion," and in particular on refinement of Technical Review Components and development of Compliance Determination Methods and Information Requirements.

In the previous period, a 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. The Regulatory Requirements, Regulatory Uncertainties, and Logic Diagram have been completed for "Igneous Processes." M. Miklas attended a NRC/DOE/NV meeting at Rockville, Maryland on Tectonic Models. Presentations and discussions at the meeting included the subject of igneous processes. Acceleration of the development of input for this Regulatory Requirement necessitated delaying development of additional input for the "Geochemical Processes" example. However, during Period 12, J. Erwin initiated development of Technical Review Components for "Geochemical Processes."

M. Miklas, J. Erwin, B. Everett, and J. Russell comprise the SwRI/Center Staff team which provided the Geologic Setting Program Element input into Program Architecture development throughout Period 12. 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.

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 Geologic Setting Program Element provided input for revision of the Center's staffing plan which established, as a high priority, the acquisition of an engineering geologist, geologist, volcanologist, tectonics/structural geologist, geomorphologist, meteorologist/climatologist, radioisotope geochemist, three additional geochemists, geostatistician, QA specialist with a background in the earth sciences, performance assessment specialists with backgrounds in geochemistry and/or hydrology, and two additional geohydrologist as full-time employees. These individuals will be tasked to conduct work for the GS, QA, Performance Assessment, WSE&I (Program Architecture development), and the Research Elements. John Russell reviewed resumes, applications, and COI questionnaires obtained from a large number of geoscientists expressing interest in employment and entered pertinent information regarding the applicants into a computer data base.

A large number of telephone calls was also made to solicit applications by qualified individuals. Announcements of employment opportunities appeared in regional newspapers and professional journals, including the American Association of Petroleum Geologists Explorer and Geotimes.

As a result of recruitment activities, Dr. Ronald Green began 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. His work at the Center will primarily be in the Geologic Setting, Research, and Performance Setting Elements.

W. Murphy presented an invited talk titled "Reaction path modeling of mineral and groundwater chemistry in the vadose zone at Yucca Mountain, Nevada" at the Gordon Research Conference on Geochemistry, which he attended on August 14-18, 1989.

Certain members of the Center's Washington Office staff attended the Yucca Mountain Site Team weekly meetings at Rockville. Attendance and reporting of activities at these meeting were conducted as Geologic Setting Program Element activities.

A magnetic tape copy of the Site and Engineering Properties Data Base (SEPDB) which is maintained by Sandia National Laboratories for the Yucca Mountain project was obtained via NRC and installed on SwRI's Division 06 VAX computer. The Center can manipulate the SEPDB using INGRES software, which is available through a "CPU license" agreement with SwRI. R. Ababou investigated computational and graphics facilities, hardware, and software required to support the Center's activities in three dimensional modeling, mapping, and scientific and engineering calculations/modeling which are pertinent to hydrology, hydrogeology, geology, geophysics, and related disciplines.

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

Technical assistance work was accomplished to support the development of the Natural Resources Technical Position. Information pertinent to DOE's approach to Natural Resources Assessment at Yucca Mountain was obtained by examination of the SCP.

5.2.1.5 Task 5: Review SCP and SCP Modifications

No activity occurred for Task 5 in Period 12.

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 Architecture input for the 10 CFR Part 60.122 Adverse Conditions-- Extreme Erosion and Igneous Processes was accomplished. M. Miklas supported P. Justus in preparation of a logic diagram for igneous processes. The logic diagram was used in the NRC/DOE/NV Tectonic Models Meeting at Rockville.

5.2.2.2 Task 2: Develop Technical and Analytical Capabilities

Dr. Ronald Green, a geohydrologist with excellent technical qualifications and pertinent professional experience, began employment at the Center during Period 12. Approximately 30 applications with academic training and experience in the geosciences were received for the Center's career opportunities.

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

Center activities associated with providing technical assistance to NRC supporting development of the Natural Resources Technical Position were conducted during the period.

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 13 of FY89 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

Initiation of activity associated with this task is presently planned for Period 13.

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

A major activity of Period 13 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 13, 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 \$59,626. 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	\$1,168,814	\$291,089	-0-	-0-

GS Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	57,223	1,176,442
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	97,012	1,168,815
VARIANCE, \$	(41,646)	0	(11,284)	(3,173)	64,386	65,846	31,847	(5,161)	30,692	(13,083)	7,497	(4,376)	(39,789)	7,627
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	-69.5	0.6
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	1,176,442	
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	1,168,815	
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	7,627	
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	0.6	

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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

CNWRA 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 were directed toward the development of the FY90-91 EBS Program Element Operations Plan. The plan incorporated the tasks outlined by NRC in the guidance documents provided to the Center and the review meeting held with the staff. The EBS Program Element Operations Plan includes several activities proposed by the Center staff and has outlined the priorities for the various activities. The major activities in the EBS Element for FY90-91 include two topics for rulemaking, i.e., Substantially Complete Containment and Greater-than-Class C waste. Also, three technical positions are planned.

P. Nair participated in a FY90-91 Operations Plan review at the NRC White Flint Offices on August 8, 1989. The attendees at the meeting included the Center and NRC program management staff. At the meeting, the Center's approach to the development of the Operations Plans and prioritization of activities were discussed.

6.2.1 Narrative Technical Progress This Period

6.2.1.1 Task 1: Support Development and Maintenance of Program Architecture

The status of the three regulatory requirements (E-3, E-4, & E-5) associated with the engineered barrier system and its performance, 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 (as applicable). Process steps 1, 2, 4b, 10 and 15a have been completed. Uncertainty Reduction Methods and the Technical Review Components have been developed.

E-5 -- No activity this period.

6.2.1.2 Task 2: Develop Technical and Analytical Capabilities

Literature review of waste package materials

continued this period. The preparation of 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 continued during this reporting period.

A technical paper titled, "Technical Considerations and an Approach for Evaluating Substantially Complete Containment of High-Level Nuclear Waste," by H. Manaktala, Y-T. Wu, C. Interrante, P. Nair, and J. Bunting, has been submitted for presentation at the First Annual International High-Level Radioactive Waste Management Conference, Las Vegas, Nevada, April 8-12, 1990.

P. Nair attended the Fourth International Symposium on Environmental Degradation of Materials in Nuclear Power Systems, sponsored by NACE, ANS, and the Metallurgical Society, at Jekyll Island, Georgia, August 9-10, 1989. The purpose of attending this meeting was to review and discuss the new developments in the area of corrosion technology with leading researchers, and to seek senior individuals in the area of material sciences for potential staff additions to the Center. Several key contacts were made and the potential for candidates for the Center appears promising.

P. Nair visited Professor Gary Was at the University of Michigan, Michigan Ion Beam Laboratory, Ann Arbor, Michigan, on August 22, 1989. Professor Was and his students are involved in studies relating to metal surface effects under environmental attack. The techniques applied here are relevant to waste package studies. The visit was also used as an opportunity for potential staff recruitment for the Center.

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

H. Manaktala and Y-T. Wu attended the DOE/NRC interface meeting on the subject of Substantially Complete Containment (SCC) at NRC White Flint Offices on August 29, 1989. Technical presentations were made on the topics of, "Technical Considerations in Evaluating Substantially Complete Containment (SCC) of High-Level Radioactive Waste" and "Treatment of Uncertainty." The meeting was attended by 36 DOE and NRC representatives and contractors from the DOE headquarters, DOE national laboratories, DOE Yucca Mountain project, and representatives of the State of Nevada. A brief summary of the meeting is as follows.

- o The meeting was designed to be information exchange meeting and no formal minutes of the meeting are planned to be issued.
- o The DOE presentation was very brief.
- o An important point to note from presentations and the discussions that followed during the meeting is the desire on the part of some of the participants to have the term "SCC" quantified, somehow, in terms of the number of acceptable failures. It was suggested that such a step in clarifying what is expected to be demonstrated by the HLW repository applicant would help it better define design criteria for the various components of the waste package.
- o There was some limited discussion on what would or would not constitute a failure. It was argued that since not all "breaches" of a canister will result in "release" of radionuclides, all "breaches" should not be considered as "failure" of the waste package, i.e. it should be possible

to take "some/partial" containment credit for a breached canister.

The presentations by the NRC exposed the attendees to the two reports that the Center is preparing as an input to the NRC's evaluation process, so that the Commission can make an assessment of the feasibility of quantifying SCC in numerical terms. There was an expression of great interest on the part of the meeting attendees in the two reports being prepared by the Center.

A two-day working meeting was held at the Center on August 31-September 1, 1989, to formulate and review progress-to-date on the Uncertainty Evaluation (Task 4.2) report. The participants were: Y-T. Wu, A. G. Journal (Stanford University), and L. Abramson (NRC-RES).

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

The code structure to integrate the FPPA code and the modules of CONVO was developed. This structure will be part of the overall EBSPAC code being developed at the Center. Computer coding of the structure is in progress. The development of a fast Monte Carlo method to supplement the FPPA method continued. An importance-sampling scheme was developed and is being evaluated using a corrosion model.

6.2.2 Milestone Status and Significant Accomplishments This Period

Significant effort was directed toward the development and completion of the EBS Program Element Operations Plan for FY90-91.

6.2.2.1 Task 1: Support Development and Maintenance of Program Architecture

The development of the regulatory requirement E-4 through Program Architecture process step 15a was completed. This includes the development of uncertainty and uncertainty reduction methods. Additionally, the technical review components were identified.

6.2.2.2 Task 2: Develop Technical and Analytical Capabilities

P. Nair attended the NACE meeting at Jekyll Island, Georgia on August 9-10, 1989, and visited the University of Michigan, Michigan Ion Beam Laboratory, to familiarize himself with their metal surface analysis techniques. The trips were also used to assist the recruiting efforts of the Center. An extended summary for a technical paper to be presented at the First Annual International High-Level Radioactive Waste Management Conference was submitted.

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. Progress was made according to the task program plan developed in FY89. H. Manaktala and Y-T. Wu participated in an information exchange meeting with DOE and others on the subject of "Substantially Complete Containment".

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

Support any additional activities necessary for the EBS FY90-91 Operations plan resulting from NRC staff review.

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. Present the paper, "Probabilistic Performance Assessment Using a New Importance Sampling Scheme Based on an Advanced Mean Value Method," authored by Y-T. Wu and P. Nair, at the FOCUS 89 conference.

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 letter report on the status of the EBSPAC development at the end of FY89. Complete the development of the importance sampling scheme using a corrosion model.

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 \$88,828. 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	Funds	Funds		Adjustment	Revised
Negotiated	Allotted	Funds	Funds	to Complete	Subelement
Subelement	by NRC	Costed	Uncosted	Subelement	Subelement
<u>Ceiling</u>	<u>to date</u>	<u>Costed</u>	<u>Uncosted</u>	<u>(+ or -)</u>	<u>Ceiling</u>
\$1,405,466	\$1,405,466	\$1,084,143	\$321,323	-0-	-0-

EBS Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	42,389	1,105,048
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	62,110	1,084,143
VARIANCE, \$	(22,079)	1	(25,803)	(3,303)	(56,943)	5,173	(1,595)	22,417	21,737	(1,188)	2,770	(3,515)	(19,721)	20,905
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	-46.5	1.9
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	1,105,048	
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	1,084,143	
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	20,905	
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	1.9	

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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.

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, 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 Operations 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

A delay in the submission date of the TRS Operations Plan until January 1990 for the FY90/91 TRS Operations Plan has been granted, 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. 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 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 finalized 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 7% of the SAND84-7174 raw data was found 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 indicated that these databases cannot simply be combined with the SAND84-7174 database for the purpose of either projection or development of scenarios. Thus, only the SAND84-7174 database will be used. Complete tables comparing extrapolated 1975 and 1982 data with 1985 projections were generated.

Further literature has been obtained on radioactive materials transportation associated with medical use. Computer codes are continuing to be documented and RADTRAN runs are continuing.

7.2.1.2.2 Subtask 2.2: Evaluation of Models and Codes

E. Oelkers completed a rough draft of the comparative evaluation of transportation models and codes. R. Weiner edited this comparison for a presentation and publication. An additional presentation for Waste Management '90 was prepared using this material.

7.2.1.2.3 Subtask 2.3: Uncertainty and Sensitivity Analysis

Evaluation of RADTRAN by conducting several verification exercises continues. A presentation for Waste Management '90 was prepared on this material.

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). This draft has been submitted to NRC, and the Center is awaiting NRC comments.

7.2.1.4 Task 4: Discussion and Analysis of Transportation Alternatives

Work in Chapter 6 "Alternative Analyses" was begun and considerable revision and reorganization of the material in Chapter 6 is needed. An extension of this milestone will be discussed with the Subelement Project Manager.

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" continues.

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

No milestones scheduled.

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

A presentation made to the NRC staff

on September 16, 1989.

7.2.2.2.2 Subtask 2.2: Evaluation of Models and Codes
A presentation was made to NRC staff on September 16, 1989.

7.2.2.2.3 Subtask 2.3: Uncertainty and Sensitivity Analysis
The uncertainty analysis of the databases and the first section of a RADTRAN sensitivity analysis have been submitted as a draft to NRC.

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

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 completed during the forthcoming period.

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. Sensitivity analysis of RADTRAN will continue.

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 complete the Overview of Radiological Effects, Chapter 3.

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 continue to 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	\$364,066	\$110,372	-0-	-0-

TRS Subelement Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	29,626	408,342
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	10,200	364,066
VARIANCE, \$	(1,770)	(4,010)	934	(4,340)	6,118	3,570	(1,756)	(9,250)	4,674	11,869	9,422	5,780	19,426	44,276
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	65.6	10.8
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	408,342	
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	364,066	
VARIANCE, \$	1,839	(2,171)	(1,237)	(5,577)	541	4,111	2,355	(6,895)	(2,221)	9,648	19,070	24,850	44,276	
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	10.8	

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,

Subcontractors/Consultants: A. Greenberg

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 reviewed and commented on TOP 001-04 and the revised TOP 001-02 and its supporting attachments. He has also been working on the revision of RR0055 (E-07), which was returned from PARC review. RR0072 (B-33) was split into two regulatory requirements. The primary text for RR0072 is 10 CFR Part 60.52 and this text has requirements for both DOE and NRC and must be split to assure clarity.

8.2.1.2 Task 2: Develop and Sustain Technical and Analytical Capability

R. Adler, S. Spector, and R. Weiner conducted interviews with three candidates for the vacant regulatory analyst position. S. Spector and P. LaPlante attended weekly Yucca Mountain Project staff meetings and reported to Center staff. P. LaPlante attended the NUDOCS Users Group meeting and implemented required actions for NUDOCS capability. J. Hageman and the Washington staff assisted in preparation of the FY90/91 Special Projects Operations Plan. R. Weiner prepared two papers for submission to the International High Level Waste Management meeting.

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

R. Adler developed task statements for FY90/91 Operations Plans covering the Center Five-Year Plan and strategic issues. No

comments were received from NRC on strategic programmatic risks and an analysis format is being developed.

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

Three Pertinent Information Summaries were prepared and distributed internally on August 11, August 18, and August 29, 1989. A review of the Federal Registers was made and updates to regulatory changes were provided to staff.

8.2.1.5 Task 5: Provide Policy Options to Streamline the Licensing Process

R. Weiner and J. Hageman worked with an NRC team to finalize the outline for the Format and Content Guide (F&CG). J. Hageman, R. Weiner, and A. Greenberg completed and submitted the "crosswalk" between 10 CFR Part 60.21 and 10 CFR Part 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

None this period.

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

None this period.

8.2.2.4 Task 4: Monitor Nuclear Waste Related Federal Regulations

Three pertinent Information Summaries were issued.

8.2.2.5 Task 5: Provide Policy Options to Streamline the Licensing Process

Comments on the final Format and Content Guide (F&CG) Table of Contents were prepared and submitted. The "crosswalk" between 10 CFR Part 60.21 and 10 CFR Part 60 Subpart E was submitted to the NRC.

8.2.3 Problems

None this period.

8.2.4 Forecast for Next Period

8.2.4.1 Task 1: Support Development of Program Architecture

Continue Program Architecture and PARC activities, including finalization of procedures (TOPs), analyses of NRC and staff comments, and review of both input for the remainder of 10 CFR Part 60 and input material in the new format.

8.2.4.2 Task 2: Develop and Sustain Technical and Analytical Capability

Based on the August 9, 1989 meeting, with J. Linehan, M. Delligatti, and Center staff, incorporate comments on the Environmental/Socioeconomic Task into the Operations Plan.

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

Procedure for analyzing program risks will be developed and submitted by October 1, 1989.

8.2.4.4 Task 4: Monitor Nuclear Waste Related Federal Regulations

Continue to monitor activities, including revised EPA Regulations for the disposal of HLW.

8.2.4.5 Task 5: Provide Policy Options to Streamline the Licensing Process

Finalize "crosswalk" for use with Format and Content Guide Table of Contents (F&CG). Conduct discussions with OGC and the Project Element Manager on previously submitted task statement and future activities.

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 \$1,500. The observed variances result primarily from tasking the staff to Program Architecture development activities outside of this Subelement.

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>
\$1,499,841	\$1,499,841	\$1,301,046	\$198,795	-0-	-0-

ATTACHMENT
SPECIAL PROJECTS AND ANALYTICAL EVALUATIONS, INCLUDING TRANSPORTATION

<u>T.D.</u>	<u>PARC Date</u>	<u>Status</u>
RR050 (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.
RR051 (B-2)	12/20/88	RR was input to mainframe.
RR052 (B-3)	8/09/89	Redone and resubmitted to PARC.
RR053 (B-4)	6/29/89	PARCed and in mainframe.
RR054 (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.
RR074 (B-6)	7/19/89	PARCed, sent to QA, and placed in mainframe.
RR055 (E-7)	8/01/89	Revisions begun after PARC comments.
RR056 (E-8)	4/1/89	PARCed and placed in mainframe.
RR073		Combined with B7, B8, B9, B10, B11 to make new RR (RR073).
RR062 (B-13)		NO ACTIVITY THIS PERIOD.
RR063 (B-14)	7/11/89	PARCed, sent to QA, and placed in mainframe.
RR064 (B-15)	7/11/89	PARCed, sent to QA, and placed in mainframe.
RR065 (B-16)		Currently being developed by J. Hageman and M. Muller.
RR066 (B-17)	7/11/89	PARCed, sent to QA, and placed in mainframe.
RR067 (B-18)	8/10/89	sent to PARC.
RR068 (B-19)	8/13/89	PARCed, sent to QA, and placed in mainframe.
RR069 (B-20)	8/11/89	sent to pre-PARC.

RR070 6/19/89 PARCed, sent to QA, and placed in mainframe.
(B-21)

RR071 Under revision by J. Hageman and K. Brewer.
(B-22)

RR072 Under revision by J. Hageman and J. O'Brien.
(B-23a)

RR076 Under revision by J. Hageman and J. O'Brien. NOTE: B-23 was split
(B-23b) because it has DOE requirements and NRC requirements mixed within 10
CFR Part 60.52.

SPAE/T Element Status Cost Report, Year 2

ITEM	13	1	2	3	4	5	6	7	8	9	10	11	12	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	125,094	1,497,475
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	90,401	1,301,046
VARIANCE, \$	12,213	1	47,680	31,608	51,978	28,951	20,946	11,050	22,082	13,460	45,176	49,022	34,693	196,429
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	27.7	13.1
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	1,497,475	
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	1,301,046	
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	196,429	
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	13.1	

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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.

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 of the SwRI staff, T. Brandshaug of Itasca, and R. Field, a consultant, performed work on the RDCO Program Element during Period 12. J. Hageman, J. Bayouth, M. Muller, T. Brandshaug and R. Field performed work on Task 1. S. Hsiung conducted work in Tasks 1, 2, 4 and draft Operations Plan for FY90 and FY91; he also worked on the 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. A. Chowdhury attended the NRC/CNWRA Operations Plans Meeting at NRC-NMSS on August 8, and 9, 1989 to present the proposed RDCO Operations Plans and to have technical discussions with the NRC RDCO Program Element Manager and Technical Guidance personnel concerning development of technical positions, and activities for the FY90 and FY91 Operations Plans.

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 (SwRI), and R. Field (Consultant).

The development of the Program Architecture on the Regulatory Requirement designated "Thermal Load" is continuing following the Center's revised Technical Operating Procedure TOP-001-02 Rev. 1.

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 a presentation of the proposed RDCO Operations Plan by A. Chowdhury at the NRC/CNWRA Operations Plans meeting at NRC-NMSS, August 8, 1989. On August 9, he had meetings with J. Pearring, J. Buckley and N. Tanious for discussions and preparation (a) of a work schedule to assist NRC in the development of technical positions on thermal loads and nuclear waste retrievability, and (b) the work schedule for the FY90 and FY91 Operations Plan activities for RDCO.

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.

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

To prepare for FY90 Program Architecture activities on a limited number of Regulatory Requirements, the Program Architecture activities for the next reporting period (Period 13) 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 thermal loads.

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 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>
\$1,182,666	\$1,182,666	\$978,197	\$204,469	-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)	Has been submitted to PARC during this reporting 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.

ATTACHMENT
REPOSITORY DESIGN, CONSTRUCTION, AND OPERATIONS

<u>ID</u>	<u>STATUS</u>
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RR87(E-52)	PARCed and QA approved through step 7.
RR88(E-38)	On hold for new format.
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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	12	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	55,621	992,615
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	40,043	978,197
VARIANCE, \$	(32,469)	2	1,407	13,232	32,955	(6,453)	10,921	9,704	9,227	(70,395)	(16,479)	(11,474)	15,578	14,418
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	28.0	1.5
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	992,615	
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	978,197	
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)	14,418	
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	1.5	

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.