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

For the Fiscal Reporting Period

May 10, 1997 – June 6, 1997

PMPR No. 97-9

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ABBREVIATIONS

1D	one-dimensional
2D	two-dimensional
3D	three-dimensional
AA	Atomic Absorption
AAI	Average Annual Infiltration
ACD	Advanced Conceptual Design
ACF	Alumina (in excess of alkali feldspar), Calcium Oxide, Ferromagnesian Oxide
ACNW	Advisory Committee on Nuclear Waste
ACRS	Advanced Computer Review System
AECL	Atomic Energy of Canada Limited
AES	Atomic Emission Spectrometry
AGU	American Geophysical Union
AI	Administrative Item
ALTS	Apache Leap Test Site
AML	Areal Mass Loading
ANS	American Nuclear Society
ANSI	American National Standards Institute
AO	Annotated Outline
AP	Administrative Procedure
APB	Acid-Producing Bacteria
ARDES	Activities Related to Development of the U.S. Environmental Protection Agency Yucca Mountain Standard
ASCE	American Society of Civil Engineers
ASCII	American Standard Code for Information Interchange
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ASU	Arizona State University
ATDTS	Automated Technical Data Tracking System
BEG	Bureau of Economic Geology
BFD	Basis for Design
BM	Bare Mountain
BMF	Bare Mountain Fault
BTP	Branch Technical Position
CAI	Color Alteration Index
CAR	Corrective Action Request
CCDF	Complementary Cumulative Distribution Function
CCL	Commitment Control Log
CCM	Constant Capacitance Model
CD-R	CDROM Recordable
CDF	Cumulative Distribution Function
CDM	Compliance Determination Method
CDOCS	Consolidated DOCument Management System
CDROM	Compact Disk Read Only Memory
CDS	Compliance Determination Strategy
CDTS	Commission Decision Tracking System
CEB	Center for Environmental Biotechnology
CEC	Commission of the European Communities
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulation
CIAC	Computer Incident Advisory Capability
CLST	Container Life and Source Term
CM	Configuration Management
CNWRA	Center for Nuclear Waste Regulatory Analyses
COI	Conflict of Interest
COPS	CNWRA Operations
CPP	Cyclic Potentiodynamic Polarization
CQAM	CNWRA Quality Assurance Manual
CRG	Center Review Group
CRWMS	Civilian Radioactive Waste Management System
CSCS	Constrained Stochastic Climate Simulator
CSH	Calcium Sulfate Hydrate
DAS	Data Acquisition System
DBE	Design Basis Event
DC	Division of Contracts
DCAA	Defense Contract Audit Agency
DCF	Dose Conversion Factor
DECOVALEX	DEvelopment of COupled Models and Their VALidation Against EXperiments in Nuclear Waste Isolation
DEIS	Draft Environmental Impact Statement
DEM	Digital Elevation Model
DF	Dilution Factor
DFCSS	Division of Fuel Cycle Safety and Safeguards
DIE	Determination of Importance Evaluation
DIMNS	Division of Industrial and Medical Nuclear Safety
DLG	Digital Line Graph
DLM	Diffuse Layer Model
DNAG	Decade of North American Geology
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOE-DP	DOE Defense Program
DRA	Division of Regulatory Applications
DST	Drift Scale Test
DTED	Digital Terrain Elevation Data
DWM	Division of Waste Management
EBS	Engineered Barrier System
EBSER	Engineered Barrier System Experimental Research
EBSPAC	Engineered Barrier System Performance Assessment Code
ECM	Equivalent Continuum Model
EDO	Office of the Executive Director for Operations
EDX	Energy-Dispersive X-Ray Spectroscopy

ABBREVIATIONS (cont'd)

EIS	Environmental Impact Statement
EM	Element Manager
EMPA	Electron MicroProbe Analysis
ENFE	Evolution of the Near-Field Environment
ENGB	ENgineering and Geosciences Branch
EnPA	Energy Policy Act of 1992
ENS	European Nuclear Society
EPA	U.S. Environmental Protection Agency
EPR	Electrochemical Potentiokinetic Reactivation
EPRI	Electric Power Research Institute
EQA	External Quality Assurance
EROS	Earth Resource Observation System
ESP	Environmental Simulation Program
ESF	Exploratory Studies Facility
EXAFS	Extended X-Ray Absorption Fine Structure
FAC	FAvorable Condition
FCRG	Format and Content Regulatory Guide
FDSHA	Fault Displacement and Seismic Hazard Analysis
FEHM	Finite Element Heat and Mass Transfer
FEM	Finite Element Method
FEP	Features, Events, and Processes
FFRDC	Federally Funded Research and Development Center
FFT	Fast Fourier Transform
FTE	Full-Time Equivalent
FTP	File Transfer Protocol
FY	Fiscal Year
FYTD	Fiscal Year-to-Date
GDF	Ghost Dance Fault
GEM	General Electrochemical Migration
GEOTRAP	GEOlogic Transport of RAdionuclides Predictions
GERT	General Employee Radiological Training
GET	General Employee Training
GFM	Geological Framework Model
GHGC	GeoHydrology and GeoChemistry
GIS	Geographic Information System
GLGP	GeoLogy and GeoPhysics
GPS	Global Positioning Satellite
GROA	Geologic Repository Operations Area
GS	Geologic Setting
GSA	Geologic Society of America
GTFE	Great Tolbachik Fissure Eruption
GUI	Graphics User Interface
GWSI	GroundWater System Integration
GWTT	GroundWater Travel Time
HLUR	High-Level Waste and Uranium Recovery Projects Branch
HLW	High-Level Waste
HRTEM	High-Resolution Transmission Electron Microscopy
IA	Igneous Activity
IBM	International Business Machines
ICP	Inductively Coupled Plasma
IDLH	Immediately Dangerous to Life and Health
IHLRWM	International High-Level Radioactive Waste Management Conference and Exposition
IM	Intermediate Milestone
IME	Industrial Mobilization Exemption
IMS	Information Management Systems
INEL	Idaho National Engineering Laboratory
INETER	Instituto Nicaraguense de Estudios TERritoriales
INTRAVAL	International Code Validation
I/O	Input/Output
IPA	Iterative Performance Assessment
IR&D	Internal Research & Development
IRIS	Interim Records Information System
IRM	Office of Information Resources Management
IRSR	Issue Resolution Status Report
IVM	Interactive Volume Modeling
IWPE	Integrated Waste Package Experiments
JC	Job Code
JPL	Jet Propulsion Laboratory
JRC	Joint Roughness Coefficient
KTI	Key Technical Issue
KTU	Key Technical Uncertainty
LAAO	License Application Annotated Outline
LAN	Local Area Network
LANL	Los Alamos National Laboratories
LARP	License Application Review Plan
LAW	Low-Activity Waste
LBL	Lawrence Berkeley Laboratory
LHS	Latin Hypercube Sampling
LITC	Lockheed Information Technology Company
LLNL	Lawrence Livermore National Laboratory
LLW	Low-Level Waste
LSS	Licensing Support System
LSSPP	Licensing Support System Pilot Project
LSSTB	Licensing Support System Test Bed
LWR	Light Water Reactor
Ma	Million Years Ago
MC	Monte Carlo
METRA	Mass and Energy TRAnsport
MGDS	Mined Geologic Disposal System
MH	Mechanical-Hydrological
MIC	Microbially Influenced Corrosion
MINC	Multiple Interacting Continua

ABBREVIATIONS (cont'd)

MIT	Massachusetts Institute of Technology
MM	Major Milestone
MO	Management and Operations
MOU	Memorandum of Understanding
MPC	Multi-Purpose Canister
MRS	Monitored Retrievable Storage
MSS	MultiSpectral Scanner
MTU	Metric Ton of Uranium
NAS	National Academy of Sciences
NAWG	Natural Analogue Working Group
NCR	NonConformance Report
NEA	Nuclear Energy Agency
NFS	Network File Server
NIOSH	National Institutes of Safety and Health
NIR	Near-InfraRed
NIST	National Institute of Standards and Technology
NMSS	Office of Nuclear Material Safety and Safeguards
NNE	North-Northeast
NNW	North-Northwest
NOAA	National Oceanographic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NSRRC	Nuclear Safety Research Review Committee
NTS	Nevada Test Site
NUREG	NRC Technical Report Designation
NWPA	Nuclear Waste Policy Act, as amended
NWTRB	Nuclear Waste Technical Review Board
OBES	Office of Basic Energy Sciences
OCRWM	Office of Civilian Radioactive Waste Management
OGC	Office of General Counsel
OITS	Open-Item Tracking System
OMB	Office of Management and Budget
OPS	Operations Plans
ORR	Operations Readiness Review
ORS	Overall Review Strategy
OWFN	One White Flint North
PA	Performance Assessment
PAAG	Performance Assessment Advisory Group
PAC	Potentially Adverse Condition
PAHT	Performance Assessment and Hydrologic Transport
PASP	Performance Assessment Strategic Plan
PC	Personal Computer
PC/TCP	Personal Computer/Transmission Control Protocol
PDR	Public Document Room
PEL	Permissible Exposure Limit
PEM	Program Element Manager
PER	Prelicensing Evaluation Report
PFD	Probabilistic Fault Displacement
PFDHA	Probabilistic Fault Displacement HAzard
PI	Principal Investigator
PDF	Probability Distribution Function
PMDA	Program Management, Policy Development and Analysis Staff
PMPR	Program Manager's Periodic Report
PMT	Photo-Multiplier Tube
PNNL	Pacific Northwest National Laboratory
PO	Project Officer
PPA	Proposed Program Approach
PPE	Prepassivated Platinum Electrode
PRA	Probabilistic Risk Assessment
PRT	Peer Review Team
PSAG	Probabilistic System Assessment Group
PSHA	Probabilistic Seismic Hazard Analysis
PTFE	PolyTetraFluoroEthylene
PTn	Paintbrush Nonwelded Tuff
PVHA	Probabilistic Volcanic Hazards Assessment
PVM	Parallel Virtual Machine
PWR	Pressurized Water Reactor
QA	Quality Assurance
QAP	Quality Assurance Procedure
QRAM	Quality Requirements Application Matrix
RASA	Regional Aquifer System Analysis
RDCO	Repository Design, Construction, and Operations
RDTME	Repository Design and Thermal-Mechanical Effects
REE	Rare Earth Element
REECO	Reynolds Electrical and Engineering Company, Inc.
RES	Office of Nuclear Regulatory Research
RFP	Request for Proposal
RH	Relative Humidity
RIP	Repository Integration Program
ROC	Repository Operations Criteria
RPD	Regulatory Program Database
RRT	Regulatory Requirement Topic
RSRG	Real Space Renormalization Group
RT	Radionuclide Transport
RTS	Radwaste Treatment System
SAR	Safety Analysis Report
SCA	Site Characterization Analysis
SCC	Substantially Complete Containment
SCCEX	Substantially Complete Containment EXample
SCM	Surface Complexation Models
SCP	Site Characterization Plan
SDMP	Site Decommissioning Management Plan
SDS	Structural Deformation and Seismicity

ABBREVIATIONS (cont'd)

SECY	Secretary of the Commission, Office of the (NRC)
SELM	Spectral ELement Method
SEM	Scanning Electron Microscopy
SER	Safety Evaluation Report
SF	Spent Fuel
SFPO	Spent Fuel Project Office
SFVF	San Francisco Volcanic Field
SGML	Standard Generalized Markup Language
SHE	Standard Hydrogen Electrodes
SIP	Scientific Investigation Plan
SKI	Swedish Nuclear Power Inspectorate
SLAR	Side Looking Airborne Radar
SNL	Sandia National Laboratories
SOTEC	SOurce TErm Code
SOW	Statement of Work
SRA	Systematic Regulatory Analysis
SRB	Sulfate-Reducing Bacteria
SRBS	Shafts, Ramps, Boreholes, and Their Seals
SRD	Software Requirements Description
SRESNR	Support Revision of the EPA Standard and NRC Rule
SS	Stainless Steel
STEM	Scanning Transmission Electron Microscopy
STP	Staff Technical Position
SUFLAT	Stochastic Analyses of Unsaturated FLow And Transport
SVF	Springerville Volcanic Field
SwRI	Southwest Research Institute
TA	Technical Assistance
TBD	To Be Determined
TBM	Tunnel Boring Machine
TCP/IP	Transmission Control Protocol/Internet Protocol
TDI	Technical Document Index
TDOCS	Technical DOCument Reference Database System
TEF	Thermal Effects on Flow
TEM	Transmission Electron Microscopy
THMC	Thermal-Hydrologic-Mechanical-Chemical
TLM	Triple-Layer Model
TM	Thermal-Mechanical
TMH	Thermal-Mechanical-Hydrologic
TMS	The Minerals, Metals, and Materials Society
TOP	Technical Operating Procedure
TP	Technical Position
TPA	Total Performance Assessment
TPI	Time Period of Regulatory Interest
TR2	DOE Seismic Topical Report No. 2
TRG	Technical Review Group
TSPA	Total System Performance Assessment
TSPAI	Total System Performance Assessment and Integration
TSw-Chnv	Topopah Spring Welded-Calico Hills Nonvitric
TVD	Total Variation Diminishing
TWFN	Two White Flint North
TWINS	Tank Waste Information Network System
TWRS	Tank Waste Remediation System
UA	University of Arizona
UACH	Universidad Autónoma de Chihuahua
UCLA	University of California-Los Angeles
UDEC	Universal Distinct Element Code
UK	United Kingdom
UNM	University of New Mexico
UR	Uranium Recovery
U.S.	United States
USDA	U.S. Department of Agriculture
USGS	U.S. Geologic Survey
UTM	Universal Transverse Mercator
USFIC	Unsaturated and Saturated Flow under Isothermal Conditions
VA	Viability Assessment
VCS	Version Control System
VF	Vitrification Facility
VIEW_PVH	VIEW Probability of Volcanic Hazards
VSIP	Vertical Slice Implementation Plan
WAN	Wide Area Network
WAPDEG	WAste Package DEGradation
WBS	Work Breakdown Structure
WCIS	Waste Containment and Isolation Strategy
WFO	Work for Others
WGB	Western Great Basin
WIPP	Waste Isolation Pilot Plant
WMB	Waste Management Branch
WNYNSC	Western New York Nuclear Service Center
WOL	Wedge-Opening Loading
WP	Waste Package
WSEI	Waste Systems Engineering and Integration
WSS	Waste Solidification Systems
WTSO	Washington Technical Support Office
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services
WWW	World Wide Web
XPS	X-ray Photoelectron Spectroscopy
XRD	X-ray Diffractometry
YM	Yucca Mountain
YMP	Yucca Mountain Project
YMSCO	Yucca Mountain Site Characterization Office

ABBREVIATIONS (cont'd)

YMR	Yucca Mountain Region
YTD	Year-to-Date

EXECUTIVE SUMMARY—PERIOD 8

In the Division of Waste Management (DWM) Job Code (JC), the following items highlight the Center for Nuclear Waste Regulatory Analyses (CNWRA) key activities and accomplishments:

- The FY97 CNWRA Management Plan (Including Staffing Plan) Update was delivered.
- The CNWRA Quality Assurance Manual Change was submitted.
- The Yucca Mountain Tectonics--Journal Article was delivered.
- The CNWRA Input to Commission Paper on New Proposed Yucca Mountain Standard—Letter Report was transmitted.
- A CNWRA staff member presented an invited paper on estimating the spatial distribution of net infiltration at the annual American Nuclear Society Meeting, June 4, 1997, in Orlando, Florida.

The DWM JC year-to-date (YTD) cost variance was 2.6 percent. This variance reflects spending estimates from the CNWRA Operations Plans Revision 9 Change 2.

In the Waste Solidification Systems (WSS) JC, the CNWRA staff engaged in limited administrative activities; no additional tasking was received nor is expected, pending further guidance. The YTD cost variance to this JC was 49.3 percent. This variance illustrates spending estimates from the Operations Plan for WSS Revision 6 Change 2.

In the Tank Waste Remediation System (TWRS) JC, the CNWRA staff delivered the Survey of Solidification Process Technologies—Interim Report (IM 5709-102-710) for NRC review. In addition, the NRC and CNWRA staffs visited the West Valley Demonstration Project and the Savannah River Site vitrification operations. The YTD cost variance was −0.7 percent. This variance depicts spending estimates from the Operations Plan for Technical Assistance to TWRS Licensing Revision 0 Change 2.

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

TITLE: Center for Nuclear Waste Regulatory Analyses (CNWRA)

CONTRACTOR: Southwest Research Institute (SwRI)
6220 Culebra Road, San Antonio, Texas 78238-5166

CONTRACT NO: NRC-02-93-005

JOB CODES: D1035, L1793, J5164

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ESTIMATED BUDGET: $89,898,141

PERIOD OF PERFORMANCE: 10/15/92-09/26/97

PERIOD OF THIS REPORT: 05/10/97-06/06/97

1 TECHNICAL

1.1 CNWRA Operations (COPS)

In addition to a wide range of day-to-day activities, COPS accomplishments included (i) participation in a joint NRC/CNWRA briefing of the Commission; (ii) initiation of Contract—NRC-02-97-001, Technical Assistance for Reviewing Licensee Submittals Concerning Decommissioning, and Letter Contract—NRC-02-97-004, Technical Assistance in the Preparation of an Environmental Impact Statement for the Application for a License to Operate an Independent Spent Fuel Storage Installation to Store TMI-2 Spent Fuel at the Idaho Nuclear Engineering Lab Site; (iii) delivery of Revision 6 Change 0 of the FY97 CNWRA Management Plan (Including Staffing Plan) Update (MM 5708-158-720); (iv) beginning the development of the Five-Year Cost Proposal; (v) participation in weekly HLW Management Board meetings; (vi) submittal of the CNWRA Quality Assurance Manual Change (IM 5708-159-710); (vii) conduct of scheduled QA surveillance, participation in meetings on software QA and COI activities, and preparation for the 1997 CNWRA QA Audit; (viii) execution of the NRC-approved and CIAC-recommended changes to the CNWRA Computer Security System; and (ix) participation in the monthly NRC/CNWRA Computer Coordination Meeting and support for maintaining LAN operations.

Status of the CNWRA staffing is indicated in table 1. The hydrologic transport specialist, scheduled to join the CNWRA staff in period 9, declined to pursue the employment offer.

As agreed, recruitment efforts and interviews for the listed open positions have been suspended until the NRC establishes FY98 funding for the CNWRA. Section 4 of the revised CNWRA Management Plan (Revision 6 Change 0) reiterates the five criteria for estimating the CNWRA staffing needs in support of the NRC-NWPA program and the requirement for maintaining 54 FTE consistent with previous staffing plans for the FY97-01 planning horizon.

In the next period, the CNWRA expects to (i) continue discussions on staffing and funding for FY98; (ii) proceed with development of the Five-Year Renewal Cost Proposal; (iii) conduct scheduled surveillances, review RFPs received by SwRI for potential COI, continue to enter CNWRA internal and product documents into the QA records, conduct the annual CNWRA QA audit and prepare the FY97 QA Audit—Letter Report (IM 5708-159-720); (iv) progress with the execution of the NRC-approved and CIAC-recommended modifications to the CNWRA Computer Security System; (v) pursue preparation of the CNWRA Computer Certification—Letter Report (IM 5708-158-730) and FY97 CNWRA Computer Security Plan Update—Letter Report (IM 5708-158-750); and (vi) provide CNWRA LAN operation and maintenance support.

1.2 Igneous Activity (IA)

Staff completed a trip report summarizing presentations and discussion at the ACNW meeting on volcanism. An author-final copy of the journal article, Dispersion of Basaltic Tephra from 1995 Cerro Negro Eruption (IM 5708-461-760), was completed. This article, now in technical review at the CNWRA, summarizes the application of the Suzuki ash dispersion code to volcanic risk analysis at a basaltic cinder cone in Nicaragua. The purpose of this application was to assess the code as a means of modeling ash dispersion from volcanoes in the YMR. Acceptance Criteria on Probability of Future Igneous Activity (IM 5708-461-700) were written by IA staff during this period. It was concluded at a HLW Management Board meeting during this period that the general format of the IA acceptance criteria IM is appropriate. The board members began providing IA staff with written comments about these acceptance criteria.

In collaboration with scientists from the Smithsonian Institution, the University of Texas, and the University of Mexico, IA and SDS staffs conducted field investigations at the Camargo Volcanic Field, Mexico, to investigate relationships between volcano location and geologic structure. This field work concentrated on the Borregas fault system, an area of classical Basin and Range style volcanism and faulting during the Pliocene. Radiometric age determinations on 20 basaltic lava flows along the fault zone indicate that volcanism and deformation occurred during an intense period of activity between 2.95 and 2.5 Ma. Preliminary study results of this fault zone suggest that areas in the Basin and Range can respond to crustal extension by penecontemporanous magmatism and deformation. This conclusion runs counter to the idea that episodes of volcanism can suppress regional seismicity, and vice versa.

An IA and SDS team began detailed ground magnetics surveys in the Amargosa Desert, Crater Flat, and Jackass Flat areas of the YMR. The goal of this work is to determine if aeromagnetic anomalies mapped in the YMR are produced by buried igneous rock.

In the next period, the detailed ground magnetic surveys will be completed. It is anticipated that approximately 6 of the 28 aeromagnetic anomalies previously identified will be mapped in detail by the end of the next period. Modeling and interpretation of magnetic data will also continue during the forthcoming period. The journal article, Dispersion of Basaltic Tephra from 1995 Cerro Negro Eruption (IM 5708-461-760), will be delivered during the next period. Work will progress on a journal article, Probability Model Parameters and Sensitivities (IM 5708-461-730), and Input to the Issue Resolution Status Report on the Probability of Future Igneous Activity (IM 5708-461-700).

1.3 Structural Deformation and Seismicity (SDS)

SDS staff observed the 6th DOE Seismic Source Characterization workshop in Salt Lake City, Utah. This was an auxiliary meeting called to discuss additional models and interpretations for the DOE expert elicitation PFDHA.

Preparations continued for the joint SDS and IA field work of ground magnetic surveys in Crater Flat, Jackass Flat, and Amargosa Valley, including arrangements for consultant support and scoping analyses to assess and prioritize the aeromagnetic anomalies identified on USGS aeromagnetic maps of the YMR. In the last week of this period, the anomaly southeast of Steve's Pass was surveyed.

Work continued on the Input to Issue Resolution Status Report Including Acceptance Criteria on Type 1 Faults (IM 5708-471-745). An outline was developed and tasks assigned to SDS staff.

In late May, GLGP staff members participated in a reconnaissance survey of the volcanic field at Camargo, Mexico, to investigate relationships between basaltic volcanic eruptions and geologic structure, in collaboration with scientists from the Smithsonian Institution, the University of Texas, and the University of Mexico. The intent of the trip was to determine suitability of the site for studying the interaction between volcanic centers and faults. Preliminary results suggest that areas in the Basin and Range can respond to crustal extension by penecontemporanous magmatism and deformation. This conclusion runs counter to the idea that episodes of volcanism suppress regional seismicity, and vice versa.

A manuscript on Constant Thickness Deformation Above a Curved Normal Fault (IM 5708-471-733) was completed and is in the review process. The equations that define hangingwall dip in terms of cutoff angle, rest angle, and layer parallel shear, given the conditions of general shear, are derived in this manuscript. Unlike other approaches commonly used to model extensional faults, constant thickness deformation predicts a vertically upward increase in the amount of deformation in the hangingwall above listric normal faults.

A manuscript on Yucca Mountain Tectonics—Journal Article (IM 5708-471-730) entitled, Paleomagnetic Constraint on the Tectonic Evolution of Bare Mountain, Nevada, was submitted.

In the next period, the IM report entitled, Geologic Input for TPA Version 3.0 Code—Letter Report (IM 5708-471-711), will be submitted, as will a manuscript on Constant Thickness Deformation Above a Curved Normal Fault (IM 5708-471-733). In addition, Input to Issue Resolution Status Report Including Acceptance Criteria on Type 1 Faults (IM 5708-471-745)

is planned for transmittal. Work will continue on the Input to Issue Resolution Status Report Including Acceptance Criteria on Tectonic Models (IM 5708-471-700). A manuscript entitled, Geometric, Thermal, and Temporal Constraints on the Tectonic Evolution of Bare Mountain (IM 5708-471-731), will be submitted also.

The NRC and CNWRA staffs will meet to discuss and plan Sensitivity Analysis Using FAULTING Module (IM 5708-471-710) and Sensitivity Analysis Using SEISMO (IM 5708-471-712).

1.4 Evolution of the Near-Field Environment (ENFE)

A meeting was held at NRC to discuss IRSR development and design of PA sensitivity studies. Additional teleconferences focused on the same issues. A preliminary expanded outline of the IRSR for coupled processes was developed and awaits HLW Management Board recommendations. Four scenarios being developed for sensitivity testing involve effects of (i) cementitious materials on water flow and RT; (ii) alternate radionuclide release rate based on natural analog data from Peña Blanca; (iii) iron oxidation products on RT; and (iv) brine formation caused by boiling on container corrosion.

Equilibrium constants for dissolution of cement phases provided by a CNWRA consultant recognized internationally for his work on cement chemistry were evaluated and compared with available values in the EQ3 database. The new values are based on relatively new experimental results, thus many of the cement solids included in this new information are not in the EQ3 database. For well-known minerals such as portlandite, the equilibrium constants from both sources are in good agreement. The stoichiometries of some minerals common to both data sets are different, which complicates direct comparison of the equilibrium constants. Several dissolution reactions in the new data set had to be rewritten using the basic species in EQ3 to allow incorporation of the new values into the MULTIFLO database.

Work progressed on modifying MULTIFLO to include an unstructured grid capability and the MINC algorithm. Coding for incorporating hydration-dehydration reactions was completed and tested.

MULTIFLO simulations of alkaline plume migration were initiated. Cement phase assemblages for initial conditions in the simulations were calculated using CEMCHEM Version 1.0, a program for calculating equilibrium phase distribution at 25 °C in blended cements. Phase distributions were calculated for a pure ordinary portland cement composition and for a blend with 70 percent ordinary portland cement and 30 percent blast furnace slag. Hydraulic properties and the mineralogic composition of Topopah Spring Tuff were derived from the DOE reports. MULTIFLO calculations were initially based on pure diffusive transport of solute species. Three cases were considered: (i) diffusion of hyperalkaline cement pore water into tuff, (ii) diffusion of tuff pore water into cement, and (iii) counter diffusion of solutes at the cement-tuff contact. Results indicate a rapid decrease in porosity in the tuff in the first and third cases. In the fully saturated case, calcification of the cement occurs only in the presence of a gas phase because of the rapid decrease in porosity in the tuff blocking transport of CO_2.

Prolonged corrosion tests continued for 1,068 days to confirm the applicability of repassivation and corrosion potentials as predictive parameters of the long-term localized

corrosion of Alloy 825 in chloride-containing solutions. No initiation of localized corrosion was observed on specimens continuously maintained below the repassivation potential. A long-term test with a creviced Alloy 825 specimen in an aerated 1,000 ppm chloride solution at 95 °C has been in progress for 657 days at the open-circuit potential. Corrosion potential of this specimen varied between 120 mV above to 100 mV below the repassivation potential in the last several months of testing. Crevice corrosion was initiated each time the corrosion potential exceeded the repassivation potential.

Galvanic corrosion tests with Alloy 825 and A516 carbon steel specimens continue. Baseline tests using different area ratios of A516 carbon steel and Alloy 825 were conducted in aerated 1,000 ppm chloride solution. The effect of temperature on the galvanic corrosion potential of the bimetallic couple is now being tested.

Characterization of the interface between A516 carbon steel and Alloy 825 has been conducted to determine efficiency of the galvanic contact between inner and outer container barriers. Resistance between the mating surfaces with and without oxide scales, chloride containing solutions, and corrosion products was measured using electrochemical impedance spectroscopy. Thermal oxidation of A516 carbon steel and Alloy 825 specimens is now being conducted. The effect of thermal oxide on resistance of the galvanic contact will be characterized.

Review continued of the DOE Summary and Synthesis Report on Mineralogy and Petrology Studies for the Yucca Mountain Site Characterization Project.

The deliverable MULTIFLO Training and Presentation (IM 5708-561-730) has been cancelled to enable work on higher priority tasks during the remainder of this year. Effects of Microbes on Near-Field Environment—Journal Paper (IM 5708-561-760) was delayed to accommodate the NRC staff available for collaboration.

In the next period, there will be progress on developing Input to Issue Resolution Status Report Including Acceptance Criteria on Near-Field Chemistry (IM 5708-561-700) and on conducting ENFE sensitivity analyses for PA. A revised EQ3 database incorporating newly received equilibrium constants will be generated. This will permit calculation of cement phase solubilities for comparison with experimental data published by the University of Aberdeen. MULTIFLO simulations of alkaline plume migration will continue. Future work will consider flow of a hyperalkaline plume along a fracture with simultaneous diffusion into the rock matrix. This will allow investigation of fracture sealing effects. Dehydration reactions will be considered in modeling the near-field chemistry to provide an estimate of the potential source of water from these reactions. MULTIFLO will continue to be enhanced. GIMRET/OS3D reactive transport calculations of alkaline plume migration will begin.

Long-term corrosion tests of Alloy 825 will continue. Additional galvanic corrosion tests are planned to evaluate the effects of other parameters such as chloride concentration. The thermally oxidized metal-to-metal interface will be characterized.

1.5 Thermal Effects on Flow (TEF)

The study on potential causative mechanisms leading to formation of perched water bodies near the proposed repository area under nonisothermal conditions continued during the reporting period. Results of this study will be reported in Evolution of Perched Water Bodies at YM—Journal Paper (IM 5708-661-760) due August 1997. Currently, this report is in preparation.

Development of an analytical model to describe heat conduction, two-phase flow, and gravity-driven fracture film flow continued. The analytical model will be solved numerically to assess the refluxing phenomenon. Assessment of two other conceptual models for gravity-driven refluxing progresses at a low level of effort.

Sensitivity-to-dose analyses to determine the importance of thermal effects on flow continue to move forward. A 3D basecase numerical model for use in these analyses has been developed. Scoping analyses continue to ascertain the effect of high (6 mm/yr) and low (0.05 mm/yr) infiltration rates. To accelerate sensitivity analyses, numerical assessment of the 1988–89 LLNL G-Tunnel heater experiment continued at a low level of effort.

The Fortran code describing the abstraction model of water refluxing to the WP submitted to the TSPAI KTI during period 8 was revised and included in TPA Version 3.1 code.

Two laboratory-scale experiments to support analysis efforts in the TEF KTI continued—one to quantify the rate of moisture removed from a volume of saturated porous material by ventilation and the other to assess depression of the boiling isotherm by infiltration or refluxing water. The apparatus for each of the two experiments is under construction. Results from the experiments will be used to evaluate ventilation and gravity driven refluxing analyses conducted in the TEF KTI.

Analyses began on the effect of ventilation on rock saturation and drift relative humidity. Results will be reported in Ventilation Effects on Repository—Journal Paper (IM 5708-661-740) due September 1997.

A TEF KTI technical staff member attended the DOE DST Heating/Cooling Plan meeting at LLNL on June 3, 1997. Technical concerns raised by the NRC/CNWRA regarding the planned test were discussed at length. The DOE now plans to conduct an eight-year (four years heating/four years cooling) test with maximum drift wall temperature of about 200 °C. Earlier plans to conduct a shorter test at elevated temperatures appear to be discounted at this time.

In the next period, TEF KTI plans to (i) conduct two laboratory-scale experiments, (ii) perform sensitivity-to-dose analyses, (iii) continue assessment of conceptual models of refluxing, and (iv) assess the effects of ventilation on moisture removal from the repository environment.

1.6 Total System Performance Assessment and Integration (TSPAI)

Work continued on development, modification, and testing of the new TPA Version 3.1 code, as outlined in the schedule provided to NRC. During this period, the TPA code activity

consisted of module modification, FOR_STUDY testing, units checks, and addition of customized output requested as by the NRC. Although significant progress was made on the new TPA version, activity was impacted by computer hardware problems that occurred as a result of an extended power outage. In addition to causing delays in accessing the computers, these hardware problems required reconstructing various source code files, which became corrupted. The TPA code development effort is approximately one week behind schedule.

Work related to Issue Resolution Status Report Including Acceptance Criteria on Model Abstraction (IM 5708-761-745) continued. Meetings and teleconferences were held to discuss the approach to this IRSR. Additional guidance on requirements for this IRSR is expected from the NRC prior to initiating actual preparation of input to the Model Abstraction IRSR. This milestone has been rescheduled (see table 2) to permit input from the TSPA Technical Exchange which is planned for July.

The report on an initial set of TPA input parameters was completed and placed in the CNWRA review process. This letter report compares and evaluates the TPA (IPA Phase 3) and RIP (TSPA-95) input parameter values on a module-by-module basis. Information in the report is a starting point for developing the TPA baseline data set that will be used in the planned KTI sensitivity analyses. This letter report will be transmitted in the next period to fulfill Comparison of TPA and RIP Data Sets (IM 5708-761-720).

The letter report on the Parametric Study of Repository Stability—Letter Report (IM 5708-761-740) was completed and placed in the CNWRA review process. This letter report documents the numerical modeling study conducted using the UDEC computer code.

Work continued on EBSPAC, Version 1.1 User's Manual (IM 5708-762-740). The report was revised to address technical and programmatic review comments. This technical report will be transmitted in the next period. This version of EBSPAC is different from that incorporated into the TPA Version 3.1 code. It was jointly decided with the NRC to have different EBSPAC versions to ensure timely completion of this milestone.

The galvanic coupling auxiliary analysis continued with calculations of corrosion potentials of both the inner and outer container barriers. These potentials were calculated by modeling kinetics of metal oxidation and oxygen and water reduction reactions. The efficiency of galvanic contact was treated as a model parameter. In addition to galvanic corrosion potentials, resistance of the galvanic contact between the two materials was calculated as the value of galvanic efficiency was varied from 0 to 1. The letter report, Auxiliary Analysis on Galvanic Coupling (IM 5708-761-730), is expected to be completed in the next period.

Evaluations of the potential significance of spurious correlations arising from statistical sampling continued. Computer simulations performed to date indicate there is essentially no difference in correlations between LHS and MC for vector sizes greater than 20. As the number of vectors (N) increases, spurious correlations vary as 1/(N-1) with expectation of zero. Confidence intervals for correlations are large such that the observations have been generally found to be statistically indistinguishable from zero. Computer runs were initiated to determine if correlation minimization algorithms possibly introduce bias in estimates, especially in the tails of distributions.

In the next period, development, modification, and testing of the TPA Version 3.1 code will progress. Preparation of input to the Model Abstraction IRSR will also continue. Three reports will be transmitted in the next period: (i) Parametric Study of Repository Stability (IM 5708-761-740), (ii) Comparison of TPA and RIP Data Sets (IM 5708-761-720), and (iii) EBSPAC, Version 1.1 User's Manual (IM 5708-762-740).

1.7 Activities Related to Development of the U.S. Environmental Protection Agency Yucca Mountain Standard (ARDES)

The report on CNWRA Input to Commission Paper on New Proposed Yucca Mountain Standard—Letter Report (IM 5708-771-730) was transmitted on schedule.

Preparation continued on the technical report for Summary of Information Relevant to the Specification of the Critical Group and Reference Biosphere—CNWRA Report (IM 5708-771-720). Following observance of the DOE TSPA biosphere abstraction workshop, a visit to Amargosa Valley was conducted to supplement understanding of local conditions related to definition of the current biosphere and potential exposure scenarios. Also, multiple linear regression analysis was conducted on current dose conversion factors (DCFs—CNWRA 95-018) to determine the most sensitive dose parameters, results of which will be included in this milestone.

CNWRA staff attended a meeting with the NRC in Rockville, Maryland to further define the technical scope of the Detailed Dilution Analysis Related to Exposure Scenarios Involving Water Wells—Letter Report (IM 5708-771-760). Pending the NRC concurrence, scope of this study will include (i) how variations in well construction practices (e.g., depth, screen placement, etc.), borehole spacing, and pumping rates affect capture of a radionuclide plume of specified shape; (ii) the magnitude of well-to-well variations in radionuclide doses; and (iii) for the purposes of computing doses, the reasonableness of assuming that all radionuclides released from the repository are completely mixed in all of the water pumped in the Amargosa Farms area.

Work progressed on construction of the MODFLOW model to be used in these analyses. A better interpretation of the boundary conditions and parameter values as approximated from other published, larger scale model results was obtained while modeling on a smaller scale (i.e., in the vicinity of Amargosa Farms) is in the literature review and data collection stage. A preliminary statistical study of well design for the area was completed. The Haitjema's analytic element code as well as the 3D finite element flow code (along with a particle tracking code) are expected to be used for the smaller scale flow simulations.

In the next period, the ARDES staff will (i) begin conducting GENII-S runs for generating revised DCFs using updated input parameters and (ii) continue developing the MODFLOW model.

1.8 Unsaturated and Saturated Flow under Isothermal Conditions (USFIC)

Modeling continued to assess the impact of vegetation and microtopography on infiltration at YM. Two-dimensional simulations incorporating several soil-filled fissures, with sink terms representing plant uptake in some of the fissures, clearly demonstrate the potential for crack-thriving species to reduce infiltration in shallow soils. Attempts to model root growth in the

presence of fissures, using a 3D simulator with discrete roots, met with only limited success due to extreme computational burden.

The impact of infiltration pulses on deep percolation at the proposed repository level was investigated using MULTIFLO simulations of a representative column from the water table to the surface. The column features a discrete fracture in the welded units but not the nonwelded units. Episodic infiltration events were approximated using a 2 mo infiltration pulse every 5 yr. Several combinations of infiltration magnitude and channel width were examined. These cases will be compared with the simpler equivalent-continuum approach.

Progress was made on modeling hillslope processes on the west flank of Solitario Canyon. When the level of detail of the drainage network was increased, storm infiltration increased nearly four-fold in the tributary channels, but there was less infiltration in the main channel reaches, so total infiltration decreased. The vast majority of water infiltrates in the main channels, but water infiltrating in the tributary channels is more likely to reach bedrock fractures and escape to depth. This result suggests that the proportion of infiltrating water that reaches the water table as recharge may depend in part on the size of the channel.

The 3D regional flow model developed by the USGS was rerun using MODFLOWP to obtain the hydraulic parameters reported by the USGS. Velocity fields were obtained from this model for the cases of (i) no irrigation pumping in the Amargosa Farms area and (ii) pumping at 8,000,000 m^3/yr. These velocity fields were then used in the MODPATH particle tracking code to evaluate gross-scale plume capture and potential dilution by uncontaminated water in the Amargosa Farms pumping center. Plans for using the 30×60 km, site-scale flow and transport model extracted from the USGS model to develop alternative radionuclide transport paths for the TPA sensitivity studies were presented to the NRC technical staff in Rockville, Maryland.

Critical review continued of the Cl-36 database from the ESF. Preliminary data published in 1996 have been substantially revised in a draft DOE publication dated March 12, 1997, available on the LANL web site. The data can be reasonably represented by two normal distributions that hypothetically correspond to uncontaminated and bomb-pulse contaminated subsets. This statistical analysis leads to the interpretation that 20 to 25 percent of all ESF samples contain some bomb-pulse contamination. Cl-36 data are also being interpreted in terms of the constraints they provide on shallow infiltration.

A CNWRA staff member attended the first meeting of the saturated zone expert elicitation conducted by the DOE June 4–6, 1997, in Denver, Colorado. Also, a CNWRA staff member presented an invited paper on estimating the spatial distribution of net infiltration at the annual ANS meeting June 4, 1997, in Orlando, Florida.

Perched Water—Journal Paper (IM 5708-861-720) has been cancelled due to the unavailability of a necessary consultant.

In the next period, USFIC staff will (i) continue preparing the Infiltration—Journal Paper (IM 5708-861-730), (ii) compare predictions of pulsed infiltration using discrete-fracture and equivalent-continuum models, (iii) extend investigations of saturated zone subregional-scale mixing processes, (iv) review of Cl-36 data from the ESF, and (v) prepare for sensitivity analyses using the TPA code.

1.9 Waste Solidification Systems (WSS)

Limited activities associated with previous tasking occurred and no additional tasking was received.

Per discussions with the PEM, no further tasking is expected for this project in subsequent periods. This project is anticipated to be restructured by DWM and DC direction.

1.10 Tank Waste Remediation System (TWRS)

The Survey of Solidification Process Technologies—Interim Report (IM 5709-102-710) was delivered for review on May 30, 1997. The NRC and CNWRA staffs visited the WVDP and the Savannah River Site vitrification operations.

In response to guidance received from the NRC on May 9, 1997, CNWRA staff reviewed the DOE guidance documents for TWRS privatization and compared them to the NRC guidance provided in the Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility (Draft NUREG-1520) and the Integrated Safety Analysis Guidance Document (Draft NUREG-1513). The Draft Report on Comparison of the DOE Requirements and Guidance With the NRC Regulations and Guidance for the Hanford TWRS (IM 5709-105-720) has been completed and is undergoing internal CNWRA review.

Preparation continued on the IM report, Preliminary High-Level Waste Chemistry Manual (IM 5709-106-705). A draft chapter on the Chemistry Relevant to Criticality Safety was completed and is being formatted prior to technical and programmatic reviews. Editorial review of the chapter on the Chemistry Relevant to Ferrocyanide Reactions was completed; the chapter is being revised. The chapter on the Chemistry Relevant to Radioactive-Decay High-Heat Generation was formatted and will be submitted for editorial review. Major sections of the chapter on Chemistry Relevant to Flammable Gas Retention have also been completed. Comments by the NRC PO on early drafts of completed chapters have been received and will be incorporated into the ongoing revisions. A meeting with the NRC staff is planned for June 1997 to discuss the progress of the report. The CNWRA staff also prepared for an internal QA audit of TWRS project tasks.

The NRC comments on the Draft Quality Assurance Requirements Report (IM 5709-107-720) will be integrated into the Final Quality Assurance Requirements Report (IM 5709-107-730) to be delivered on or before June 30, 1997.

In the next period, information collected on the solidification technologies health and safety issues will be incorporated into the Final Waste Solidification Process Report (IM 5709-102-720). The final report will also include the NRC comments on the interim report and update information on the Savannah River Site and WVDP vitrification operations. Preparation will continue on the Preliminary HLW Chemistry Manual (IM 5709-106-710). Technical and programmatic reviews will be conducted on completed chapters. A meeting with the NRC staff is planned for June 1997 to discuss the progress of report preparation.

2 MANAGEMENT ISSUES

None to report.

3 MAJOR PROBLEMS

None to report.

4 SUMMARY OF SCHEDULE CHANGES

Schedule changes for IMs are included in table 2. Deliverables completed in period 9 are provided in table 3 and listed in the Executive Summary.

5 SUMMARY OF FINANCIAL STATUS

Table 4 summarizes the CNWRA financial status in the context of authorized funds provided by the NRC. Total commitments of the CNWRA are $143,909. The appendix lists planned and actual costs to date, as well as variances between these, without allowance for fee, on both a per-period and a cumulative basis. These data do not include commitments. Pertinent financial information is provided for the DWM JC, WSS JC, and TWRS JC as well as for COPS and seven KTIs. The planned costs per period for the DWM JC reflect the CNWRA OPS, Revision 9 Change 2. Those for the WSS JC and TWRS JC represent accommodations made in Revision 6 Change 2 and Revision 0 Change 2, respectively.

This period expenditures decreased one percent from last period. Through period 9, the CNWRA composite (all three JCs) was underspent by $169,385 or 2.6 percent; the DWM JC was underspent by $152,323 or 2.6 percent; the WSS JC was underspent by $20,351 or 49.3 percent; and the TWRS JC was overspent by $3,288 or −0.7 percent. Only the TWRS JC evidenced a lower spending level for period 9. As mentioned last period, estimated adjustments were made in period 7 to all JCs except TWRS. These adjustments are expected to (i) preserve carryover monies—partially mitigating the effects of two successive FYs of budget reductions; (ii) reflect the reallocation of existing staff to other NRC-related JCs; (iii) recognize the elimination of three KTIs during this FY; and (iv) allow time for proposal preparation related to the NRC tasking. During period 9, expenditures in the DWM JC rose by 0.4 percent over the previous period—indicating increased spending primarily in COPS and the ARDES KTI; disbursements in the WSS JC increased to reflect administrative-type charges; expenditures in the TWRS JC declined from the previous period—indicating completion of certain tasking and allocation of CNWRA staff to higher priority, NRC-related work.

As shown in table 1, the CNWRA has 43 core and 1 limited-term staff members. The CNWRA will submit revised Staffing and Hiring Plans when FY98 budgets become better known. The hydrologic transport specialist will not join the staff in period 9, as expected. The available pool of approved consultants and subcontractors increased to 43. Expenditures for consultants, subcontractors, and SwRI labor in all JCs as a percentage of the CNWRA composite spending were 15.7 percent for period 9 in FY97. For consultants and subcontractors alone, this percentage was 6.1.

This FYTD no capital or sensitive equipment was purchased with NRC funds (other than overhead, general and administrative expenses, and fees).

DWM JC

The DWM JC cumulative cost variance through period 9 was 2.6 percent.

Expenditures in this JC increased from the previous period in COPS and the SDS, TEF, and ARDES KTIs. Specific rationales for over/underspending for COPS and each KTI follow.

The cost variance for COPS was 0.9 percent. The cost variance was −1.5 percent for the Management, Planning, and Computer Support Subtask (5708-158) and 11.1 percent for the QA Subtask (5708-159). Expenditures in the former subtask increased because of charges associated with staff professional development and expanded allocation of labor in support of CNWRA-wide activities. Expenses in the latter subtask have escalated owing to preparations for the annual QA Audit and will further increase during the audit and writing the final audit report (by the independent QA audit team of auditors and technical specialists).

The cost variance for the IA KTI was 5.0 percent. When unpaid commitments are included in budgeting calculations, the cost variance reduces to within 3.5 percent of the planned spending. It is anticipated that IA KTI spending will remain on target during the next several periods.

The cost variance for the SDS KTI was 9.3 percent. The adjustment to estimated spending provided a positive variance for this KTI. Increased spending is anticipated in future periods as consultants begin work on the geophysical surveys, PSHA analysis, and fracture studies.

The cost variance for the ENFE KTI was 7.9 percent. Existing commitments not yet posted to this account reduce the current variance to 4.8 percent. There may be some increase to this variance in the future caused by reduced availability of consultant time.

There is no further activity in the CLST KTI. As of period 05, work has been deferred.

The cost variance for the TEF KTI was 0.7 percent. Spending is expected to remain on target during period 10.

There is no further activity in the RDTME KTI. As of period 05, work has been deferred.

The cost variance for the TSPAI KTI was −3.4 percent. This variance is slightly higher than the previous period and reflects focused efforts on TPA code development, testing, and documentation. Spending is expected to remain at about the current level until the major TPA code work is completed.

The cost variance for the ARDES KTI was 7.0 percent. Expenditures for this KTI are expected to increase but at a relatively gradual rate.

The cost variance for the USFIC KTI was 4.4 percent. Adjusting for existing commitments not yet posted to this account changes this variance to −1.7 percent.

There is no further activity in the RT KTI. As of period 05, work has been deferred.

The cost variance for WSS was 49.3 percent. Spending during the reporting period was essentially related to administrative tasks. For the next period, decreased expenses are expected based on lack of tasking.

The cost variance for the TWRS project was −0.7 percent. The actual period cost overall was less than the previous period, but still greater than the period 9 estimate. The variance reflects continued activities in subtasks 1.2, 1.5, and 1.6 related to deliverables in these subtasks. The rate of spending is expected to maintain in the next period due to activities in subtask 1.1 (revisions to the Hanford TWRS Familiarization Report in response to the NRC comments), subtask 1.2 (preparation of the Final Waste Solidification Process Report while awaiting NRC staff comments), and subtask 1.6 (preparation of the Preliminary High-Level Waste Chemistry Manual).

Table 1. CNWRA Core Staff—Current Profile and Hiring Plan* (Period 9)

EXPERTISE/EXPERIENCE	CURRENT NO.	PROFESSIONAL STAFF	POSITIONS OPEN FY97
ADMINISTRATION	4	H.GARCIA, W.PATRICK, J.RUSSELL, B.SAGAR	
CHEMICAL PROCESSING ENGNG.	1	V.JAIN	
CODE ANALYSIS/DEVELOPMENT	2	R.JANETZKE, R.MARTIN	1
DOSE/RISK/HAZARD ANALYSIS	0		2
ELECTROCHEMISTRY	1	G.CRAGNOLINO	
ENGINEERING GEOLOGY/GEOLOGICAL ENGNG	2	R.CHEN, G.OFOEGBU	
ENVIRONMENTAL SCIENCES	1	P.LaPLANTE	
GEOCHEMISTRY/PHYS.CHEM.	5	W.MURPHY, R.PABALAN, E.PEARCY, J.PRIKRYL, D.TURNER	
GEOHYDROLOGY/HYDROGEOLOGY	4	R.GREEN, S.STOTHOFF, J.WINTERLE, R.FEDORS	1
GEOLOGY	2	L.McKAGUE, M.MIKLAS	
HYDROLOGIC TRANSPORT	2	G.WITTMEYER, A.ARMSTRONG	1
INFORMATION MANAGEMENT SYSTEMS	1	R.MARSHALL	
MATERIAL SCIENCES	2	D.DUNN, N.SRIDHAR	
MINING ENGINEERING	1	S-M.HSIUNG	
NUCLEAR ENGINEERING	1	M.JARZEMBA	1
OPERATIONAL HEALTH PHYSICS	1	J.WELDY	
PERFORMANCE ASSESSMENT	2	R.BACA, S.MOHANTY	3
QUALITY ASSURANCE	1	B.MABRITO	
RADIOISOTOPE GEOCHEMISTRY	1	D.PICKETT	
ROCK MECHANICS, INCLUDING CIVIL/STRUC. ENGR.	3	M.AHOLA, A.CHOWDHURY, A.GHOSH	
SOURCE-TERM/SPENT FUEL DEGRAD	1	P.LICHTNER	
STRUCTURAL GEOLOGY/SEISMO-TECTONICS	2	D.FERRILL, J.STAMATAKOS	
SYSTEMS ENGINEERING	1	P.MACKIN	
VOLCANOLOGY/IGNEOUS PROCESSES	2(1)†	C.CONNOR, B.HILL, M.CONWAY†	
TOTAL	43(1)†		9

* SEE STAFFING PLAN FOR DETAILS (Open positions will not be filled in FY97 pending resolution of the FY98 budget.)

† LIMITED TERM

Table 2. Summary of Schedule Changes (Period 9)

MILESTONE NUMBER	TYPE	DESCRIPTION	ORIGINAL DATE	REVISED DATE	RATIONALE FOR CHANGE
5708-158-730	IM	CNWRA Computer Certification—Letter Report	02/24/97	07/21/97	Awaiting concurrence from NRC on implementation of prioritization schedule
5708-158-750	IM	FY97 CNWRA Computer Security Plan Update—Letter Report	04/07/97	08/04/97	Contingent on development of 5708-158-730
5708-462-710	IM	Documentation of IA Probability Code and User's Manual	08/25/97	01/26/98	Higher priority work and new programming support have slowed down development of software
5708-471-710	IM	Sensitivity Analysis Using Faulting Module—Letter Report	05/12/97	09/26/97	Date changed to reflect change in TPA V.3.1 code final delivery; TPA code required to complete deliverable
5708-471-711	IM	Geologic Input for TPA Version 3.0 Code—Letter Report	04/30/97	06/30/97	Higher priority work and temporary lack of technical support
5708-471-712	IM	Sensitivity Analysis Using SEISMO—Letter Report	09/26/97	—	New milestone to cover sensitivity analysis
5708-471-731	IM	Geometric, Thermal, and Temporal Constraints on the Tectonic Evolution of Bare Mountain, NV—Journal Article	04/30/97	06/30/97	Work completed by staff on a time available basis
5708-471-733	IM	Constant Thickness Deformation Above Curved Normal Faults	06/23/97	—	New milestone—work completed by staff and consultant on a time available basis
5708-471-745	IM	Issue Resolution Status Report Including Acceptance Criteria on Type 1 Faults	05/27/97	06/30/97	More time required to assess attenuation function proposed by USGS for YMR
5708-561-730	IM	MULTIFLO Training and Presentation	02/28/97	Cancelled	Cancelled to allow work on higher priority tasks during remainder of this FY

Table 2. Summary of Schedule Changes (Period 9) (cont'd)

MILESTONE NUMBER	TYPE	DESCRIPTION	ORIGINAL DATE	REVISED DATE	RATIONALE FOR CHANGE
5708-561-760	IM	Effects of Microbes on Near-Field Environment—Journal Paper	04/07/97	08/19/97	Delayed to accommodate NRC staff available for collaboration
5708-761-745	IM	Input to Issue Resolution Status Report Including Acceptance Criteria on Model Abstraction	07/31/97	09/17/97	Rescheduled because of need to factor in technical exchange input and permit interaction with other KTIs
5708-861-720	IM	Perched Water—Journal Paper	05/10/97	Cancelled	Cancelled because a necessary consultant is unavailable

Table 3. Deliverables (Period 9)

MILESTONE NO.	TYPE	DESCRIPTION	ORIGINAL COMPLETION DATE	REVISED DATE	# OF REVISIONS	ACTUAL COMPLETION DATE	REASON (IF DELAYED)
5708-158-720	MM	FY97 CNWRA Management Plan (Including Staffing Plan) Update	05/26/97			05/23/97	
5708-159-710	IM	CNWRA Quality Assurance Manual Change	09/26/97	06/06/97	1	05/26/97	
5708-471-730	IM	Yucca Mountain Tectonics—Journal Article	05/15/97			05/14/97	
5708-771-730	IM	CNWRA Input to Commission Paper on New Proposed Yucca Mountain Standard—Letter Report	09/26/97	05/30/97	1	05/27/97	
5709-102-710	IM	Survey of Solidification Process Technologies Interim Report	04/22/97	05/30/97	1	05/29/97	NRC/CNWRA staffs visit to SRS was scheduled for week of 05/20/97

Table 4. Financial Status (Period 9)

COPS/KTI/WSS/TWRS	Funds Authorized	Funds Costed to Date	Funds Uncosted	Commitments
COPS	2,662,624	2,250,004	412,620	2,210
IA	1,433,884	1,235,990	197,895	8,749
SDS	1,999,476	1,786,272	213,204	14,620
ENFE	1,562,394	1,160,389	402,005	20,967
CLST	825,741	794,308	31,434	0
TEF	1,188,005	985,581	202,425	66,769
RDTME	835,512	800,592	34,921	0
TSPAI	3,044,654	2,711,377	333,277	25,844
ARDES	926,026	594,695	331,332	875
USF[illegible]	1,415,714	986,591	429,123	1,875
RT	496,803	478,741	18,061	0
DWM COSTS	16,390,834	13,784,539	2,606,295	
DWM AWARD FEE	0	0	0	
DWM BASE FEE	0	508,361	(508,361)	
TOTAL DWM	16,390,834	14,292,900	2,097,934	141,909
WSS COSTS	620,126	573,244	46,882	0
WSS AWARD FEE	0	0	0	
WSS BASE FEE	0	26,089	(26,089)	
TOTAL WSS	620,126	599,333	20,793	0
TWRS COSTS	505,654	495,739	9,915	2,000
TWRS AWARD FEE	33,600	0	33,600	
TWRS BASE FEE	20,746	19,224	1,522	
TOTAL TWRS	560,000	514,964	45,037	2,000
TOTAL	17,570,960	15,407,197	2,163,763	143,909

Note: Additional authorized funds of $348,910 for DWM have not been allocated.

APPENDIX A
Planned and Actual Costs, and Cost Variances Period 9, FY97

CNWRA COMPOSITE
TOTAL ESTIMATE COST

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	878,458	848,730	837,396	717,525	734,600	747,901	189,486	757,829	745,749	768,645	744,294	771,636	743,417	6,457,471
Act Pd Cost	845,277	852,931	629,882	568,010	701,860	677,699	662,431	778,935	771,065	0	0	0	0	6,288,090
Variance, $	33,181	195,800	207,515	149,515	32,740	70,202	(472,945)	(21,306)	(25,315)	0	0	0	0	169,385
Variance, %	3.8%	23.1%	24.8%	20.8%	4.5%	9.4%	-249.6%	-2.8%	-3.4%	0.0%	0.0%	0.0%	0.0%	2.6%
Est FY Cumul	878,458	1,727,188	2,564,585	3,282,110	4,016,710	4,764,611	4,954,096	5,711,725	6,457,475	7,226,120	7,970,413	8,742,049	9,485,466	
Act FY Cumul	845,277	1,498,208	2,128,089	2,696,099	3,397,960	4,075,659	4,738,089	5,517,025	6,288,090	0	0	0	0	
% Complete	8.9%	15.8%	22.4%	28.4%	35.8%	43.0%	50.0%	58.2%	66.3%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	33,181	228,981	436,496	586,010	618,750	688,952	216,007	194,701	169,385	0	0	0	0	
Cumul Var, %	3.8%	13.3%	17.0%	17.9%	15.4%	14.5%	4.4%	3.4%	2.6%	0.0%	0.0%	0.0%	0.0%	

DIVISION OF WASTE MANAGEMENT (DWM)
5708-000

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	779,359	749,755	739,763	743,685	676,002	682,676	172,578	692,019	687,892	702,778	686,737	705,009	685,974	5,923,729
Act Pd Cost	832,548	596,259	581,181	512,833	615,075	628,012	590,682	706,036	708,780	0	0	0	0	5,771,406
Variance, $	(53,189)	153,496	158,582	230,852	60,927	54,663	(418,104)	(14,017)	(20,888)	0	0	0	0	152,323
Variance, %	-6.8%	20.5%	21.4%	31.0%	9.0%	8.0%	-242.3%	-2.0%	-3.0%	0.0%	0.0%	0.0%	0.0%	2.6%
Est FY Cumul	779,359	1,529,114	2,268,877	3,012,563	3,688,565	4,371,241	4,543,818	5,235,837	5,923,729	6,626,507	7,313,243	8,018,252	8,704,227	
Act FY Cumul	832,548	1,428,806	2,009,988	2,522,821	3,137,896	3,765,908	4,356,590	5,062,626	5,771,406	0	0	0	0	
% Complete	9.6%	16.4%	23.1%	29.0%	36.1%	43.3%	50.1%	58.2%	66.3%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	(53,189)	100,308	258,889	489,742	550,669	605,332	187,228	173,211	152,323	0	0	0	0	
Cumul Var, %	-6.8%	6.6%	11.4%	16.3%	14.9%	13.8%	4.1%	3.3%	2.6%	0.0%	0.0%	0.0%	0.0%	

ONWRA OPERATIONS (OOPS) 5708-150														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	124,493	124,594	123,421	123,635	123,421	123,636	67,039	123,908	123,243	124,053	122,970	124,341	122,799	1,057,390
Act Pd Cost	138,117	106,238	113,089	138,661	58,224	106,267	115,364	123,070	148,681	0	0	0	0	1,047,714
Variance, $	(13,624)	18,355	10,331	(15,026)	65,197	17,369	(48,325)	838	(25,438)	0	0	0	0	9,676
Variance, %	-10.9%	14.7%	8.4%	-12.2%	52.8%	14.0%	-72.1%	0.7%	-20.6%	0.0%	0.0%	0.0%	0.0%	0.9%
Est FY Cumul	124,493	249,087	372,507	496,143	619,564	743,200	810,239	934,147	1,057,390	1,181,443	1,304,413	1,428,754	1,551,554	
Act FY Cumul	138,117	244,355	357,445	496,106	554,330	660,598	775,962	899,032	1,047,714	0	0	0	0	
% Complete	8.9%	15.7%	23.0%	32.0%	35.7%	42.6%	50.0%	57.9%	67.5%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	(13,624)	4,731	15,062	37	65,233	82,602	34,277	35,115	9,676	0	0	0	0	
Cumul Var, %	-10.9%	1.9%	4.0%	0.0%	10.5%	11.1%	4.2%	3.8%	0.9%	0.0%	0.0%	0.0%	0.0%	
IGNEOUS ACTIVITY (IA) 5708-460														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	61,936	62,080	61,695	62,522	61,659	62,547	61,393	66,725	65,267	66,819	65,264	67,211	65,182	565,824
Act Pd Cost	56,487	66,448	47,904	49,147	68,279	64,272	55,501	65,506	64,133	0	0	0	0	537,676
Variance, $	5,450	(4,368)	13,791	13,375	(6,620)	(1,724)	5,893	1,219	1,134	0	0	0	0	28,149
Variance, %	8.8%	-7.0%	22.4%	21.4%	-10.7%	-2.8%	9.6%	1.8%	1.7%	0.0%	0.0%	0.0%	0.0%	5.0%
Est FY Cumul	61,936	124,016	185,711	248,233	309,892	372,439	433,833	500,557	565,824	632,643	697,907	765,118	830,300	
Act FY Cumul	56,487	122,935	170,839	219,986	288,265	352,537	408,037	473,543	537,676	0	0	0	0	
% Complete	6.8%	14.8%	20.6%	26.5%	34.7%	42.5%	49.1%	57.0%	64.8%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	5,450	1,081	14,872	28,247	21,627	19,903	25,796	27,015	28,149	0	0	0	0	
Cumul Var, %	8.8%	0.9%	8.0%	11.4%	7.0%	5.3%	5.9%	5.4%	5.0%	0.0%	0.0%	0.0%	0.0%	

STRUCTURAL DEFORMATION AND SEISMICITY (SDS)
5708-470

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	80,954	75,326	73,577	74,537	73,547	74,674	135,851	81,514	84,326	86,311	84,323	86,392	84,323	754,306
Act Pd Cost	161,282	80,540	73,497	55,866	79,808	64,021	33,346	66,405	69,028	0	0	0	0	683,792
Variance, $	(80,327)	(5,214)	80	18,671	(6,261)	10,654	102,505	15,109	15,298	0	0	0	0	70,514
Variance, %	-99.2%	-6.9%	0.1%	25.0%	-8.5%	14.3%	75.5%	18.5%	18.1%	0.0%	0.0%	0.0%	0.0%	9.3%
Est FY Cumul	80,954	156,281	229,857	304,394	377,941	452,615	588,466	669,980	754,306	840,617	924,940	1,011,332	1,095,655	
Act FY Cumul	161,282	241,822	315,319	371,185	450,993	515,014	548,359	614,764	683,792	0	0	0	0	
% Complete	14.7%	22.1%	28.8%	33.9%	41.2%	47.0%	50.0%	56.1%	62.4%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	(80,327)	(85,541)	(85,462)	(66,791)	(73,052)	(62,398)	40,107	55,216	70,514	0	0	0	0	
Cumul Var, %	-99.2%	-54.7%	-37.2%	-21.9%	-19.3%	-13.8%	6.8%	8.2%	9.3%	0.0%	0.0%	0.0%	0.0%	

EVOLUTION OF THE NEAR-FIELD ENVIRONMENT (ENFE)
5708-560

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	81,110	80,823	80,614	81,142	60,445	81,342	(80,569)	96,668	94,803	96,955	94,461	97,240	94,460	596,380
Act Pd Cost	62,233	52,181	38,993	30,224	62,256	78,861	73,040	85,251	65,977	0	0	0	0	549,017
Variance, $	18,877	28,642	41,621	50,918	18,189	2,481	(153,609)	11,417	28,826	0	0	0	0	47,363
Variance, %	23.3%	35.4%	51.6%	62.8%	22.6%	3.1%	109.7%	11.8%	30.4%	0.0%	0.0%	0.0%	0.0%	7.9%
Est FY Cumul	81,110	161,933	242,548	323,690	404,135	485,477	404,909	501,576	596,380	693,334	787,795	885,035	979,495	
Act FY Cumul	62,233	114,414	153,407	183,631	245,888	324,748	397,788	483,039	549,017	0	0	0	0	
% Complete	6.4%	11.7%	15.7%	18.7%	25.1%	33.2%	40.6%	49.3%	56.1%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	18,877	47,519	89,140	140,059	158,248	160,729	7,120	18,537	47,363	0	0	0	0	
Cumul Var, %	23.3%	29.3%	36.8%	43.3%	39.2%	33.1%	1.8%	3.7%	7.9%	0.0%	0.0%	0.0%	0.0%	

CONTAINER LIFE AND SOURCE TERM (CLST)
5708-570

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	30,612	20,094	20,521	20,094	0	0	0	0	0	0	0	0	0	91,322
Act Pd Cost	56,243	15,696	13,946	7,257	848	2	0	0	0	0	0	0	0	93,994
Variance, $	(25,630)	4,396	6,575	12,837	(848)	(2)	0	0	0	0	0	0	0	(2,672)
Variance, %	-83.7%	21.9%	32.0%	63.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.9%
Est FY Cumul	30,612	50,707	71,228	91,322	91,322	91,322	91,322	91,322	91,322	91,322	91,322	91,322	91,322	
Act FY Cumul	56,243	71,940	85,886	93,144	93,992	93,994	93,994	93,994	93,994	0	0	0	0	
% Complete	61.6%	78.8%	94.0%	102.0%	102.9%	102.9%	102.9%	102.9%	102.9%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	(25,630)	(21,234)	(14,659)	(1,822)	(2,670)	(2,672)	(2,672)	(2,672)	(2,672)	0	0	0	0	
Cumul Var, %	-83.7%	-41.9%	-20.6%	-2.0%	-2.9%	-2.9%	-2.9%	-2.9%	-2.9%	0.0%	0.0%	0.0%	0.0%	

THERMAL EFFECTS ON FLOW (TEF)
5708-660

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	58,817	58,899	58,512	59,028	58,154	59,028	21,178	59,185	58,037	59,457	58,035	59,570	58,032	490,842
Act Pd Cost	56,775	43,156	39,111	52,125	60,898	51,597	48,050	58,887	70,939	0	0	0	0	487,535
Variance, $	2,042	15,743	19,401	6,903	(8,745)	7,431	(26,872)	302	(12,902)	0	0	0	0	3,303
Variance, %	3.5%	26.7%	33.2%	11.7%	-15.0%	12.6%	-126.9%	0.5%	-22.2%	0.0%	0.0%	0.0%	0.0%	0.7%
Est FY Cumul	58,817	117,716	176,229	235,256	293,410	352,438	373,616	432,805	490,842	550,299	608,334	667,904	725,936	
Act FY Cumul	56,775	99,932	139,043	191,168	252,066	309,663	357,712	416,599	487,538	0	0	0	0	
% Complete	7.8%	13.8%	19.2%	26.3%	35.5%	42.7%	49.3%	57.4%	67.2%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	2,042	17,784	37,186	44,089	35,344	42,775	15,903	16,206	3,303	0	0	0	0	
Cumul Var, %	3.5%	15.1%	21.1%	18.7%	12.0%	12.1%	4.3%	3.7%	0.7%	0.0%	0.0%	0.0%	0.0%	

REPOSITORY DESIGN AND THERMAL-MECHANICAL EFFECTS (RDTME)
5708-670

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	25,569	23,337	23,707	23,337	0	0	0	0	0	0	0	0	0	95,950
Act Pd Cost	26,768	23,095	32,011	8,424	1,679	207	0	0	0	0	0	0	0	92,184
Variance, $	(1,199)	243	(8,304)	14,913	(1,679)	(207)	0	0	0	0	C	0	0	3,766
Variance, %	-4.7%	1.0%	-35.0%	63.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%
Est FY Cumul	25,569	48,906	72,613	95,950	95,950	95,950	95,950	95,950	95,950	95,950	95,950	95,950	95,950	
Act FY Cumul	26,768	49,862	81,873	90,297	91,976	92,184	92,184	92,184	92,184	0	0	0	C	
% Complete	27.9%	52.0%	85.3%	94.1%	95.9%	96.1%	96.1%	96.1%	96.1%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	(1,199)	(956)	(9,261)	5,653	3,974	3,766	3,766	3,766	3,766	0	0	0	0	
Cumul Var, %	-4.7%	-2.0%	-12.8%	5.9%	4.1%	3.9%	3.9%	3.9%	3.9%	0.0%	0.0%	0.0%	0.0%	

TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION (TSPAI)
5708-760

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	166,917	156,614	150,062	150,893	150,062	150,955	149,527	164,097	168,199	171,977	168,002	172,666	167,702	1,407,325
Act Pd Cost	162,260	111,904	124,509	105,297	175,657	194,857	172,634	207,440	200,079	0	0	0	0	1,454,638
Variance, $	4,656	44,710	25,553	45,596	(25,596)	(43,903)	(23,107)	(43,343)	(31,880)	0	0	0	0	(47,313)
Variance, %	2.8%	28.5%	17.0%	30.2%	-17.1%	-29.1%	-15.5%	-26.4%	-19.0%	0.0%	0.0%	0.0%	0.0%	-3.4%
Est FY Cumul	166,917	323,531	473,593	624,485	774,547	925,502	1,075,029	1,239,126	1,407,325	1,579,301	1,747,303	1,919,969	2,087,671	
Act FY Cumul	162,260	274,164	398,673	503,970	679,628	874,485	1,047,119	1,254,559	1,454,638	0	0	0	0	
% Complete	7.8%	13.1%	19.1%	24.1%	32.6%	41.9%	50.2%	60.1%	69.7%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	4,656	49,366	74,919	120,515	94,919	51,017	27,910	(15,433)	(47,313)	0	0	0	0	
Cumul Var, %	2.8%	15.3%	15.8%	19.3%	12.3%	5.5%	2.6%	-1.2%	-3.4%	0.0%	0.0%	0.0%	0.0%	

ACTIVITIES RELATED TO DEVELOPMENT OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY YUCCA MOUNTAIN STANDARD (ARDES) 5708-770														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	44,410	44,312	44,154	44,392	43,901	44,392	(97,184)	19,139	15,475	16,146	15,331	16,258	15,237	202,989
Act Pd Cost	38,571	21,178	14,667	8,653	30,213	11,337	10,750	15,365	38,042	0	0	0	0	188,775
Variance, $	5,838	23,134	29,487	35,739	13,688	33,055	(107,934)	3,774	(22,567)	0	0	0	0	14,214
Variance, %	13.1%	52.2%	66.8%	80.5%	31.2%	74.5%	111.1%	19.7%	-145.8%	0.0%	0.0%	0.0%	0.0%	7.0%
Est FY Cumul	44,410	88,721	132,875	177,267	221,167	265,559	168,375	187,514	202,989	219,135	234,466	250,724	265,961	
Act FY Cumul	38,571	59,749	74,416	83,069	113,282	124,618	135,369	150,734	188,775	0	0	0	0	
% Complete	14.5%	22.5%	28.0%	31.2%	42.6%	46.9%	50.9%	56.7%	71.0%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	5,838	28,972	58,459	94,198	107,886	140,941	33,007	36,781	14,214	0	0	0	0	
Cumul Var, %	13.1%	32.7%	44.0%	53.1%	48.8%	53.1%	19.6%	19.6%	7.0%	0.0%	0.0%	0.0%	0.0%	
UNSATURATED AND SATURATED FLOW UNDER ISOTHERMAL CONDITIONS (USFIC) 5708-860														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	85,799	85,640	84,921	86,069	84,814	86,101	(84,658)	80,780	78,542	81,061	78,351	81,331	78,239	588,008
Act Pd Cost	50,108	58,439	62,069	46,546	70,504	56,514	81,998	84,113	51,901	0	0	0	0	562,192
Variance, $	35,691	27,201	22,851	39,523	14,310	29,587	(166,656)	(3,333)	26,641	0	0	0	0	25,815
Variance, %	41.6%	31.8%	26.9%	45.9%	16.9%	34.4%	196.8%	-4.1%	33.9%	0.0%	0.0%	0.0%	0.0%	4.4%
Est FY Cumul	85,799	171,440	256,360	342,429	427,243	513,344	428,686	509,466	588,008	669,068	747,419	828,750	906,989	
Act FY Cumul	50,108	108,547	170,617	217,163	287,667	344,181	426,179	510,292	562,192	0	0	0	0	
% Complete	5.5%	12.0%	18.8%	23.9%	31.7%	37.9%	47.0%	56.3%	62.0%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	35,691	62,892	85,743	125,266	139,576	169,163	2,507	826)	25,815	0	0	0	0	
Cumul Var, %	41.6%	36.7%	33.4%	36.6%	32.7%	33.0%	0.6%	0.2%	4.4%	0.0%	0.0%	0.0%	0.0%	

RADIONUCLIDE TRANSPORT (RT)
5708-870

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	18,741	18,036	18,581	18,036	0	0	0	0	0	0	0	0	0	73,394
Act Pd Cost	23,704	17,381	21,384	10,633	707	76	0	0	0	0	0	0	0	73,886
Variance, $	(4,963)	655	(2,803)	7,403	(707)	(76)	0	0	0	0	0	0	0	(493)
Variance, %	-26.5%	3.6%	-15.1%	41.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.7%
Est FY Cumul	18,741	36,777	55,358	73,394	73,394	73,394	73,394	73,394	73,394	73,394	73,394	73,394	73,394	
Act FY Cumul	23,704	41,085	62,469	73,102	73,810	73,886	73,886	73,886	73,886	0	0	0	0	
% Complete	32.3%	56.0%	85.1%	99.6%	100.6%	100.7%	100.7%	100.7%	100.7%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	(4,963)	(4,308)	(7,112)	291	(416)	(493)	(493)	(493)	(493)	0	0	0	0	
Cumul Var, %	-26.5%	-11.7%	-12.8%	0.4%	-0.6%	-0.7%	-0.7%	-0.7%	-0.7%	0.0%	0.0%	0.0%	0.0%	

WASTE SOLIDIFICATION SYSTEMS (WSS)
5706-000

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	9,767	9,640	9,193	9,640	8,298	9,894	(33,171)	9,990	8,045	9,991	8,043	10,165	8,041	41,296
Act Pd Cost	6,285	249	4,316	2,799	1,002	437	1,389	966	3,503	0	0	0	0	20,945
Variance, $	3,482	9,391	4,877	6,841	7,296	9,457	(34,560)	9,024	4,542	0	0	0	0	20,351
Variance, %	35.7%	97.4%	53.1%	71.0%	87.9%	95.6%	104.2%	90.3%	56.5%	0.0%	0.0%	0.0%	0.0%	49.3%
Est FY Cumul	9,767	19,407	28,600	38,240	46,538	56,432	23,261	33,251	41,296	51,287	59,330	69,494	77,535	
Act FY Cumul	6,285	6,534	10,849	13,648	14,651	15,087	16,476	17,442	20,945	0	0	0	0	
% Complete	8.1%	8.4%	14.0%	17.6%	18.9%	19.5%	21.2%	22.5%	27.0%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	3,482	12,874	17,751	24,592	31,888	41,345	6,785	15,808	20,351	0	0	0	0	
Cumul Var, %	35.7%	66.3%	62.1%	64.3%	68.5%	73.3%	29.2%	47.5%	49.3%	0.0%	0.0%	0.0%	0.0%	

TANK WASTE REMEDIATION SYSTEM (TWRS) 5709-000														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	89,332	89,334	88,441	(35,801)	50,300	55,332	50,0[illegible]	55,620	49,813	55,876	49,514	56,462	49,402	492,451
Act Pd Cost	6,445	56,423	44,385	52,378	85,783	49,250	70,360	71,933	58,782	0	0	0	0	495,739
Variance, $	82,888	32,912	44,056	(88,179)	(35,483)	6,082	(20,281)	(16,313)	(8,969)	0	0	0	0	(3,288)
Variance, %	92.8%	36.8%	49.8%	246.0%	-70.5%	11.0%	-40.5%	-29.3%	-18.0%	0.0%	0.0%	0.0%	0.0%	-0.7%
Est FY Cumul	89,332	178,667	267,107	231,307	281,607	336,939	387,018	442,638	492,451	548,327	597,841	654,303	703,705	
Act FY Cumul	6,445	62,867	107,252	159,630	245,413	294,664	365,024	436,957	495,739	0	0	0	0	
% Complete	0.9%	8.9%	15.2%	22.7%	34.9%	41.9%	51.9%	62.1%	70.4%	0.0%	0.0%	0.0%	0.0%	
Cumul Var, $	82,888	115,799	159,856	71,676	36,193	42,275	21,994	5,681	(3,288)	0	0	0	0	
Cumul Var, %	92.8%	64.8%	59.8%	31.0%	12.9%	12.5%	5.7%	1.3%	-0.7%	0.0%	0.0%	0.0%	0.0%	