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

For the Fiscal Reporting Period

August 29 – September 25, 1998

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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
ADAMS	Agencywide Documents Access and Management 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
AR	Assessment Report
ARDR	Activities Related to Development of the NRC High-Level Waste Regulations
ASCE	American Society of Civil Engineers
ASCII	American Standard Code for Information Interchange
ASLB	Atomic Safety and Licensing Board
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
BNFL	British Nuclear Fuels Limited
BTP	Branch Technical Position
CAI	Color Alteration Index
CAM	Corrosion Resist Material
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
CISF	Centralized Interim Storage Facility
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
CRM	Corrosion Allowance Material
CRWMS	Civilian Radioactive Waste Management System
CSCS	Constrained Stochastic Climate Simulator
CSH	Calcium Silicate Hydrate
CSPE	Corrosion Science and Process Engineering
DAS	Data Acquisition System
DBE	Design Basis Event
DC	Division of Contracts
DCAA	Defense Contract Audit Agency
DCB	Double Cantilever Beam
DCF	Dose Conversion Factor
DCM	Dual Continuum Model
D&D	Decommissioning and Decontamination
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
DKM	Dual Permeability Model
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
DOE-RU	U.S. Department of Energy Regulatory Unit
DRA	Division of Regulatory Applications

ABBREVIATIONS (cont'd)

DST	Drift Scale Test
DTED	Digital Terrain Elevation Data
DTS	Dry Transfer System
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
EIS	Environmental Impact Statement
EM	Element Manager
EMPA	Electron MicroProbe Analysis
ENE	East-Northeast
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
ESF	Exploratory Studies Facility
ESP	Environmental Simulation Program
EW	East-West
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
GIA	Generalized Importance Analysis
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
ICPP	Idaho Chemical Processing Plant
IDLH	Immediately Dangerous to Life and Health
IHLRWMC	International High-Level Radioactive Waste Management Conference and Exposition
IM	Intermediate Milestone
IME	Industrial Mobilization Exemption
IMS	Information Management Systems
INEEL	Idaho National Engineering and Environmental 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
ISA	Initial Safety Analysis
ISFSI	Independent Spent Fuel Storage Installation
ISM	Integrated Site Model
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
LA	License Application
LAAO	License Application Annotated Outline
LAN	Local Area Network
LANL	Los Alamos National Laboratory
LARP	License Application Review Plan

ABBREVIATIONS (cont'd)

LAW	Low-Activity Waste
LBNL	Lawrence Berkeley National Laboratory
LBT	Large Block Test
LHS	Latin Hypercube Sampling
LITC	Lockheed Information Technology Company
LLNL	Lawrence Livermore National Laboratory
LLW	Low-Level Waste
LMAES	Lockheed Martin Advanced Environmental Systems
LSS	Licensing Support System
LSSPP	Licensing Support System Pilot Project
LSSTB	Licensing Support System Test Bed
LWR	Light Water Reactor
Ma	Million Years Ago
MAI	Mean Annual Infiltration
MC	Monte Carlo
METRA	Mass and Energy transport
MGDS	Mined Geologic Disposal System
MH	Mechanical-Hydrological
MIC	Microbially Influenced Corrosion
MINC	Multiple Interacting Continua
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
NEI	Nuclear Energy Institute
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
NS	North-South
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
PDF	Probability Distribution Function
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
PFS	Private Fuel Storage
PFSF	Private Fuel Storage Facility
PHA	Preliminary Hazard Analysis
PI	Principal Investigator
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 Analyses
PTFE	PolyTetraFluoroEthylene
PTn	Paintbrush Nonwelded Tuff
PVHA	Probabilistic Volcanic Hazards Assessment
PVHVIEW	Probability of Volcanic Hazards VIEW
PVM	Parallel Virtual Machine
PWR	Pressurized Water Reactor
QA	Quality Assurance
QAP	Quality Assurance Procedure
QRAM	Quality Requirements Application Matrix

ABBREVIATIONS (cont'd)

RAI	Request for Additional Information
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
SAP	Standards Approval Package
SAR	Safety Analysis Report
SCA	Site Characterization Analysis
SCC	Substantially Complete Containment
SCCEX	Substantially Complete Containment EXample
SCE	Standard Calomel Electrode
SCFF	Southern Crater Flat Fault
SCM	Surface Complexation Models
SCP	Site Characterization Plan
SDMP	Site Decommissioning Management Plan
SDS	Structural Deformation and Seismicity
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
SGI	Silicon Graphics Inc.
SGML	Standard Generalized Markup Language
SHE	Standard Hydrogen Electrode
SHT	Single Heater Test
SIP	Scientific Investigation Plan
SKI	Swedish Nuclear Power Inspectorate
S-L	Short Transverse-Longitudinal
SLAR	Side Looking Airborne Radar
SNF	Spent Nuclear Fuel
SNL	Sandia National Laboratories
SOTEC	Source term Code
SOW	Statement of Work
SPCR	Software Problem Correction Report
SRA	Systematic Regulatory Analysis
SRB	Sulfate-Reducing Bacteria
SRBS	Shafts, Ramps, Boreholes, and Their Seals
SRD	Software Requirements Description
SRS	Savannah River Site
SRSASF	Savannah River Site Aluminum-Based Spent Fuel
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
SZ	Saturated Zone
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
THC	Thermal-Hydrologic-Chemical
THMC	Thermal-Hydrologic-Mechanical-Chemical
T-L	Transverse-Longitudinal
TLM	Triple-Layer Model
TM	Thermal-Mechanical
TMH	Thermal-Mechanical-Hydrologic
TMI-2	Three Mile Island Unit 2
TMS	The Minerals, Metals, and Materials Society
TOP	Technical Operating Procedure
TP	Technical Position
TPA	Total-system Performance Assessment
TPI	Time Period of Regulatory Interest
TR2	DOE Seismic Topical Report No. 2
TRG	Technical Review Group
TSAR	Topical Safety Analysis Report
TSPA	Total System Performance Assessment
TSPAI	Total System Performance Assessment and Integration
TSw-Chnv	Topopah Spring Welded-Calico Hills Nonvitric
TVD	Total Variation Diminishing

ABBREVIATIONS (cont'd)

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
UZ	Unsaturated Zone
VA	Viability Assessment
VCS	Version Control System
VF	Vitrification Facility
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
WSRC	Westinghouse Savannah River Company
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
YMR	Yucca Mountain Region
YTD	Year-to-Date

EXECUTIVE SUMMARY—PERIOD 13

In the Division of Waste Management (DWM) Job Code (JC), the Center for Nuclear Waste Regulatory Analyses (CNWRA) continued work on numerous analyses and revisions to several issue resolution status reports. Staff delivered Slip Tendency, Dilation Tendency, and Anisotropic Permeability at Yucca Mountain, Nevada—Journal Article, which was also submitted for publication in *Geology Today;* Crossing Conjugate Normal Faults—Journal Article, an invited paper for the American Association of Petroleum Geologists book, Recognition and Characterization of Reservoir Scale Structures; and Auxiliary Analysis on Rock Falls—Journal Paper. Further, staff conveyed the Geographic Information System Archive—CNWRA Report and another report, Thermal-Mechanical Drift Stability Analysis at Repository Scale. The staff provided the CNWRA Input to Commission Paper on Draft Rulemaking through comments on the draft rule. Moreover, at the DISTEC '98 conference in Hamburg, Germany, staff presented a general overview paper and poster on the Nuclear Regulatory Commission (NRC) Total-system Performance Assessment approach that were jointly prepared by the NRC and CNWRA staffs.

The DWM JC year-to-date (YTD) cost variance was 9.7 percent. Spending rose from last period. Although the cumulative variance increased in dollars since the previous month, this variance decreased on a percentage basis as work accelerated in certain areas.

In the Tank Waste Remediation System JC, the report titled Assessment of the U.S. Department of Energy (DOE) Regulatory Unit Initial Safety Analysis Report of the British Nuclear Fuels Limited, Inc. Initial Safety Analysis Package Open Items Part–I was delivered. The YTD cost variance was 4.8 percent. Spending rose slightly and the cumulative variance, both in absolute and relative terms, increased. Some milestones have been rescheduled into FY99 to meet budgetary restraints.

In the Three Mile Island Unit 2 (TMI-2) Independent Spent Fuel Storage Installation (ISFSI) JC, the CNWRA technical staff continued preparation of the draft safety evaluation report, including evaluation of the DOE response to the NRC second round request for additional information (RAI). The YTD cost variance for the TMI-2 ISFSI was 14.0 percent—reflecting staff participation in the site visit to the Idaho National Engineering and Environmental Laboratory (INEEL).

In the Dry Transfer System JC, the staff also participated in the site visit to INEEL. The YTD cost variance was 28.9 percent, down from last period on a percentage basis, because of increased costs associated with staff travel to the site.

In the Centralized Interim Storage Facility (CISF) JC, staff continued to evaluate the DOE response to the NRC RAI and prepare the draft assessment report. The YTD cost variance for the CISF was 2.5 percent. This variance increased slightly, reflecting decreased spending over the previous period.

In the Private Fuel Storage Facility JC, the staff submitted the Second Round Request for Additional Information—Final Letter Report. The YTD cost variance was 19.3 percent, notwithstanding increased spending in this JC.

In the Savannah River Site Aluminum-Based Spent Fuel (SRSASF) JC, the staff worked on various milestones. The YTD cost variance increased to 39.1 percent. Spending rose over the previous period.

It should be noted that the current spending estimates in all JCs are based on the assumption that staffing is at authorized levels. Current staffing remains below authorized levels and recruitment continues.

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

TITLE: Center for Nuclear Waste Regulatory Analyses (CNWRA)

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CONTRACT NO: NRC-02-97-009

JOB CODES: D1035, J5164, J5186, J5206, J5226, J5210

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ESTIMATED BUDGET: $87,611,477

PERIOD OF PERFORMANCE: 09/27/97–09/27/02

PERIOD OF THIS REPORT: 08/29/98–09/25/98

1 TECHNICAL

1.1 CNWRA Operations (COPS)

In addition to a wide range of day-to-day activities, accomplishments in the management and planning area included (i) preparing for the 1998 CNWRA Annual Program Review; (ii) responding to the revised Interim Guidance for the Development of Fiscal Year 1999 CNWRA OPS for the repository program (DWM, TWRS, and SFPO) by preparing the necessary documents; (iii) providing financial information for the balance of this FY and for carryover monies for the next FY; (iv) further addressing COI-related issues among the NRC, SwRI, and CNWRA management staffs; and (v) participating in weekly HLW Management Board meetings.

Status of CNWRA staffing is indicated in table 1, consistent with the revised staffing plan submitted as part of the revision to the CNWRA Management Plan. During period 13, recruitment efforts and interviews continued for the approved open positions. One limited-term employee accepted an offer and will begin employment in period 3 next FY.

Computer system support activities encompassed (i) employing a UNIX administrator for SUN Microsystems and Silicon Graphics systems; (ii) preparing to receive the hardware and software associated with the GIS and IMS computing facilities; (iii) implementing a strategy for standardizing desktop computer systems; (iv) pursuing a replacement for the

CDOCS software; (v) participating, as requested, in the monthly NRC/CNWRA Computer Coordination meeting; and (vi) maintaining LAN operations.

QA activities focused on (i) finishing the revision of QAP-001, Scientific Notebook Control, and distributing it to CNWRA staff members in response to one of the QA audit CARs; (ii) making draft changes to another QAP dealing with procurement control and soliciting comments from CNWRA staff members expected to implement the procedure; (iii) conducting surveillances, issuing nonconformance reports as required, and working with cognizant staff in response to these reports; (iv) leading the configuration control effort of the CNWRA scientific and engineering software determined ready for release; (v) controlling issued documents and maintaining QA records; (vi) preventing organizational COIs by reviewing SwRI RFPs; (vii) performing QA verification checks on each CNWRA deliverable; and (viii) evaluating potential changes to the CNWRA Quality Assurance Manual, which may be required as flow-down QAPs are revised.

In the next period, the CNWRA staff expects to (i) prepare for the 1998 CNWRA Annual Program Review; (ii) complete development of the FY99 CNWRA OPS; (iii) pursue hiring for open core staff positions; (iv) prepare for installation of computer hardware and software for GIS and IMS computing facilities, as well as continue the search for a replacement for the CDOCS software; and (v) provide CNWRA LAN operation and maintenance support.

In addition, the staff will (i) complete work on the second CAR and review the second revised QAP identified as deficient in the FY98 CNWRA QA Audit, (ii) proceed with scheduled QA surveillances, (iii) perform QA indoctrinations for new CNWRA staff and consultants, (iv) input internal documentation and record copies of delivered documents into QA records, (v) review SwRI RFPs for potential COI, (vi) perform QA verification checks on each CNWRA outgoing deliverable, and (vii) consider a change to the CNWRA CQAM relating to comments made during the QA audit.

1.2 Igneous Activity (IA)

Staff documented a detailed examination of the process of rock-fragment entrainment and conduit development in a journal article entitled Xenolith Formation and the Development of Basaltic Volcanic Conduits During the 1975 Tolbachik Eruptions, Kamchatka, with Implications for Volcanic Hazards Assessments at Yucca Mountain, Nevada (IM 1402-461-860). This journal article, currently under internal review, examines how the volcanic conduit progressively enlarges during an eruption by eroding shallow (< 2 km deep) wall-rocks by several mechanisms. Using data from the 1975 Tolbachik eruptions in Kamchatka, Russia, conduits enlarged from initial diameters around 5 m to around 15 m by the end of cone-forming activity. Late-stage interactions between > 500-m-deep groundwater, heated wall-rock, and basaltic magma resulted in explosive expansion of water. These explosions resulted in significant wall-rock disruption and expanded conduits to around 48 m in diameter. The youngest basaltic volcanoes in the YMR have cone deposits characterized by elevated rock-fragment abundances and distinctive rock-fragment blocks. These features are characteristic of conduit widening events at the 1975 Tolbachik volcanoes. Extrapolation of the 1975 Tolbachik data suggests conduits for some YMR basaltic volcanoes may have widened on the order of 50 m in response to late-stage interactions between subsurface groundwater and the heated conduit. Volcanic disruption models in TPA Version 3.2 consider that conduits may range from 10 to 50 m in diameter at

repository depths. The contents of the previously mentioned journal article provide the technical basis in support of this range.

Staff continued to review chapter 10 of the draft DOE TSPA-VA Technical Basis document in preparation for the October 5–6, 1998, DOE/NRC Appendix 7 Meeting on Disruptive Events. Acceptance criteria for the consequences of igneous activity developed in revision 1 of the IA-KTI IRSR specify staff technical bases for issue resolution. These criteria provide the framework for review of the draft DOE TSPA-VA Technical Basis document. Staff have several questions regarding the data and models used by the DOE to conclude that the probability of future igneous activity at the proposed repository site is low enough to permit dismissal of this scenario class and that the dose consequences of volcanic disruption are $< 10^{-6}$ rem/yr over a 10^{6} postclosure period considered by DOE. These questions focus on technical bases used to restrict future volcanism to the Crater Flat area, WP and waste-form resilience during igneous events, eruption character for basaltic volcanoes, and dose modeling.

In the next period, IA staff will submit Xenolith Formation and the Development of Basaltic Volcanic Conduits During the 1975 Tolbachik Eruptions, Kamchatka, with Implications for Volcanic Hazards Assessments at Yucca Mountain, Nevada—Journal Article (IM 1402-461-860). Staff also will participate in an DOE/NRC Appendix 7 Meeting on Disruptive Events. Preparation for the CNWRA Annual Program Review will begin. Work will continue on repository-magma interactions, including modeling of magma+gas velocities in repository drifts and temperature gradients in the drifts during igneous activity.

1.3 Structural Deformation and Seismicity (SDS)

Staff submitted three milestones. The first milestone is a journal manuscript entitled Slip Tendency, Dilation Tendency, and Anisotropic Permeability at Yucca Mountain, Nevada—Journal Article (IM 1402-471-862). The manuscript uses 3DSTRESS and a reinterpretation of the C-Well complex pumping data to show that fracture permeability at YM is anisotropic. The manuscript will be submitted to the Geological Society of America monthly publication *Geology Today*. The second milestone is an update of the GIS Archive—CNWRA Report (IM 1402-471-850). The GIS archive update has been submitted on a CDROM and contains CNWRA developed data, as well as data acquired from other sources. Coverages include global, regional, and local areas. Gravity and magnetic surveys, landsat images and aerial photographs, geochemical analyses, and benchmarks and geoposition references are some of the included data. The third milestone is a manuscript entitled Crossing Conjugate Normal Faults—Journal Article (IM 1402-471-950). The manuscript is an invited paper for the American Association of Petroleum Geologists book, Recognition and Characterization of Reservoir Scale Structures, and shows how deformation mechanisms related to the development of crossing conjugate normal faults lead to permeability anisotropy and channelization of groundwater flow in faults, including the faulted rocks beneath YM. The manuscript was originally planned as a FY99 milestone, but completed and submitted ahead of schedule.

Staff also completed a review of the DOE Geologic Framework Model 3.0. The review was scheduled as an IM—CNWRA Report (IM 1402-471-865), however, because of a change in scope, the review will now be submitted as an AI that will be incorporated into the SDS IRSR. Staff continue work on an EARTHVISION model of the structural framework of the Amargosa trough, identified as 3D Structural Model of Amargosa for Input to

USFIC—CNWRA Report (IM 1402-471-860). The model will be used as input to saturated flow models by the USFIC KTI. Staff also continued work on Structural Evolution of Crater Flat, Nevada—Journal Article (IM 1402-471-832).

Staff participated in GPS field work in the Volcanic Tablelands of eastern California. The GPS work will be used to test alternative models of crustal strain accumulation and release recently advocated by Wernicke et al. in a 1998 *Science* article. In addition, staff completed the SDS portion of the FY99 CNWRA OPS.

In the next period, staff will continue review of the DOE probabilistic seismic and fault displacement hazard analyses report. Staff will participate in the DOE/NRC Appendix 7 Meeting in Las Vegas, Nevada, on Scenarios and Disruptive Events. Staff will also participate in two field trips, one to review the surficial record of faulting in the YM led by the Friends of the Pleistocene and one to continue evaluation of crustal strains in the Volcanic Tablelands of eastern California.

1.4 Evolution of the Near-Field Environment (ENFE)

Preparation of the ENFE portion of the FY99 CNWRA OPS continued, including the scoping of technical activities through discussions with the NRC PEM.

Solubility computations continued to examine a suite of possible near-field solution chemistries and solubility-controlling phases.

Staff continued debugging, testing, and documenting the MULTIFLO code Version 1.2β. Software validation tests continued on the new DCM capabilities in the METRA flow module. Similar tests were initiated for the GEM reactive-transport module. These tests identified a number of coding errors, which were corrected. Testing also revealed potential run time and numerical diffusion problems in the current numerical implementation; these are being studied in more detail. Work continues on the semi-implicit operator splitting algorithm. A MULTIFLO simulation for a 1D carbonate system and WP heat source was successfully benchmarked and verified using the code EQ3/6 Version 7.2b. The pH dependent kinetic dissolution and precipitation of amorphous silica is being benchmarked using a fixed volume porous medium model under no-flow, isothermal conditions.

Staff participated in a DOE/NRC Appendix 7 Meeting on Cementitious Materials, September 2–3, 1998, in Las Vegas, Nevada, and participated in an associated tour of the YM site. Highlights of the Appendix 7 meeting were presented at a YM team meeting. Staff also participated in the DOE/NRC License Application Technical Exchange by videoconference on September 16, 1998.

Staff continued review of the LLNL Near-Field and Altered-Zone Models Report and initiated review of the draft DOE TSPA-VA Technical Basis document, particularly Chapter 4 Near-Field Geochemical Environment.

In the next period, the CNWRA staff will continue preparation of the FY99 CNWRA OPS and review of the draft DOE TSPA-VA Technical Basis document. A meeting is planned to establish the technical basis for revision of the SRD for the MULTIFLO code. Debugging and benchmarking of this code will continue. Near-field radioelement solubility modeling and aqueous actinide chemistry studies will advance. Preparations are ongoing

for participation in a October 29, 1998, meeting at the NRC on coupled THC effects on UZ flow. A paper on PA sensitivity studies related to the dependence of the source term on near-field environmental conditions will be completed and submitted for internal review.

1.5 Container Life and Source Term (CLST)

Technical and programmatic comments of the NRC staff on the Container Life and Source Term IRSR, Rev. 1, were addressed. Staff completed the CLST portion of the FY99 CNWRA OPS and comments were resolved.

Electrochemical corrosion testing, performed to confirm the applicability of repassivation and corrosion potentials as predictive parameters for the long-term, localized corrosion of Alloy 825 in chloride-containing solutions at 95 °C, was temporarily interrupted after a total time of 1,479 days due to an extended power failure affecting the laboratory facilities. The specimens were removed from the test cells, examined for signs of localized corrosion, and weighed. Several small shallow regions of crevice corrosion were observed on the specimens tested at the corrosion potential under air saturated conditions for a total of 1,074 days. During 6 months of continuous exposure to the 1,000 ppm chloride solutions, the corrosion potential reached levels as high as 300 mV_{SCE}. No localized corrosion was observed on specimens maintained below the repassivation potential. After inspection, all long-term tests were restarted.

The load frame that will be used to precrack the Alloy C-22 and type 316L SS double cantilever beam specimens for stress corrosion cracking testing has been calibrated according to ASTM E4. One specimen of each material is being used to generate compliance curves as a function of crack length. Specimens of 316L SS will be tested to validate the testing procedure by combining them with existing data. When complete, the set of compliance curves will be used to determine the crack opening displacement and necessary loading wedge thickness for the initial stress intensities to be used in the tests. Fatigue precracking and wedge loading of specimens exposed to a acidified chloride solution will begin after the compliance curves are completed. For Alloy C-22, testing will be conducted using initial stress intensities of 30 and 40 $MPa \cdot m^{1/2}$. For type 316L SS, specimens will be tested with initial stress intensities of 20 and 40 $MPa \cdot m^{1/2}$.

Localized corrosion testing of Alloy C-22 in solutions with chloride concentrations of 0.5, 1.0, and 4.0 M at temperatures ranging from 95 to 175 °C continues. Cyclic potentiodynamic polarization curves are being determined using creviced specimens of Alloy C-22. An internal Ag/AgCl/KCl (0.1 M) reference electrode, calibrated at room temperature against a saturated calomel electrode, is used in these measurements. Components to assemble an additional internal $Ag/AgCl/Cl^-$ reference electrode were obtained. Prior to its use, the new internal reference electrode will be calibrated.

The interdependence of solution chemistry, temperature, and potential on localized corrosion of A 516 carbon steel is being investigated in simulated repository environments containing bicarbonate and chloride anions. Potentiostatic crevice corrosion testing of carbon steel progresses, primarily focusing on the effect of pH (from 8.2 to 11.0), temperature (20, 65, and 95 °C), and chloride concentration (1.2 to 50 mM). Further work aimed at the lower pH corrosion regime has begun with particular emphasis on whether localized corrosion initiation occurs at pH values less than 9.5.

In the next period, long-term corrosion tests on Alloy 825 will continue, as will localized corrosion testing of A 516 carbon steel and Alloys C-22 and 625. Stress corrosion cracking testing of Alloy C-22 will also begin. Technical assistance to the NRC for preparation of the CLST IRSR Rev. 1 is expected to be completed.

1.6 Thermal Effects on Flow (TEF)

The staff continued testing of the DCM capability in the MULTIFLO code. Drift-scale 2D models were compared to the DOE results reported in the DOE Near Field/Altered Zone Report. The formation of heat pipes in the model results was evaluated. The thermal source term was modified to reflect the current assessments of projected repository thermal load.

The second phase of the laboratory-scale boiling isotherm depression heater experiment continued during the reporting period. Integration of this heater test with the CLST and ENFE KTIs was explored. A parallel experiment has been designed to evaluate the evolution of the infiltration water chemistry as it reacts with the pretest concrete. The CLST KTI team initiated efforts to design a candidate material assessment apparatus that can be incorporated into the laboratory-scale heater test.

Interpretation of results from the first laboratory-scale heater test continued. These results were analyzed and modeled with MULTIFLO-DCM. A paper describing the experimental and modeling results was submitted to the Second International Symposium on Two-Phase Flow Modeling and Experimentation.

Numerical modeling of the DOE DST and LBT was temporarily suspended pending availability of staff currently assigned to another KTI task. These analyses will resume in FY99.

An abstract on the Mechanistic Refluxing Model was submitted to the Witherspoon Conference on Flow Through Fractured Media.

Sensitivity analyses using the REFLUX3 module of the TPA Version 3.2 code continued and will be completed when the final reference base case is assembled.

In the next period, TEF KTI staff plans to (i) initiate the next phase of the boiling isotherm penetration laboratory-scale experiment, (ii) continue analysis of the results from the first phase of the laboratory-scale heater test, (iii) continue testing of the MULTIFLO-DCM numerical code, (iv) evaluate the conceptual model of refluxing, (v) attend the DOE quarterly thermal test workshop at LLNL, and (vi) attend the vadose zone workshop at Colorado School of Mines.

1.7 Repository Design and Thermal-Mechanical Effects (RDTME)

During this period, the staff continued the analyses, using the UDEC code, to predict rockfall under seismic load in the repository thermal environment. This simulation work is expected to provide a technical basis for determining the magnitude of the dynamic impact load on the WPs resulting from rockfall. Also, the results will be used as input to the SEISMO module in the TPA code for disruptive scenario assessment. The progress to date regarding the rockfall study was submitted as Auxiliary Analysis on Rock Falls—Journal Paper or Presentation (IM 1402-671-830).

A report documenting the preliminary results regarding the study of the rock mass behavior under heated conditions at the repository scale was conveyed as TM Drift Stability Analysis at Repository Scale (IM 1402-671-845). The report emphasized the effect of variability and long-term degradation of rock mass material properties and strengths on the stability of repository drifts.

The investigation of drift-scale rock mass behavior and its effect on concrete lining stability using UDEC progressed during this reporting period. Staff continued the literature review on concrete performance at high temperature. The review will provide valuable information to assess the DOE design of the concrete liner for use at high temperature.

Three abstracts on TM and seismic behavior of repository drifts were prepared and submitted for presentation at the 37th U.S. Rock Mechanics Symposium to be held in Vail, Colorado, June 6–9, 1999.

In the next period, RDTME KTI staff plans to (i) review the literature collected on concrete performance at high temperature, (ii) investigate rock mass behavior under heated conditions on both repository and drift scales with an emphasis on long-term degradation of rock mass material properties and strengths, (iii) conduct rockfall simulations, (iv) use the ABAQUS code to model WPs, (v) attend the DOE quarterly thermal test workshop at LLNL, and (vi) conduct reactive activities including review of design documents.

1.8 Total System Performance Assessment and Integration (TSPAI)

Work on User's Guide for TPA Version 3.2—Letter Report (IM 1402-762-810) continued in preparation for submittal on September 30, 1998. Technical and programmatic reviews of the document were jointly conducted by the NRC/CNWRA staffs. Finalizing the basis for choosing parameter values for the NRC data set was completed and appendix A updated.

The nomination letter and proposed scope and schedule for conducting a formal external review of the TPA Version 3.2 code were presented to the HLW Management Board; these were modified in response to board and staff comments. Consideration of NEA conducting the external review (to reduce costs and avoid any semblance of COI) is awaiting an NRC decision in light of a concern raised regarding the tight review schedule. In the meantime, work continued to update the list of nominators as the first of the nomination packages was disseminated.

Considerable progress was made on Input to TPA Version 3.1 Sensitivity Studies Report—Letter Report (IM 1402-761-810). Technical review of Volume I: Conceptual Models and Data was completed and editorial review initiated. Volume II: Results and Conclusions has undergone revision in response to editorial and programmatic reviews conducted by the NRC and CNWRA staffs. A decision was made to publish the two-volume report as NUREG–1668 instead of NUREG/CR–5549, since this report represents a joint efforts by the NRC and CNWRA PA staffs. To accommodate timely delivery of the user's guide for TPA Version 3.2, October 21, 1998 was approved by the NRC as the new submission date for the two volumes.

The staff presented a general overview paper and poster on the NRC TPA approach, jointly prepared by the NRC and CNWRA staffs, at the DISTEC '98 conference held

September 9–11, 1998, in Hamburg, Germany. Moreover, staff completed TSPAI input to the FY99 CNWRA OPS.

Significant progress was made on (i) the PC version of the TPA Version 3.2 code, (ii) the Java-based post processor for the TPA Version 3.2 code, and (iii) the PVM implementation of the TPA Version 3.2 code. The PC version of the TPA Version 3.2 code has been developed to run under the Windows NT operating system. Continuing problems in executing the TPA code appear to be caused by a bug in the Lahey Fortran compiler. The Lahey support group was contacted to address the problems. Testing of the Java-based post processor continued and the on-screen help option is currently under development. The PVM version of the TPA Version 3.2 code is currently undergoing testing on the CNWRA SUN network and the user's manual is under preparation.

In the next period, the PA staff will focus on (i) completing the first volume of Input to TPA Version 3.1 Sensitivity Studies Report—Letter Report (IM 1402-761-810); (ii) finalizing the second volume of the Input to TPA Version 3.1 Sensitivity Studies Report—Letter Report (IM 1402-761-810), which reflects actual results of the sensitivity study; (iii) attending an Appendix 7 meeting on scenarios in Las Vegas, Nevada; (iv) assisting the NRC with revisions to the Total System Performance Assessment IRSR; (v) finalizing the approach for the external review of the TPA Version 3.2 code; and (vi) completing the PC and PVM versions of TPA Version 3.2 code and the Java-based post processor for the TPA Version 3.2 code. In addition, recruitment is ongoing for the PA modeler and risk assessment positions.

1.9 Activities Related to Development of the NRC High-Level Waste Regulations (ARDR)

The staff submitted their contribution to the CNWRA Input to Commission Paper on Draft Conforming Rulemaking (IM 1402-771-820) through comments on the draft rule and provided text as requested by the NRC. In addition, they completed their input to the FY99 CNWRA OPS.

The staff progressed on evaluating the effects of well characteristics and plume dimensions on dose estimates, which are needed to support development of attributes of the critical group to be used in 10 CFR Part 63. The purpose of this task is to determine if using more complex models of site hydrogeology affect estimates of radionuclide concentrations at pumping wells for both residential and agricultural receptor locations. The modeling approach that has been adopted incorporates spatially variable material properties, complex initial and boundary conditions, and multiple pumping wells with variable pumping rates. This period, the ISATIS program was used to develop a geostatistical model of conductivity in the welded tuff aquifer using pooled data from both large- and small-scale tests. The geostatistical model was used to generate randomly correlated conductivity fields. An additional geostatistical model was also developed from the large-scale test data.

Efforts to incorporate soil survey map data for the region surrounding YM into the CNWRA GIS database continued. The information obtained from the Soil Conservation Service provides spatial characterizations of soil taxonomies for the region. The spatial soil data will provide an additional coverage of GIS data that can be used with other regional GIS data to support definition of the critical group at YM. This period, the need to digitize the map information was obviated because the same information was found in digital format on the Natural Resources Conservation Service web site. All quadrangles for the area of

southern Nye County were downloaded and processed into one large coverage for the area. Attribute data were then reviewed to determine the utility of including additional information in the new coverage.

In response to issues brought forward at a recent DOE/NRC technical exchange, the investigation on issues pertaining to calculation of age-specific doses at YM continued. Age-specific DCFs were identified and preparations were made for initial calculations.

At the end of this period, staff began revising the previously issued report, Information and Analyses to Support Selection of Critical Groups and Reference Biospheres for Yucca Mountain Exposure Scenarios. The revised report is intended to be issued as a NUREG/CR and will be a key reference document for the rulemaking effort and TSPAI activities.

In the next period, staff will complete a geostatistical model based on small-scale test data. The dilution study will focus on estimating additional structure in the welded tuff aquifer using other data sources. Assessment of age-specific DCFs will continue and the initial results made available to the NRC. If EPA publishes the draft standard, staff will assist the NRC with reviewing it and preparing comments. The revised report on Information and Analyses to Support Selection of Critical Groups and Reference Biospheres for Yucca Mountain Exposure Scenarios will be formatted for delivery.

1.10 Unsaturated and Saturated Flow Under Isothermal Conditions (USFIC)

Close interactions with the NRC staff continued during this period to support development of the USFIC IRSR, Revision 1.

The staff attended the inaugural meeting of the NAS expert panel on conceptual models of flow and transport in the fractured vadose zone. The panel will convene a workshop in March 1999 and produce a summary report along with papers from invited speakers by August 1999. The report will focus on the iterative process of developing a conceptual model for fractured media, isolating the important physical processes, and establishing the methodologies for parameterization and quantifying uncertainty.

USFIC staff attended a FRACMAN modeling workshop in Seattle, Washington, September 14 - 18, 1998. The FRACMAN software and the accompanying MAFIC module will be used to perform discrete fracture modeling of the C-Well hydraulic and tracer tests.

USFIC staff collaborated with SDS staff to write a manuscript entitled Slip Tendency, Dilation Tendency, and Anisotropic Permeability at Yucca Mountain, Nevada—Journal Article (IM 1402-471-862). USFIC contributions to this manuscript included an analysis of regional anisotropy in the hydraulic transmissivity of the volcanic tuff aquifer, based on interpretations of the C-Well hydraulic tests, and an analysis of the effect of anisotropy on groundwater flow paths.

Characterization of nonwelded vitric layers below the potential repository horizon continued. Geophysical data obtained from the DOE is being plotted against mineral logs and x-ray diffraction data to estimate aggregate thicknesses of vitric layers for use in PA. Characterization of strata in the Calico Hills Unit and the Prow Pass Tuff is also being used to support alternative conceptual models for flow and transport from the repository horizon to the water table.

Analysis of the potential hydrologic impact of the invasion of Bromus continued. Bromus is a non-native grass currently found at and around YM. The influence of this grass on infiltration is of interest because of its early season life cycle, shallow rooting patterns, and ability to replace native vegetation rather than coexist. Studies on Bromus invasion in other areas indicate the possibility of increased flux of water to the water table. Literature review on the impact of Bromus continues.

The results from 440 1D bare-soil simulations were collected, documented, and assessed. Improved representations were derived for MAI as a function of climate, soil, and fracture properties. Implications for deep percolation under climatic change were examined, including the direct meteorologic effects of climate change and the indirect effects of change in soil texture and thickness. The simulations suggest that changes in soil properties may in large part counteract direct climatic change effects, although soil genesis will likely significantly lag climatic change.

Efforts continued toward developing an improved conceptual model of seepage into drifts under isothermal conditions. Modeling of the liquid injection test above niche 3,650 confirmed the results of LLNL studies and highlighted the dependence of model results on assumed boundary conditions and domain geometry. An analysis was also conducted comparing two methods of representing drift space: drift elements with a constant zero matric potential condition versus drift elements that simply use a large van Genuchten alpha parameter. Preliminary results showed that while drift representation makes some difference, it is a relatively small factor in the overall results. A comparison of domains using the arbitrarily located no-flow boundaries in the LLNL model versus natural no-flow boundaries may illuminate the influence of domain geometry and boundary conditions on the TSPA-VA model of seepage into drifts. It is clear that a 3D domain will be necessary when incorporating heterogeneity and this will require greater simulation run times.

Development progressed on a preliminary 3D geological model of the area south of YM, in collaboration with the SDS KTI. A site-scale model for the YM area was extracted from the regional model for the NTS area. Refining the spatial resolution of the site-scale model with available data also progressed.

Interpretation of data from the CNWRA field studies at YM continued. Gravity survey data were used to develop a preliminary two-layer subsurface model for the Amargosa Farms area.

In the next period, USFIC activities will include (i) interpretation of data from the CNWRA field studies at YM, (ii) progress on alternative conceptual models for flow and transport from the potential repository to the water table, (iii) progress on approaches for modeling future infiltration, (iv) continued development of conceptual models for seepage into drifts, (v) review of the LBNL site-scale UZ model of YM, (vi) site visit to YM, (vii) preparation of a 3D subregional site-scale flow and transport model, (viii) ongoing interaction with the NRC working group on structural controls on groundwater flow, and (ix) continued efforts toward interpreting data from C-Well hydraulic and tracer tests.

1.11 Radionuclide Transport (RT)

Work continued on two manuscripts for publication in the proceedings volume of the Materials Research Society Symposium on the Scientific Basis for Nuclear Waste Management XXII, Boston, Massachusetts, November 30–December 3, 1998. The first manuscript, entitled Radionuclide Sorption at Yucca Mountain, Nevada—Demonstration of an Alternative Approach for PA, uses mechanistic sorption models and site-specific hydrochemical data to constrain K_D PDFs for PA abstractions and provides a discussion of spatial distributions of calculated K_D in the vicinity of YM. The total range in calculated K_D for Np and U sorption is as much as nine orders of magnitude, but the total range in the immediate vicinity downgradient from YM is typically much less.

In the second manuscript, entitled Unsaturated Zone Waters From the Nopal I Natural Analog, Chihuahua, Mexico—Implications for Radionuclide Mobility at YM, chemical data on Nopal I UZ waters are used to model uranium speciation and solubility and reaction paths affected by uraninite dissolution. Modeling shows that resulting aqueous uranium concentrations are highly sensitive to (i) adopted solubility products for phases such as soddyite and haiweeite, for which such data are uncertain over several orders of magnitude; (ii) redox conditions as constrained by oxygen fugacities in open versus closed systems; (iii) carbonate contents related to CO_2 fugacity and calcite saturation state; and (iv) starting aqueous SiO_2 contents. Dissolved U contents as high as 6×10^{-5} molal are calculated. The IM numbers for these products will be established in the FY99 CNWRA OPS.

A draft of a manuscript was completed for submittal to a peer-reviewed journal. This manuscript is based on an evaluation of data (published literature and unpublished CNWRA results) on ion exchange between aqueous solutions and the zeolite mineral clinoptilolite. It also discusses a thermodynamic model for describing and predicting ion exchange equilibria. A literature review was concluded on geochemical parameters likely to control colloid stability during transport; the CNWRA staff are reviewing and evaluating the literature to determine which, if any, parameters can be used to develop abstractions of colloid transport suitable for PA. The effects of the pseudo-colloid formation on RT parameters are being investigated using mechanistic sorption models, site-specific hydrochemistry, and observed natural colloid concentrations in the vicinity of YM. This paper is proposed as a new deliverable in table 2 of this PMPR, Experimental and Modeling Study of Ion Exchange Between Aqueous Solutions and the Zeolite Mineral Clinoptilolite (IM 1402-871-940).

Well logs for water wells drilled in the vicinity of YM were screened and located on topographic maps of the YM vicinity. Several hundred wells drilled over a 50-yr period were examined. About 65 wells drilled during the 1980s and 1990s provided a representative coverage of the alluvial wells. Lithologic information in these logs was been entered into an electronic database that includes alluvium lithology, limited mineralogy information, depth to water, perforated intervals, and producing horizons. The well locations have been digitized to yield UTM coordinates and the DEM coverages for the region are being used to determine the elevation of each wellhead.

Liquid scintillation analysis was completed for a set of experiments to examine uranium-233 sorption on clinoptilolite. Mineral preparation continued for quartz-clinoptilolite mixed mineral absorption experiments. One hundred eighty-five g of quartz has been prepared with a surface area to mass ratio of 0.280 sq. m/g.

The CNWRA staff continued to assist the NRC staff in finalizing the RT IRSR. The CNWRA staff also continued to develop input for the FY99 CNWRA OPS.

In the next period, technical and programmatic reviews of the manuscript on ion exchange equilibria will be completed and submitted for publication in the *Journal of Solution Chemistry*. Well logs will continue to be used to construct a database for alluvium mineralogy. Peer-reviewed papers on the application of sorption modeling for PA calculations will be prepared. There will be continued laboratory analysis, including initiation of multiple-mineral experiments. RT staff will assist in the PA abstraction process. The staff will support completion of the FY99 CNWRA OPS.

1.12 Tank Waste Remediation System (TWRS)

In subtask 1.2, the Low-Activity Retrieval and Pretreatment Technology and Process System Hazard and Safety for TWRS—Letter Report (IM 1403-102-831) was sent electronically as an AI (1403-102-005) on September 29, 1998. To better reflect its contents, the title of the report was changed to TWRS-P Pretreatment Technologies: Process Hazards and Safety Issues. In addition, staff is continuing to work on the Low-Activity Waste Feed Makeup, Solidification, and Offgas Technology and Process System Hazard and Safety Issues Report for TWRS—Letter Report (IM 1403-102-832).

In subtask 1.6, staff is preparing the Final Report on Chemistry of the DOE Contractor Pretreatment Activities (IM 1403-106-815). Draft chapters on sludge washing, ion exchange, electrochemical ion exchange, and organic ozonation were received from the subcontractors and SwRI staff. Their input is being complied in a single report.

In subtask 1.8, based on the NRC guidance for reviewing the DOE-RU Evaluation of the BNFL Initial Safety Analysis and Safety Requirements document, the CNWRA has issued the first part of the report titled Assessment of DOE Regulatory Unit Initial Safety Analysis Report of the BNFL, Inc. ISA Package Open Items–Part I (IM 1403-108-860). This report provides an assessment on 36 out of 90 open issues in the DOE-RU evaluation report and incorporates the NRC staff comments on the draft report. In addition, the CNWRA has received the NRC staff comments on part II of the report. Resolution of the NRC comments will require significant changes and hence delay by two weeks the final issuance of the part II report. With concurrence from the NRC PI, the new deliverable date for part II has been moved from September 30, 1998 to October 9, 1998. This report will address the CNWRA assessment of the additional 28 open items.

FY99 Operations Plan for Technical Assistance Related to TWRS Licensing, Rev. 2, Chg 0, was prepared and is awaiting transmittal with other HLW operations plans.

In the next period, activities in subtask 1.2 will continue on the Low-Activity Waste Feed Makeup, Solidification, and Offgas Technology and Process System Hazard and Safety Issues Report for TWRS—Letter Report (IM 1403-102-832). In subtask 1.6, the Final Report on Chemistry of the DOE Contractor Pretreatment Activities (IM 1403-106-815) will be sent as an AI. In subtask 1.8, responses to the remaining BNFL open items will be forwarded to the NRC staff and the NRC comments on part II of the report will be incorporated.

1.13 Three Mile Island Unit 2 Independent Spent Fuel Storage Installation (TMI-2 ISFSI

Preparation of the draft SER, including evaluation of the DOE response to the NRC second round RAI, continued during this reporting period. The draft SER will be documented as Safety Evaluation Report—Draft Letter Report (IM 1405-014-910). Four CNWRA staff participated in the TMI-2 ISFSI site visit at INEEL on September 14–15, 1998.

In the next period, TMI-2 ISFSI staff plans to continue evaluation of the DOE response to the NRC second round RAI and preparation of the draft SER.

1.14 Dry Transfer System (DTS)

The staff participated in the DTS site visit at INEEL on September 14–15, 1998.

In the next period, staff plans to participate in the DOE/NRC meeting on DTS first round RAI.

1.15 Centralized Interim Storage Facility (CISF)

Evaluation of the DOE response to the NRC RAI and preparation of the draft AR continued. This draft AR will be documented in a report for submission as Assessment Report—Draft Letter Report (IM 1405-031-840).

In the next period, staff plans to prepare the draft AR and participate in a meeting at NRC on this draft AR.

1.16 Private Fuel Storage Facility (PFSF)

The evaluation of the PFS Limited Liability Company response to the NRC first round RAI and the preparation of the second round RAI were completed. These were documented as Second Round Request for Additional Information—Final Letter Report (IM 1405-041-820).

In the next period, PFSF staff plans to initiate activities related to the PFSF proceeding before the ASLB.

1.17 Savannah River Site Aluminum-Based Spent Fuel (SRSASF)

The criticality evaluation of direct codisposal and melt-dilute Al-clad fuels was reviewed. In the case of the direct/codisposal fuels, the DOE performed criticality analyses of degraded canisters and found that the stability of the neutron poison, gadolinium, is extremely important in maintaining subcriticality. The geochemical basis for the assumption of gadolinium stability is being reviewed. The review comments will be provided as a letter report, Review of Criticality Evaluation of Direct Codisposal and Melt-Dilute Fuels (IM 1407-001-905). This report will be issued as part of the FY99 activities, in place of an earlier milestone in FY98, Review of Additional Information Supplied by the DOE on Disposition of Al-based Spent Nuclear Fuel (IM 1407-001-830). The Operations Plan for Technical Assistance on Department of Energy Aluminum Based Spent Nuclear Fuels Disposition Program, Rev. 1, Chg. 0, was prepared and is awaiting transmittal with other HLW operations plans.

In the next period, a letter report, Review of Criticality Evaluation of Direct Codisposal and Melt-Dilute Fuels (IM 1407-001-905), will be transmitted.

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. Completed deliverables are noted on table 3 and 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 $161,198. 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, including COPS and 10 KTIs, TWRS JC, TMI-2 ISFSI JC, DTS JC, CISF JC, PFSF JC, and SRSASF JC. The planned costs per period are based on the spending plans contained in the CNWRA OPS, Revision 10, Change 2, for the DWM JC; TWRS OPS, Revision 1, Change 1, for the TWRS JC; SFPO OPS, Revision 1, Change 5, for the TMI-2 ISFSI, DTS, CISF, and PFSF JCs; and SRSASF OPS, Revision 0, Change 2, for the SRSASF JC.

It should be noted the current spending estimates in all JCs are based on the assumption that staffing is at authorized levels. Staffing remains below authorized levels and accelerated recruitment is in progress. An updated staffing plan was delivered as part of Revision 6, Change 3, to the CNWRA Management Plan.

Period 13 FY98 CNWRA composite expenditures rose 1.1 percent from last period, and this aggregate of all JCs was underspent by $1,135,587 or 10.0 percent. Only the CISF JC evidenced lower spending levels, while the DWM, TWRS, TMI-2 ISFSI, DTS, PFSF, and SRSASF JCs showed higher levels. In percentages, the DTS, PFSF, and SRSASF JCs registered a sharp rise in expenses in contrast with a significant decline in expenditures for the CISF JC. Specific explanations for these swings are provided in the individual sections of each JC.

The DWM JC was underspent by $942,404 or 9.7 percent. Overall expenditures increased 2.6 percent from the previous period as costs rose in the SDS, ENFE, RDTME, TSPA, ARDR, and RT KTIs, but declined in COPS and the IA, CLST, TEF, and USFIC KTIs.

FY98 spending was about $8,740K before fee. This amount is consistent with the estimate made the previous period and the summary carryover analysis conveyed earlier this period.

Work and associated spending accelerated in the last six periods compared to the first seven periods of this fiscal year. Per period expenditures for the last six periods averaged $777,903, without fee, while those for the seven previous periods were $581,745—evidencing a 33.7 percent increase in

per-period spending. Moreover, the variance between estimated and actual aggregate spending narrowed to approximately 10 percent in the last three periods, markedly below the highs of 15–17 percent that occurred in the first few periods of this FY. A further comparison between these two intervals reveals a net increase of six core FTE and 15 qualified consultants and subcontractors from period 1 through period 13. Spending on consultants and subcontractors rose by 33 percent in the most recent six periods relative to the initial seven periods.

Furthermore, the mean projected spending for periods 10–13 was $833,851 without fee. This per-period expenditure approximates expected spending for the first three periods of FY99, based on the most recent budget estimates.

The TWRS JC was underspent by $39,759 or 4.8 percent. Although spending increased over last period, the cumulative variance increased, primarily the result of reduced activity and rescheduled deliverables.

The TMI-2 ISFSI JC was underspent by $22,037 or 14.0 percent. Costs rose from the last period as a result of CNWRA staff participation at the INEEL site visit.

The DTS JC was underspent by $55,625 or 28.9 percent. Spending increased dramatically from the last period because of staff participation at the INEEL site visit.

The CISF JC was underspent by $5,633 or 2.5 percent. Expenses declined significantly from the previous period as work involving evaluation of the DOE response to the NRC First Round RAI for incorporation into a draft AR continued, no new work was assigned, and resources were directed to PFSF work.

The PFSF JC was underspent by $27,605 or 19.3 percent. Expenditures doubled over last period as work resumed on the review and evaluation of the PFS Limited Liability Company response to the NRC First Round RAI, along with the preparation of the Second Round RAI.

The SRSASF JC was underspent by $42,526 or 39.1 percent. Spending increased over last period. This increase may be attributed to preparation of a letter report and the SRSASF section in the operations plan.

The CNWRA expenditures on SwRI labor, consultants, and subcontractors as a proportion of composite spending on all JCs were 26.1 percent. The CNWRA expense on consultants and subcontractors as a fraction of composite spending on all JCs was 19.0 percent. These percentages increased from the previous period—reflecting the payment of outstanding vouchers. The CNWRA remains committed to enhance, where appropriate, participation of consultants and subcontractors in the conduct of the CNWRA work.

As shown in table 1, the CNWRA has 48 core and one limited-term staff members. The CNWRA updated the staffing plan portion of the Management Plan, reflected in table 1. The available pool of approved consultants and subcontractors declined to 46.

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 13 was 9.7 percent. Expenditures in this JC increased by 2.6 percent over the previous period. Specific explanations for over/underspending for COPS and each KTI follow.

The cost variance for COPS was 2.9 percent: 1.3 percent for the Management, Planning, and Computer Support subtask (1402-158) and 10.0 percent for the QA subtask (1402-159). Spending in the 158 subtask fell relative to last period but rose in the 159 subtask. In the next period, expenses in the Management, Planning, and Computer Support subtask are expected to follow estimates, while those for the QA subtask are expected to be close to the estimated levels.

The cost variance for the IA KTI was -14.0 percent. Spending is anticipated to remain stable in the next period as FY99 OPS are implemented.

The cost variance for the SDS KTI was -19.3 percent. Spending in the first period of FY99 is anticipated to decrease slightly.

The cost variance for the ENFE KTI was 18.2 percent. This slight percentage reduction from period 12 (18.9 percent) reflects payment of existing obligations.

The cost variance for the CLST KTI was 7.4 percent. The positive cost variance increased slightly relative to the previous period. The underspending results from being understaffed. The hiring of new staff will result in an increased rate of spending in the next FY.

The cost variance for the TEF KTI was 18.9 percent. The underspending reflects reallocation of staff to other areas. This variance may decline in FY99 as newly hired staff work on TEF KTI activities.

The cost variance for the RDTME KTI was 12.0 percent. Spending increased in this KTI over the previous period. This variance may be reduced in FY99 as additional non-CNWRA staff work on KTI activities.

The cost variance for the TSPAI KTI was 14.9 percent. The variance may remain about the same, since the spending rate is expected to remain roughly constant during period 1 of FY99.

The cost variance for the ARDR KTI was 57.9 percent. Despite an increase in spending in period 13, this percentage variance is higher than the variance for last period. There is still no indication the draft EPA standard will be released for review in the coming months, so underspending will continue and may even increase during period 1 of FY99 unless new tasking is received.

The cost variance for the USFIC KTI was 12.1 percent, a slight increase from period 12 (11.4 percent). Spending declined over last period as the result of staff allocation to other assignments.

The final cost variance for the RT KTI at the end of FY98 was 10.8 percent, compared to 14.7 percent in period 12. This decreased variance is due to payment of existing commitments at the end of FY98.

The cost variance for the TWRS project was 4.8 percent. Aggregate underspending has resulted from the rescheduling of some FY98 milestones into FY99.

The cost variance for the TMI-2 ISFSI project was 14.0 percent—significantly lower than that of the previous period. This cost underrun will decrease as the CNWRA evaluates the DOE response to the NRC second round RAI and as resources are allocated for preparing the draft SER.

The cost variance for the DTS project was 28.9 percent—significantly lower than that of the previous period. This cost underrun was primarily because of delays in authorization of work and lack of continuity of funding during periods 3 through 6 in FY98. The cost underrun is expected to decrease after the DOE response to the NRC first round RAI is received and evaluated.

The cost variance for the CISF project was 2.5 percent. Although per period spending declined this period, actual expenditures are close to the budgeted amount.

The cost variance for the PFSF project was 19.3 percent. This cost underrun will diminish as the CNWRA assists the NRC staff regarding the PFSF proceeding before the ASLB.

The cost variance for the SRSASF was 39.1 percent. Spending increased in period 13—resulting from the review of additional documents sent by the DOE.

Table 1. CNWRA Core Staff—Current Profile and Hiring Plan* (Period 13)

Expertise/Experience	Current No.	Professional Staff	Positions Open FY98
ADMINISTRATION	4	H.GARCIA, W.PATRICK, J.RUSSELL, B.SAGAR	
CHEMICAL PROCESSING ENGNG./PHYS. CHEM.	2	V.JAIN, D.DARUWALLA	
CODE ANALYSIS/DEVELOPMENT	3	R.JANETZKE, R.MARTIN, J.BANGS	
DATA MANAGEMENT/PROCESSING, INCLUDING FINANCIAL	1	P.MALDONADO	
DOSE/RISK/HAZARD ANALYSIS	0		1
ELECTROCHEMISTRY	1	G.CRAGNOLINO	
ENGINEERING GEOLOGY/GEOLOGICAL ENGNG.	2	R.CHEN, G.OFOEGBU	
ENVIRONMENTAL SCIENCES	1	P.LaPLANTE	
GEOCHEMISTRY	5	W.MURPHY, R.PABALAN, E.PEARCY, J.PRIKRYL, D.TURNER	
GEOHYDROLOGY/HYDROGEOLOGY	4	R.FEDORS, R.GREEN, J.WINTERLE, D.FARRELL	1
GEOLOGY	2(1)†	L.McKAGUE, M.MIKLAS, P.LAFEMINA†	
HYDROLOGIC TRANSPORT	3	A.ARMSTRONG, S.PAINTER, D. HUGHSON	
INFORMATION MANAGEMENT SYSTEMS	1	R. KOTARA	
MATERIAL SCIENCES	3	D.DUNN, N.SRIDHAR, S.BROSSIA	1
MECHANICAL, INCLUDING DESIGN & FABRICATION	0		1
MINING ENGINEERING	1	S-M.HSIUNG	
NUCLEAR ENGINEERING	1	M.JARZEMBA	
OPERATIONAL HEALTH PHYSICS	2	J.WELDY, L.DEERE	
PERFORMANCE ASSESSMENT	2	S.MOHANTY, G.WITTMEYER	2
QUALITY ASSURANCE	1	B.MABRITO	
RADIOISOTOPE GEOCHEMISTRY	1	D.PICKETT	
ROCK MECHANICS, INCLUDING CIVIL/STRUC. ENGNG.	2	A.CHOWDHURY, A.GHOSH	
SOURCE-TERM/SPENT FUEL DEGRAD.	0		1
STRUCTURAL GEOLOGY/ SEISMO-TECTONICS	3	D.FERRILL, J.STAMATAKOS, D.SIMS	
SYSTEMS ENGINEERING	1	P.MACKIN	
VOLCANOLOGY/IGNEOUS PROCESSES	2	C.CONNOR, B.HILL	
TOTAL	48(1)†		7

* See staffing plan for details

† Limited term

Table 2. Summary of Schedule Changes (Period 13)

MILESTONE NUMBER	TYPE	DESCRIPTION	ORIGINAL DATE	REVISED DATE	RATIONALE FOR CHANGE
1402-471-832	IM	Structural Evolution of Crater Flat Nevada—Journal Article	09/25/98	09/26/99	Start on deliverable delayed by work on SDS IRSR, Rev. 1. Report will be completed under new milestone in FY99 (IM 1402-471-920).
1402-471-865	AI	Input to Review of DOE's GFM 3.0 EARTHVISION Model	09/25/98	10/05/98	Subsequent to last PMPR, NRC decided to include this in the SDS IRSR, Rev. 1, therefore changing the scope. Both deliverable level and delivery date are changed. Input to IRSR was made electronically on 9/25/98.
1402-761-810	IM	Input to TPA 3.1 Sensitivity Studies Report—Letter Report (Vols. I and II)	07/31/98	10/21/98	Postponed to allow completion of IM 1402-762-810
1402-761-820	IM	Review Comments on DOE TSPA-VA—Letter Report	09/30/98	09/24/99	Pending release of VA
1403-108-861	IM	Response to DOE Regulatory Unit Initial Safety Analysis Report of the BNFL Inc. ISA Package Open Items— Part II	09/30/98	10/09/98	NRC comments on draft report require significant changes to the text
1405-031-840	IM	Assessment Report--Draft Letter Report (CISF)	09/25/98	11/2098	More time needed to implement NRC guidance
1407-001-830	IM	Review of Additional Information Supplied by the DOE on Disposition of Al-based Spent Nuclear Fuel	09/30/98	10/30/98	Geochemical stability of gadolinium needs to be examined, which required additional time. Report will be completed under new milestone in FY99 (IM 1407-001-905).

Table 3. Deliverables (Period 13)

MILESTONE NO.	TYPE	DESCRIPTION	ORIGINAL COMPLETION DATE	REVISED DATE	# OF REVISIONS	ACTUAL COMPLETION DATE	REASON (IF DELAYED)
1402-471-850	IM	GIS Archive—CNWRA Report	06/25/98	[illegible]/98	2	09/24/98	Higher priority work on SDS IRSR required
1402-471-862	IM	Dilation Tendency Analysis of Fracture Patterns—Journal Article	06/15/98	09/25/98	4	09/24/98	Additional analysis by hydrologist required
1402-671-830	IM	Auxiliary Analysis on Rock Falls—Journal Paper or Presentation	09/18/98	09/25/98	1	09/24/98	More resources to assist NRC to finalize RDTME IRSR Rev. 1 needed
1402-671-845	IM	TM Drift Stability Analysis at Repository Scale	09/25/98			09/24/98	
1402-771-820	IM	CNWRA Input to Commission Paper on Draft Conforming Rulemaking	08/31/98			08/31/98	
1402-471-950	IM	Crossing Conjugate Normal Faults—Journal Article	11/02/98			09/16/98	
1403-108-860	IM	Response to DOE Regulatory Unit Initial Safety Analysis Report of the BNFL ISA Package Open Items—Part I	09/22/98			09/21/98	
1405-041-820	IM	Second Round Request for Additional Information—Final Letter Report (PFSF)	09/25/98			09/23/98	

Table 4. Financial Status (Period 13)

Project Names	Funds Authorized	Funds Costed to Date	Funds Uncosted	Commitments
COPS	1,626,360	1,578,770	47,590	4,852
IA	619,186	705,836	(86,650)	2,681
SDS	784,930	936,611	(151,681)	39,861
ENPE	922,779	754,689	168,090	42,975
CLST	715,548	662,741	52,807	8,445
TEF	736,729	597,313	139,416	903
RDTME	483,829	425,594	58,235	0
TSPAI	1,738,058	1,478,356	259,702	4,650
ARDR	463,756	195,175	268,581	0
USFIC	1,113,397	978,714	134,683	15,631
RT	477,466	425,834	51,632	21,428
DWM Costs	9,682,038	8,739,633	942,405	
DWM Award Fee	563,865	260,531	303,334	
DWM Base Fee	375,910	339,790	36,120	
TOTAL DWM	10,621,812	9,339,954	1,281,858	141,427
TWRS Costs	821,901	782,142	39,759	19,771
TWRS Award Fee	47,643	22,741	24,902	
TWRS Base Fee	31,762	30,481	1,280	
TOTAL TWRS	901,305	835,364	65,941	19,771
TMI-2 ISFSI SAR Costs	157,704	135,640	22,064	0
TMI-2 ISFSI SAR Award Fee	9,191	5,585	3,606	
TMI-2 ISFSI Base Fee	6,127	5,247	880	
TOTAL TMI-2 ISFSI SAR	173,023	146,472	26,551	0
DTS Costs	192,277	136,652	55,625	0
DTS Award Fee	11,175	7,774	3,401	
DTS Base Fee	7,451	5,276	2,174	
TOTAL DTS	210,903	149,703	61,200	0
CISF Costs	228,022	222,389	5,633	0
CISF Award Fee	13,245	6,203	7,042	
CISF Base Fee	8,831	8,583	248	
TOTAL CISF	250,098	237,175	12,923	0
PFSF Costs	142,880	115,275	27,605	0
PFSF Award Fee	8,310	3,512	4,798	
PFSF Base Fee	5,540	4,450	1,090	
TOTAL PFSF	156,730	123,237	33,493	0
WVDP Costs	34,495	34,266	229	0
WVDP Award Fee	2,287	1,896	391	
WVDP Base Fee	1,331	1,331	0	
TOTAL WVDP	38,112	37,492	620	0
SRSASF Costs	108,826	66,300	42,526	0
SRSASF Award Fee	6,340	3,351	2,989	
SRSASF Base Fee	4,227	2,566	1,661	
TOTAL SRSASF	119,393	72,217	47,176	0
Grand Total	12,471,376	10,941,615	1,529,761	161,198
Note: All authorized funds have been allocated.				

Table 5. Private Fuel Storage Facility License Fee Cost Recovery Status (Period 13)

LICENSE FEE COST RECOVERY STATUS

JOB CODE: J5226

TITLE: Private Fuel Storage Facility

PERIOD: August 29–September 25, 1998

TASK NUMBER	FACILITY NAME	DOCKET NUMBER	TAC OR INSPECTION IDENTIFICATION NUMBER	PERIOD COSTS	CUMULATIVE COSTS THIS FISCAL YEAR
20-1405-041	Private Fuel Storage Facility	72-22	L22462	$10,468.78	$119,725.35

Note: Costs include 4 percent actual base fee but not award fee, which is determined annually.

APPENDIX

Planned and Actual Costs,

and Cost Variances

Period 13–FY98

CNWRA COMPOSITE

TOTAL ESTIMATE COST

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	792,693	896,744	564,254	715,293	891,897	916,052	925,522	898,190	929,339	956,981	948,620	984,943	947,384	11,367,913
Act Pd Cost	581,443	701,484	651,807	532,261	712,281	740,997	880,402	860,031	853,440	901,800	977,277	914,550	924,552	10,232,326
Variance, $	211,250	195,260	(87,552)	183,032	179,615	175,055	45,120	38,160	75,900	55,181	(28,657)	70,393	22,831	1,135,587
Variance, %	26.6%	21.8%	-15.5%	25.6%	20.1%	19.1%	4.9%	4.2%	8.2%	5.8%	-3.0%	7.1%	2.4%	10.0%
Est FY Cumul	792,693	1,689,437	2,253,691	2,968,984	3,860,880	4,776,932	5,702,454	6,600,645	7,529,984	8,486,966	9,435,586	10,420,529	11,367,913	
Act FY Cumul	581,443	1,282,927	1,934,733	2,466,994	3,179,276	3,920,272	4,800,675	5,660,706	6,514,145	7,415,946	8,393,223	9,307,773	10,232,326	
% Complete	5.1%	11.3%	17.0%	21.7%	28.0%	34.5%	42.2%	49.8%	57.3%	65.2%	73.8%	81.9%	90.0%	-
Cumul Var, $	211,250	406,510	318,958	501,990	681,605	856,660	901,780	939,939	1,015,839	1,071,020	1,042,363	1,112,756	1,135,587	
Cumul Var, %	26.6%	24.1%	14.2%	16.9%	17.7%	17.9%	15.8%	14.2%	13.5%	12.6%	11.0%	10.7%	10.0%	

DIVISION OF WASTE MANAGEMENT (DWM)

1402-000

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	594,821	697,393	356,542	760,809	750,668	768,644	784,380	824,192	809,185	826,244	829,016	851,975	828,168	9,682,038
Act Pd Cost	492,507	600,030	558,113	449,328	591,389	630,604	750,245	734,372	746,387	784,602	809,075	786,103	806,878	8,739,633
Variance, $	102,314	97,363	(201,571)	311,481	159,279	138,040	34,135	89,820	62,798	41,642	19,941	65,873	21,290	942,404
Variance, %	17.2%	14.0%	-56.5%	40.9%	21.2%	18.0%	4.4%	10.9%	7.8%	5.0%	2.4%	7.7%	2.6%	9.7%
Est FY Cumul	594,821	1,292,214	1,648,756	2,409,565	3,160,233	3,928,877	4,713,256	5,537,448	6,346,634	7,172,878	8,001,894	8,853,869	9,682,038	
Act FY Cumul	492,507	1,092,537	1,650,650	2,099,978	2,691,367	3,321,970	4,072,216	4,806,588	5,552,975	6,337,577	7,146,652	7,932,755	8,739,633	
% Complete	5.1%	11.3%	17.0%	21.7%	27.8%	34.3%	42.1%	49.6%	57.4%	65.5%	73.8%	81.9%	90.3%	
Cumul Var, $	102,314	199,677	(1,894)	309,587	468,866	606,906	641,041	730,861	793,659	835,301	855,242	921,114	942,404	
Cumul Var, %	17.2%	15.5%	-0.1%	12.8%	14.8%	15.4%	13.6%	13.2%	12.5%	11.6%	10.7%	10.4%	9.7%	

CNWRA OPERATIONS (COPS)

1402-150

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	120,424	120,574	132,169	125,526	125,186	125,616	125,033	125,650	124,826	125,652	124,578	126,550	124,578	1,626,360
Act Pd Cost	106,290	129,997	136,880	97,262	111,411	102,585	124,571	113,661	111,745	122,601	130,817	156,633	134,317	1,578,770
Variance, $	14,134	(9,423)	(4,711)	28,264	13,775	23,031	462	11,989	13,080	3,051	(6,239)	(30,083)	(9,739)	47,590
Variance, %	11.7%	-7.8%	-3.6%	22.5%	11.0%	18.3%	0.4%	9.5%	10.5%	2.4%	-5.0%	-23.8%	-7.8%	2.9%
Est FY Cumul	120,424	240,998	373,167	498,693	623,879	749,495	874,528	1,000,178	1,125,003	1,250,655	1,375,233	1,501,783	1,626,360	
Act FY Cumul	106,290	236,287	373,167	470,429	581,840	684,425	808,996	922,656	1,034,402	1,157,003	1,287,820	1,444,453	1,578,770	
% Complete	6.5%	14.5%	22.9%	28.9%	35.8%	42.1%	49.7%	56.7%	63.6%	71.1%	79.2%	88.8%	97.1%	
Cumul Var, $	14,134	4,711	(0)	28,264	42,039	65,070	65,532	77,521	90,601	93,652	87,413	57,329	47,590	
Cumul Var, %	11.7%	2.0%	0.0%	5.7%	6.7%	8.7%	7.5%	7.8%	8.1%	7.5%	6.4%	3.8%	2.9%	

IGNEOUS ACTIVITY (IA)														
1402-460														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	48,715	48,716	13,506	49,490	50,593	51,355	50,360	51,612	50,358	51,787	50,294	52,305	50,094	619,189
Act Pd Cost	39,614	34,754	36,569	39,730	45,968	49,808	56,534	52,793	48,989	73,777	72,938	83,081	71,282	705,836
Variance, $	9,101	13,962	(23,063)	9,760	4,625	1,547	(6,174)	(1,181)	1,369	(21,989)	(22,643)	(30,776)	(21,188)	(86,650)
Variance, %	18.7%	28.7%	-170.8%	19.7%	9.1%	3.0%	-12.3%	-2.3%	2.7%	-42.5%	-45.0%	-58.8%	-42.3%	-14.0%
Est FY Cumul	48,715	97,431	110,937	160,427	211,020	262,375	312,735	364,347	414,705	466,492	516,787	569,092	619,186	
Act FY Cumul	39,614	74,368	110,937	150,667	196,634	246,442	302,976	355,769	404,758	478,535	551,473	634,554	705,836	
% Complete	6.4%	12.0%	17.9%	24.3%	31.8%	39.8%	48.9%	57.5%	65.4%	77.3%	89.1%	102.5%	114.0%	
Cumul Var, $	9,101	23,063	0	9,760	14,386	15,933	9,759	8,578	9,947	(12,042)	(34,686)	(65,462)	(86,650)	
Cumul Var, %	18.7%	23.7%	0.0%	6.1%	6.8%	6.1%	3.1%	2.4%	2.4%	-2.6%	-6.7%	-11.5%	-14.0%	
STRUCTURAL DEFORMATION AND SEISMICITY (SDS)														
1402-470														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	51,967	51,970	164,832	46,924	49,533	50,317	49,051	54,073	52,487	54,391	52,428	54,644	52,313	784,930
Act Pd Cost	99,973	104,899	63,346	58,408	47,715	63,352	54,248	56,376	67,482	76,292	85,956	76,169	82,395	936,611
Variance, $	(48,006)	(52,929)	101,486	(11,484)	1,818	(13,035)	(5,197)	(2,303)	(14,995)	(21,901)	(33,528)	(21,525)	(30,082)	(151,681)
Variance, %	-92.4%	-101.8%	61.6%	-24.5%	3.7%	-25.9%	-10.6%	-4.3%	-28.6%	-40.3%	-64.0%	-39.4%	-57.5%	-19.3%
Est FY Cumul	51,967	103,937	268,769	315,693	365,226	415,543	464,594	518,667	571,154	625,545	677,973	732,617	784,930	
Act FY Cumul	99,973	204,872	268,218	326,626	374,341	437,693	491,941	548,317	615,799	692,091	778,047	854,216	936,611	
% Complete	12.7%	26.1%	34.2%	41.6%	47.7%	55.8%	62.7%	69.9%	78.5%	88.2%	99.1%	108.8%	119.3%	
Cumul Var, $	(48,006)	(100,935)	551	(10,933)	(9,115)	(22,150)	(27,347)	(29,650)	(44,645)	(66,546)	(100,074)	(121,599)	(151,681)	
Cumul Var, %	-92.4%	-97.1%	0.2%	-3.5%	-2.5%	-5.3%	-5.9%	-5.7%	-7.8%	-10.6%	-14.8%	-16.6%	-19.3%	
EVOLUTION OF THE NEAR-FIELD ENVIRONMENT (ENFE)														
1402-560														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	67,378	67,719	69,339	72,374	71,411	72,375	71,267	72,613	70,871	72,670	70,672	73,456	70,637	922,779
Act Pd Cost	71,128	76,576	56,732	34,826	59,438	52,000	58,198	64,795	46,082	78,692	48,346	44,487	63,387	754,689
Variance, $	(3,750)	(8,857)	12,607	37,548	11,973	20,374	13,068	7,817	24,789	(6,023)	22,325	28,969	7,250	168,090
Variance, %	-5.6%	-13.1%	18.2%	51.9%	16.8%	28.2%	18.3%	10.8%	35.0%	-8.3%	31.6%	39.4%	10.3%	18.2%
Est FY Cumul	67,378	135,097	204,436	276,810	348,221	420,596	491,862	564,475	635,345	708,015	778,686	852,142	922,779	
Act FY Cumul	71,128	147,704	204,436	239,262	298,700	350,700	408,898	473,694	519,775	598,468	646,814	691,301	754,689	
% Complete	7.7%	16.0%	22.2%	25.9%	32.4%	38.0%	44.3%	51.3%	56.3%	64.9%	70.1%	74.9%	81.8%	
Cumul Var, $	(3,750)	(12,607)	0	37,548	49,521	69,895	82,964	90,781	115,570	109,547	131,872	160,841	168,090	
Cumul Var, %	-5.6%	-9.3%	0.0%	13.6%	14.2%	16.6%	16.9%	16.1%	18.2%	15.5%	16.9%	18.9%	18.2%	

CONTAINER LIFE AND SOURCE TERM (CLST)

1402-570

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	0	37,055	15,783	52,904	59,077	59,727	69,899	70,665	69,814	70,669	69,615	70,725	69,615	715,548
Act Pd Cost	0	16,677	36,161	27,404	47,447	58,016	65,024	82,263	76,515	55,175	60,959	73,695	63,407	662,741
Variance, $	0	20,378	(20,378)	25,500	11,630	1,711	4,875	(11,598)	(6,701)	15,494	8,656	(2,970)	6,208	52,807
Variance, %	0.0%	55.0%	-129.1%	48.2%	19.7%	2.9%	7.0%	-16.4%	-9.6%	21.9%	12.4%	-4.2%	8.9%	7.4%
Est FY Cumul	0	37,055	52,838	105,742	164,819	224,546	294,445	365,110	434,924	505,593	575,208	645,933	715,548	
Act FY Cumul	0	16,677	52,838	80,242	127,689	185,705	250,729	332,992	409,507	464,681	525,640	599,334	662,741	
% Complete	0.0%	2.3%	7.4%	11.2%	17.8%	26.0%	35.0%	46.5%	57.2%	64.9%	73.5%	83.8%	92.6%	
Cumul Var, $	0	20,378	0	25,500	37,130	38,841	43,716	32,118	25,417	40,912	49,568	46,599	52,807	
Cumul Var, %	0.0%	55.0%	0.0%	24.1%	22.5%	17.3%	14.8%	8.8%	5.8%	8.1%	8.6%	7.2%	7.4%	

THERMAL EFFECTS ON FLOW (TEF)

1402-660

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	53,077	53,079	36,424	53,750	53,232	53,751	53,197	63,582	62,914	63,708	62,913	64,332	62,771	736,729
Act Pd Cost	33,343	54,058	55,179	35,140	49,982	40,049	37,672	45,016	56,111	39,963	45,143	65,413	40,243	597,313
Variance, $	19,734	(979)	(18,755)	18,610	3,250	13,702	15,525	18,566	6,803	23,745	17,770	(1,082)	22,527	139,416
Variance, %	37.2%	-1.8%	-51.5%	34.6%	6.1%	25.5%	29.2%	29.2%	10.8%	37.3%	28.2%	-1.7%	35.9%	18.9%
Est FY Cumul	53,077	106,156	142,580	196,330	249,562	303,313	356,510	420,092	483,006	546,714	609,627	673,959	736,729	
Act FY Cumul	33,343	87,401	142,581	177,721	227,703	267,752	305,424	350,440	406,551	446,514	491,657	557,070	597,313	
% Complete	4.5%	11.9%	19.4%	24.1%	30.9%	36.3%	41.5%	47.6%	55.2%	60.6%	66.7%	75.6%	81.1%	
Cumul Var, $	19,734	18,755	(1)	18,609	21,859	35,561	51,086	69,652	76,455	100,200	117,970	116,889	139,416	
Cumul Var, %	37.2%	17.7%	0.0%	9.5%	8.8%	11.7%	14.3%	16.6%	15.8%	18.3%	19.4%	17.3%	18.9%	

REPOSITORY DESIGN AND THERMAL-MECHANICAL EFFECTS (RDTME)

1402-670

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	0	34,896	(16,027)	42,936	42,933	43,568	42,685	49,251	48,364	49,421	48,148	49,507	48,148	483,829
Act Pd Cost	0	2,457	17,938	18,182	24,107	32,250	52,242	50,180	39,461	51,330	46,584	41,230	49,632	425,594
Variance, $	0	32,439	(33,965)	24,754	18,826	11,318	(9,557)	(929)	8,903	(1,909)	1,564	8,276	(1,485)	58,235
Variance, %	0.0%	93.0%	-2.2%	57.7%	43.8%	26.0%	-22.4%	-1.9%	18.4%	-3.9%	3.2%	16.7%	-3.1%	12.0%
Est FY Cumul	0	34,896	18,869	61,805	104,738	148,306	190,991	240,242	288,606	338,027	386,175	435,682	483,829	
Act FY Cumul	0	2,457	20,395	38,578	62,685	94,935	147,177	197,357	236,818	288,148	334,732	375,962	425,594	
% Complete	0.0%	0.5%	4.2%	8.0%	13.0%	19.6%	30.4%	40.8%	48.9%	59.6%	69.2%	77.7%	88.0%	
Cumul Var, $	0	32,439	(1,526)	23,227	42,053	53,371	43,814	42,885	51,788	49,879	51,444	59,720	58,235	
Cumul Var, %	0.0%	93.0%	-8.1%	37.6%	40.2%	36.0%	22.9%	17.9%	17.9%	14.8%	13.3%	13.7%	12.0%	

TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION (TSPAI)

1402-760

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	125,724	126,309	5,517	137,718	133,247	142,520	144,640	150,409	146,700	151,137	156,496	161,386	156,256	1,738,058
Act Pd Cost	79,059	94,441	84,050	65,303	106,318	116,391	137,329	123,857	138,644	114,129	146,986	119,244	152,606	1,478,356
Variance, $	46,665	31,868	(78,533)	72,415	26,929	26,129	7,311	26,551	8,055	37,008	9,510	42,142	3,650	259,702
Variance, %	37.1%	25.2%	-1423.5%	52.6%	20.2%	18.3%	5.1%	17.7%	5.5%	24.5%	6.1%	26.1%	2.3%	14.9%
Est FY Cumul	125,724	252,033	257,550	395,268	528,515	671,035	815,675	966,084	1,112,783	1,263,920	1,420,416	1,581,802	1,738,058	
Act FY Cumul	79,059	173,500	257,550	322,853	429,171	545,562	682,891	806,748	945,392	1,059,521	1,206,507	1,325,751	1,478,356	
% Complete	4.5%	10.0%	14.8%	18.6%	24.7%	31.4%	39.3%	46.4%	54.4%	61.0%	69.4%	76.3%	85.1%	
Cumul Var, $	46,665	78,533	0	72,415	99,344	125,473	132,784	159,336	167,391	204,399	213,909	256,051	259,702	
Cumul Var, %	37.1%	31.2%	0.0%	18.3%	18.8%	18.7%	16.3%	16.5%	15.0%	16.2%	15.1%	16.2%	14.9%	

ACTIVITIES RELATED TO DEVELOPMENT OF THE NRC HIGH-LEVEL WASTE REGULATIONS TECHNICAL ASSISTANCE (ARDR)

1402-770

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	31,214	31,300	(19,397)	36,061	35,465	36,117	35,465	40,872	40,106	41,111	51,351	52,799	51,293	463,756
Act Pd Cost	20,453	12,747	9,918	7,597	19,412	15,949	12,315	17,422	16,396	17,957	22,395	8,340	14,274	195,175
Variance, $	10,761	18,553	(29,315)	28,464	16,053	20,168	23,150	23,450	23,710	23,154	28,956	44,458	37,018	268,581
Variance, %	34.5%	59.3%	-1.5%	78.9%	45.3%	55.8%	65.3%	57.4%	59.1%	56.3%	56.4%	84.2%	72.2%	57.9%
Est FY Cumul	31,214	62,514	43,117	79,178	114,643	150,760	186,225	227,097	267,203	308,314	359,665	412,464	463,756	
Act FY Cumul	20,453	33,199	43,117	50,714	70,126	86,076	98,390	115,813	132,209	150,166	172,561	180,901	195,175	
% Complete	4.4%	7.2%	9.3%	10.9%	15.1%	18.6%	21.2%	25.0%	28.5%	32.4%	37.2%	39.0%	42.1%	
Cumul Var, $	10,761	29,315	0	28,464	44,517	64,684	87,835	111,284	134,994	158,148	187,104	231,562	268,581	
Cumul Var, %	34.5%	46.9%	0.0%	35.9%	38.8%	42.9%	47.2%	49.0%	50.5%	51.3%	52.0%	56.1%	57.9%	

UNSATURATED AND SATURATED FLOW UNDER ISOTHERMAL CONDITIONS (USHC)

1402-860

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	96,322	96,437	(35,952)	104,088	91,068	93,819	94,516	96,338	94,481	96,569	94,312	97,142	94,257	1,113,396
Act Pd Cost	42,647	67,346	47,731	51,525	56,150	74,615	109,747	80,092	105,474	101,479	81,370	84,863	75,674	978,714
Variance, $	53,675	29,091	(83,683)	52,563	34,918	19,204	(15,231)	16,246	(10,993)	(4,910)	12,942	12,280	18,583	134,683
Variance, %	55.7%	30.2%	-2.3%	50.5%	38.3%	20.5%	-16.1%	16.9%	-11.6%	-5.1%	13.7%	12.6%	19.7%	12.1%
Est FY Cumul	96,322	192,759	156,807	260,895	351,963	445,782	540,298	636,636	731,116	827,685	921,997	1,019,139	1,113,396	
Act FY Cumul	42,647	109,994	157,724	209,249	265,400	340,015	449,762	529,854	635,328	736,807	818,176	903,039	978,714	
% Complete	3.8%	9.9%	14.2%	18.8%	23.8%	30.5%	40.4%	47.6%	57.1%	66.2%	73.5%	81.1%	87.9%	
Cumul Var, $	53,675	82,765	(917)	51,646	86,563	105,767	90,537	106,782	95,789	90,878	103,821	116,160	134,683	
Cumul Var, %	55.7%	42.9%	-0.6%	19.8%	24.6%	23.7%	16.8%	16.8%	13.1%	11.0%	11.3%	11.4%	12.1%	

RADIONUCLIDE TRANSPORT

1402-870

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	0	29,338	(9,652)	39,038	38,923	39,479	48,267	49,128	48,266	49,129	48,209	49,130	48,208	477,466
Act Pd Cost	0	6,077	13,610	13,950	23,441	25,588	42,366	47,918	39,487	53,207	67,582	32,948	59,660	425,834
Variance, $	0	23,261	(23,262)	25,088	15,482	13,891	5,902	1,211	8,779	(4,077)	(19,373)	16,183	(11,452)	51,633
Variance, %	0.0%	79.3%	-2.4%	64.3%	39.8%	35.2%	12.2%	2.5%	18.2%	-8.3%	-40.2%	32.9%	-23.8%	10.8%
Est FY Cumul	0	29,338	19,686	58,724	97,647	137,126	185,393	234,522	282,788	331,918	380,127	429,258	477,466	
Act FY Cumul	0	6,077	19,687	33,637	57,078	82,666	125,032	172,950	212,437	265,643	333,226	366,174	425,834	
% Complete	0.0%	1.3%	4.1%	7.0%	12.0%	17.3%	26.2%	36.2%	44.5%	55.6%	69.8%	76.7%	89.2%	
Cumul Var, $	0	23,261	(1)	25,087	40,569	54,460	60,362	61,572	70,352	66,275	46,902	63,084	51,633	
Cumul Var, %	0.0%	79.3%	0.0%	42.7%	41.5%	39.7%	32.6%	26.3%	24.9%	20.0%	12.3%	14.7%	10.8%	

TANK WASTE REMEDIATION SYSTEM (TWRS)

1403-000

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	104,800	104,888	103,954	(116,898)	72,723	73,778	72,431	74,089	64,207	69,379	64,200	70,238	64,112	821,901
Act Pd Cost	58,211	34,643	37,343	41,773	68,873	48,751	88,565	65,378	61,095	67,678	123,639	42,359	43,833	782,142
Variance, $	46,589	70,244	66,611	(158,671)	3,850	25,027	(16,134)	8,711	3,112	1,701	(59,439)	27,879	20,279	39,759
Variance, %	44.5%	67.0%	64.1%	-1.4%	5.3%	33.9%	-22.3%	11.8%	4.8%	2.5%	-92.6%	39.7%	31.6%	4.8%
Est FY Cumul	104,800	209,688	313,641	196,743	269,466	343,244	415,675	489,765	553,972	623,351	687,551	757,789	821,901	
Act FY Cumul	58,211	92,854	130,197	171,970	240,843	289,595	378,160	443,538	504,633	572,311	695,950	738,309	782,142	
% Complete	7.1%	11.3%	15.8%	20.9%	29.3%	35.2%	46.0%	54.0%	61.4%	69.6%	84.7%	89.8%	95.2%	
Cumul Var, $	46,589	116,833	183,444	24,773	28,623	53,649	37,515	46,227	49,339	51,040	(8,399)	19,480	39,759	
Cumul Var, %	44.5%	55.7%	58.5%	12.6%	10.6%	15.6%	9.0%	9.4%	8.9%	8.2%	-1.2%	2.6%	4.8%	

THREE MILE ISLAND UNIT 2 INDEPENDENT SPENT FUEL STORAGE INSTALLATION (TMI-2 ISFSI)

1405-010

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	20,995	22,153	19,515	10,008	9,143	10,008	8,996	10,121	8,761	10,177	8,760	10,308	8,760	157,704
Act Pd Cost	11,023	3,270	11,411	4,257	799	14,887	21,226	7,854	264	4,814	5,387	22,245	28,229	135,667
Variance, $	9,972	18,884	8,104	5,751	8,344	(4,879)	(12,230)	2,267	8,497	5,362	3,373	(11,938)	(19,469)	22,037
Variance, %	47.5%	85.2%	41.5%	57.5%	91.3%	-48.8%	-135.9%	22.4%	97.0%	52.7%	38.5%	-115.8%	-222.3%	14.0%
Est FY Cumul	20,995	43,148	62,664	72,672	81,815	91,823	100,819	110,940	119,701	129,877	138,637	148,944	157,704	
Act FY Cumul	11,023	14,293	25,704	29,961	30,760	45,648	66,874	74,728	74,991	79,806	85,193	107,438	135,667	
% Complete	7.0%	9.1%	16.3%	19.0%	19.5%	28.9%	42.4%	47.4%	47.6%	50.6%	54.0%	68.1%	86.0%	
Cumul Var, $	9,972	28,856	36,960	42,711	51,055	46,175	33,945	36,212	44,710	50,072	53,444	41,506	22,037	
Cumul Var, %	47.5%	66.9%	59.0%	58.8%	62.4%	50.3%	33.7%	32.6%	37.4%	38.6%	38.5%	27.9%	14.0%	

DRY TRANSFER SYSTEM (DTS)

1405-020

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	36,476	36,707	36,293	8,234	7,631	8,234	7,311	9,082	8,103	9,167	7,972	9,393	7,673	192,277
Act Pd Cost	12,889	28,222	585	93	102	1,268	6,582	34,286	16,930	7,932	6,176	5,357	16,230	136,652
Variance, $	23,587	8,485	35,708	8,141	7,529	6,966	729	(25,204)	(8,827)	1,235	1,796	4,036	(8,557)	55,625
Variance, %	64.7%	23.1%	98.4%	98.9%	98.7%	84.6%	10.0%	-277.5%	-108.9%	13.5%	22.5%	43.0%	-111.5%	28.9%
Est FY Cumul	36,476	73,183	109,476	117,710	125,341	133,575	140,886	149,968	158,071	167,238	175,211	184,604	192,277	
Act FY Cumul	12,889	41,111	41,697	41,790	41,892	43,160	49,742	84,028	100,957	108,890	115,066	120,423	136,652	
% Complete	6.7%	21.4%	21.7%	21.7%	21.8%	22.4%	25.9%	43.7%	52.5%	56.6%	59.8%	62.6%	71.1%	
Cumul Var, $	23,587	32,072	67,779	75,920	83,449	90,415	91,144	65,940	57,114	58,349	60,145	64,181	55,625	
Cumul Var, %	64.7%	43.8%	61.9%	64.5%	66.6%	67.7%	64.7%	44.0%	36.1%	34.9%	34.3%	34.8%	28.9%	

CENTRALIZED INTERIM STORAGE FACILITY (CISF)

1405-030

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	13,072	13,072	12,711	18,600	18,027	18,769	18,027	19,824	18,691	19,909	18,578	20,164	18,578	228,022
Act Pd Cost	0	13,753	27,523	18,695	20,791	3,927	926	7,965	8,704	28,857	21,910	52,858	16,481	222,389
Variance, $	13,072	(681)	(14,812)	(95)	(2,764)	14,842	17,101	11,859	9,987	(8,948)	(3,332)	(32,694)	2,097	5,633
Variance, %	100.0%	-5.2%	-116.5%	-0.5%	-15.3%	79.1%	94.9%	59.8%	53.4%	-44.9%	-17.9%	-162.1%	11.3%	2.5%
Est FY Cumul	13,072	26,144	38,855	57,455	75,482	94,251	112,278	132,102	150,793	170,702	189,280	209,444	228,022	
Act FY Cumul	0	13,753	41,275	59,971	80,762	84,689	85,615	93,580	102,283	131,140	153,050	205,908	222,389	
% Complete	0.0%	6.0%	18.1%	26.3%	35.4%	37.1%	37.5%	41.0%	44.9%	57.5%	67.1%	90.3%	97.5%	
Cumul Var, $	13,072	12,392	(2,420)	(2,516)	(5,280)	9,562	26,663	38,522	48,510	39,562	36,230	3,536	5,633	
Cumul Var, %	100.0%	47.4%	-6.2%	-4.4%	-7.0%	10.1%	23.7%	29.2%	32.2%	23.2%	19.1%	1.7%	2.5%	

PRIVATE FUEL STORAGE FACILITY (PFSF)

1405-040

ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	0	0	13,092	11,941	11,706	13,659	13,178	13,772	12,773	13,773	12,476	14,034	12,475	142,880
Act Pd Cost	0	0	7,300	6,733	23,751	25,329	1,669	3,285	15,646	7,397	9,046	5,041	10,079	115,275
Variance, $	0	0	5,792	5,208	(12,045)	(11,670)	11,509	10,487	(2,873)	6,376	3,430	8,994	2,396	27,605
Variance, %	0.0%	0.0%	44.2%	43.6%	-102.9%	-85.4%	87.3%	76.1%	-22.5%	46.3%	27.5%	64.1%	19.2%	19.3%
Est FY Cumul	0	0	13,092	25,033	36,739	50,398	63,576	77,348	90,121	103,894	116,370	130,404	142,880	
Act FY Cumul	0	0	7,300	14,032	37,784	63,113	64,781	68,066	83,713	91,110	100,156	105,196	115,275	
% Complete	0.0%	0.0%	5.1%	9.8%	26.4%	44.2%	45.3%	47.6%	58.6%	63.8%	70.1%	73.6%	80.7%	
Cumul Var, $	0	0	5,792	11,001	(1,045)	(12,715)	(1,205)	9,282	6,408	12,784	16,214	25,208	27,605	
Cumul Var, %	0.0%	0.0%	44.2%	43.9%	-2.8%	-25.2%	-1.9%	12.0%	7.1%	12.3%	13.9%	19.3%	19.3%	

WEST VALLEY DEMONSTRATION PROJECT (WVDP)														
1406-000														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	13,579	13,582	13,579	13,615	13,579	13,977	13,579	(61,221)	0	0	0	0	0	34,266
Act Pd Cost	6,571	15,974	2,511	5,437	2,350	1,421	1	0	0	0	0	0	0	34,266
Variance, $	7,007	(2,393)	11,067	8,178	11,228	12,556	13,577	(61,221)	0	0	0	0	0	0
Variance, %	51.6%	-17.6%	81.5%	60.1%	82.7%	89.8%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Est FY Cumul	13,579	27,160	40,739	54,353	67,932	81,908	95,487	34,266	34,266	34,266	34,266	34,266	34,266	
Act FY Cumul	6,571	22,546	25,057	30,494	32,844	34,265	34,266	34,266	34,266	34,266	34,266	34,266	34,266	
% Complete	19.2%	65.8%	73.1%	89.0%	95.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Cumul Var, $	7,007	4,614	15,681	23,859	35,088	47,643	61,221	0	0	0	0	0	0	
Cumul Var, %	51.6%	17.0%	38.5%	43.9%	51.7%	58.2%	64.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
SAVANNAH RIVER SITE ALUMINUM-BASED SPENT FUEL (SRSASF)														
1407-000														
ITEM	01	02	03	04	05	06	07	08	09	10	11	12	13	Total
Est Pd Cost	8,950	8,950	8,569	8,984	8,420	8,984	7,620	8,331	7,619	8,332	7,618	8,830	7,617	108,826
Act Pd Cost	242	5,592	7,020	5,945	4,226	14,809	11,188	6,891	4,414	520	2,044	587	2,823	66,300
Variance, $	8,708	3,358	1,549	3,039	4,194	(5,825)	(3,568)	1,440	3,205	7,813	5,574	8,243	4,795	42,526
Variance, %	97.3%	37.5%	18.1%	33.8%	49.8%	-64.8%	-46.8%	17.3%	42.1%	93.8%	73.2%	93.4%	62.9%	39.1%
Est FY Cumul	8,950	17,900	26,469	35,453	43,873	52,857	60,477	68,808	76,427	84,759	92,378	101,208	108,826	
Act FY Cumul	242	5,833	12,853	18,799	23,024	37,833	49,021	55,912	60,327	60,846	62,891	63,478	66,300	
% Complete	0.2%	5.4%	11.8%	17.3%	21.2%	34.8%	45.0%	51.4%	55.4%	55.9%	57.8%	58.3%	60.9%	
Cumul Var, $	8,708	12,067	13,616	16,654	20,849	15,024	11,456	12,896	16,100	23,913	29,487	37,731	42,526	
Cumul Var, %	97.3%	67.4%	51.4%	47.0%	47.5%	28.4%	18.9%	18.7%	21.1%	28.2%	31.9%	37.3%	39.1%	