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

For The Fiscal Reporting Period

April 16—May 13, 1994

PMPR No. 94-08

May 27, 1994

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LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
1D, 2D, 3D	1-Dimensional, 2-Dimensional, 3-Dimensional
AA	Atomic Absorption
ACF	Alumina (in excess of alkali feldspar), Calcium oxide, Ferromagnesianoxide
ACNW	Advisory Committee on Nuclear Waste
ACRS	Advanced Computer Review System
AECL	Atomic Energy Canada Limited
AES	Atomic Emission Spectrometry
AGU	American Geophysical Union
AML	Arc Macro Language
ASCII	American Standard Code for Information Interchange
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ASU	Arizona State University
ATDTS	Automated Technical Data Tracking System
BFD	Basis for Design
CAI	Conodont Color Alteration Index
CAR	Corrective Action Request
CCDF	Complementary Cumulative Distribution Function
CCL	Commitment Control Log
CCM	Constant Capacitance Model
CDM	Compliance Determination Method
CDROM	Compact Disk Read Only Memory
CDS	Compliance Determination Strategy
CDTS	Commission Decision Tracking System
CFD	Computational Fluid Dynamics
CM	Configuration Management
CNWRA	Center for Nuclear Waste Regulatory Analyses
COI	Conflict of Interest

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
COPS	CNWRA Operations
CQAM	CNWRA Quality Assurance Manual
CRWMS	Civilian Radioactive Waste Management System
DAS	Data Acquisition System
DBE	Design Basis Event
DCPM	Division of Contracts and Property Management
DECOVALEX	Development of Coupled Models and Their Validation Against Experiments in Nuclear Waste Isolation
DEM	Digital Elevation Model
DFCSS	Division of Fuel Cycle Safety & Safeguards
DHLWM	Division of High-Level Waste Management
DIE	Determination of Importance Evaluation
DIMNS	Division of Industrial & Medical Nuclear Safety
DLG	Digital Line Graph
DLM	Diffuse Layer Model
DNAG	Decade of North American Geology
DOE	Department of Energy
DRA	Division of Regulatory Applications
DWM	Division of Waste Management
EBS	Engineered Barrier System
EBSPAC	Engineered Barrier System Performance Assessment Code
EDO	Office of the Executive Director for Operations
EDS	Energy Dispersive Spectrometry
EDX	Energy Dispersive X-Ray Spectroscopy
EM	Element Manager
EMPA	Electron Microprobe Analysis
EPA	Environmental Protection Agency
EPR	Electrochemical Potentiokinetic Reactivation

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
EPRI	Electric Power Research Institute
EQA	External Quality Assurance
ESF	Exploratory Studies Facility
FAC	Favorable Condition
FCRG	Format and Content Regulatory Guide
FD&SHA	Fault Displacement and Seismic Hazard Analysis
FEM	Finite Element Method
FIN	Financial Identification Number
FTE	Full Time Equivalent
GEM	General Electrochemical Migration
GIS	Geographic Information System
GPS	Global Positioning Satellite
GROA	Geologic Repository Operations Area
GS	Geologic Setting
GWSI	Groundwater System Integration
GWTT	Groundwater Travel Time
HLW	High-Level Waste
HRTEM	High Resolution Transmission Electron Microscopy
ICP-AES	Inductively-Coupled Plasma Atomic Emission Spectrometry
IHLRWM	International High-Level Radioactive Waste Management Conference and Exposition
IM	Intermediate Milestone
IMS	Information Management Systems
INEL	Idaho National Engineering Laboratory
INTRAVAL	International Code Validation
I/O	Input/Output
IPA	Iterative Performance Assessment
IRM	Office of Information Resources Management

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
IVM	Interactive Volume Modeling
IWPE	Integrated Waste Package Experiments
JC	Job Code
JRC	Joint Roughness Coefficient
KTU	Key Technical Uncertainty
LAN	Local Area Network
LANL	Los Alamos National Laboratories
LARP	License Application Review Plan
LBL	Lawrence Berkeley Laboratory
LLNL	Lawrence Livermore National Laboratory
LSSA	Licensing Support System Administrator
LWR	Light Water Reactor
MGDS	Mined Geologic Disposal System
MH	Mechanical-Hydrological
M&O	Management and Operations
MIT	Massachusetts Institute of Technology
MM	Major Milestone
MPC	Multi-Purpose Canister
MRS	Monitored Retrievable Storage
NAS	National Academy of Science
NCR	Nonconformance Reports
NFS	Network File Server
NMSS	Office of Nuclear Material Safety & Safeguards
NOAA	National Oceanographic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NSRRC	Nuclear Safety Research Review Committee
NTS	Nevada Test Site
NWPA	Nuclear Waste Policy Act, as amended

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
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
OPS	Operations Plans for the Division of High-Level Waste Management for FY94-95
PA	Performance Assessment
PAAG	Performance Assessment Advisory Group
PAC	Potentially Adverse Condition
PAC/FC	Potentially Adverse Condition/Favorable Condition
PA&HT	Performance Assessment and Hydrologic Transport
PASP	Performance Assessment Strategic Plan
PSHA	Probabilistic Seismic Hazard Analysis
PEM	Program Element Manager
PFD	Probabilistic Fault Displacement
PI	Principal Investigator
PMDA	Program Management Decision Analysis Staff
PMPR	Program Manager's Periodic Report
PNL	Pacific Northwest Laboratory
PRA	Probabilistic Risk Assessment
PSAG	Probabilistic System Assessment Group
PTFE	Polytetrafluoroethylene
QA	Quality Assurance
QAP	Quality Assurance Procedure
RASA	Regional Aquifer-System Analysis
RDCO	Repository Design, Construction, and Operations
REE	Rare Earth Element

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
REECO	Reynolds Electrical & Engineering Company, Inc.
RES	Office of Nuclear Regulatory Research
RFA-ROC	Repository Functional Analysis—Repository Operations Criteria
RIC	Repository Isolation Criteria
ROC	Repository Operations Criteria
RPD	Regulatory Program Database
RRT	Regulatory Requirement Topic
RSRG	Real Space Renormalization Group
SAIC	Science Applications International Corporation
SAR	Safety Analysis Report
SCA	Site Characterization Analysis
SCC	Substantially Complete Containment
SCCEX	Substantially Complete Containment Example
SCM	Surface Complexation Models
SCP	Site Characterization Plan
SEM	Scanning Electron Microscopy
SELM	Spectral Element Method
SGML	Standard Generalized Markup Language
SHE	Standard Hydrogen Electrodes
SKI	Swedish Nuclear Power Inspectorate
SLAR	Side Looking Airborne Radar
SNL	Sandia National Laboratories
SOW	Statement of Work
SRA	Systematic Regulatory Analysis
SRBS	Shafts, Ramps, Boreholes, and their Seals
STP	Staff Technical Position
SUFLAT	Stochastic Analyses of Unsaturated Flow and Transport

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
SwRI	Southwest Research Institute
TBD	To Be Determined
TDAS	Technical Database Access System
TDI	Technical Document Index
TDOCS	Technical Document Reference Database System
TEM	Transmission Electron Microscopy
THMC	Thermal-Hydrologic-Mechanical-Chemical
TLM	Triple Layer Model
TM	Thematic Mapper
TMH	Thermal-Mechanical-Hydrological
TOP	Technical Operating Procedure
TPA	Total Performance Assessment
TSPA	Total System Performance Assessment
TSw-Chnv	Topopah Spring-Calico Hills
UA	University of Arizona
UDEC	Universal Distinct Element Code
UNM	University of New Mexico
U.S.	United States
USDA	United States Department of Agriculture
USGS	United States Geologic Survey
UTM	Universal Transverse Mercator
VCS	Version Control System
VF	Vitrification Facility
WAN	Wide Area Network
WIPP	Waste Isolation Pilot Plant
WMB	Waste Management Branch
WP	Waste Package
WSE&I	Waste Systems Engineering and Integration

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
WSS	Waste Solidification Systems
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services
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

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<u>TITLE</u>: Center for Nuclear Waste Regulatory Analyses
<u>CONTRACTOR</u>: Southwest Research Institute
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<u>CONTRACT NO</u>: NRC-02-93-005

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<u>ESTIMATED BUDGET</u>: $89,898,141

<u>PERIOD OF PERFORMANCE</u>: 10/15/92 - 09/26/97
<u>PERIOD OF THIS REPORT</u>: 04/16/94 - 05/13/94

1. TECHNICAL

1.1 *CNWRA Operations (COPS)*

The NRC and the CNWRA management continued coordination meetings and telephone conferences addressing a range of day-to-day and long-term management topics. CNWRA management staff continued its coordination with specific personnel from the PMDA, DWM, RES/WMB, and DCPM, responding to *ad hoc* requests for information addressing management issues affecting the conduct of CNWRA work. CNWRA senior management participated in another periodic NRC/CNWRA Management Meeting at One White Flint North on April 25, 1994. Among the management issues addressed were: (i) management scheduling of assigned tasks including the TDOCS system, (ii) status of SOWs for RES-funded projects in Near-Field Environment and Subregional Ground-Water Flow and Transport beginning in FY94, (iii) plans and status of workshops and peer reviews in the RES JC, (iv) anticipated work assignments for WSS and MRS as well as reduced or no funding for MRS, (v) status of electronic PMPR development, (vi) review of policies for the CNWRA or SwRI conducting work for other U.S. Government agencies, and (vii) possible redirection of CNWRA activities resulting from reorganization or budgetary restraints.

The CNWRA continued its participation with the DWM in numerous budget-related discussions and meetings, and prepared a comparison of base salaries using data from the

CNWRA/SwRI salary administration program, national and local surveys, and federal workers executive and grade system.

Alternative approaches for implementing an electronic version of the PMPR remain under consideration, and discussions have continued with cognizant PMDA and DWM staff on an appropriate recommendation for the introduction of this electronic version.

The current status of CNWRA staffing is indicated in Tables 1 and 2. Recruitment efforts and interviews continued for open positions.

The changes to specific element/project plans, including revised cost and resource utilization data, were sent on schedule to the NRC, and the CNWRA awaits formal acceptance of such changes.

The internal audit of the CNWRA QA program implementation and selected technical activities was performed during this period. Five deficient areas were identified, and corrective action plans were initiated to correct these deficient areas. The audit was observed by an NRC DWM QA staff member. In addition, a supplier qualification survey of the UA was performed for rock mechanics testing services, and a CNWRA QA staff member performed routine QA verification and administrative activities at that location.

The CNWRA is awaiting the acceptance and approval of the External Database Access Plan for Internet (IM 5702-155-406) submitted to the DWM on April 14, 1994.

As development work progresses on the TDOCS, the CNWRA submitted separate letter reports covering: (i) hardware and software requirements for TDOCS, (ii) network loading estimates, (iii) proposed network server security summary, (iv) response to the acceptance letter issues for the TDOCS System Design report (IM 5702-156-401), and (v) minutes of the April 18, 1994 teleconference on TDOCS.

The following activities are expected to occur during the next period. The CNWRA will pursue resolution of management issues from the previous NRC/CNWRA management meeting, and it will continue its participation in budget-related discussions and meetings. Testing of the potential delivery of an electronic PMPR will continue in connection with the development of the TDOCS.

Recruitment and interviews will continue, as may be required, for CNWRA core staff.

During the next period, the QA staff will: (i) coordinate corrective action responses to the deficiencies identified during the internal audit, (ii) participate in regular COI Management Committee meetings, (iii) conduct QA indoctrinations, (iv) continue CNWRA QA record processing and maintenance, and (v) perform requisite surveillances. In addition, work will continue on the Internal/External QA assignment to reevaluate QA requirements.

The CNWRA will continue development of the TDOCS and conduct its second meeting with the CNWRA and DWM TDOCS Advisory Groups, currently scheduled for the week of June 6, 1994. A letter report providing TDOCS scanner hardware and software recommendations will be delivered on schedule as an Administrative Milestone. During the next several periods, the CNWRA will provide technical advice and support, as appropriate, on NRC requests for technical data from the DOE or other parties.

1.2 *Waste Systems Engineering and Integration (WSE&I)*

There was no activity related to the rulemaking for clarification of siting criteria, and none is expected during the next period. Work so far has been limited to reviewing public comments submitted on the proposed rulemaking to ensure CNWRA staff familiarity with them.

No activity related to support for review of the FCRG was undertaken, and none is anticipated in the near future.

There was essentially no activity undertaken in support of NWPA-mandated actions, and none is expected in the next period.

The NRC accepted the CDS Development Report FY93 (MM 5702-221-420) on April 21, 1994. In response to direction from the NRC necessitated by the expanded responsibilities of the newly organized DWM, options were prepared which would allow opportunities for greater initiative by the CNWRA in continuing LARP development work. These options, which include descriptions of activities, schedules, and any required deliverables, will be submitted for NRC review, modification, and concurrence early in the next period. Proposed activities include providing recommendations for revisions to CDSs based on the results of an integration review conducted by the NRC and CNWRA staffs, proposing recommendations for modification of review plan interface tables, developing a generic review plan for general information reviews required by 10 CFR Part 60, and conducting an integration review of KTUs. All results will be submitted to the NRC for concurrence. The objectives of these activities are to support the development of LARP, Revision 1 and to update research user needs, both scheduled for completion in December 1994.

Development proceeded on the CDM for RRT 1.4, Certification of Safeguards (IM 5702-222-411); the CDM for RRT 1.5, Physical Security Plan (IM 5702-222-412); and the CDM for RRT 2.7, Nuclear Material Control (IM 5702-222-413). NRC staff from the DFCSS have taken primary responsibility for writing these CDMs since they should be consistent with other licensing reviews for these topics conducted throughout the NRC. Generic text for CDMs dealing with descriptive review plans and CDMs dealing with PACs and FACs was refined and is being used to prepare drafts of those CDMs. Some of the CDMs may be completed in the next period. Training on CDM development was conducted for various CNWRA staff to ensure compliance with QA requirements. Activity continues on development of a Crosswalk of Regulatory/Institutional Uncertainties with Review Plan Topics (IM 5702-222-451). This will become an appendix to the LARP.

At the end of this period, NRC staff tasked the CNWRA for support of a special project to provide input to the CDTS. This activity is expected to take approximately 45 days. CNWRA support is limited to those issues related to HLW. Requirements for the

Procedure for Uncertainty Identification and Resolution (IM 5702-251-401) were refined. Work on the development of this procedure will intensify in the next period, and this PMPR documents a change in the delivery date from June 30, 1994 to September 30, 1994.

Work is continuing on RPD development with the implementation of Phase 2 of the RPD design for a generalized report writer. The success of the prototype demonstration discussed in last period's report has allowed the development team to proceed with final design implementation. The first draft of the User Guide for Generalized Report Writer Facility (IM 5702-252-403) has been completed. It will be refined as the system test plan is executed and as the design is completed. Delivery is scheduled for June 30, 1994.

RPD and OITS maintenance and operation efforts continued with the installation of RPD Version 1.0 on some OS/2 workstations for final testing. The DOS/Windows and MacIntosh installations will be completed following the OS/2 installations.

During the next period, the WSE&I Element will focus on the following areas: (i) loading of two CDMs into the RPD; (ii) producing CDMs; (iii) developing of porting software to support the installation of RPD Version 1.0 on various computer platforms; (iv) developing RPD Phase II (Report Writer); (v) continuing design of the migration/incorporation of OITS into RPD; (vi) coordinating LARP development activities throughout the CNWRA, including conducting training necessary to support CDM development; (vii) preparing a Crosswalk of Regulatory/Institutional Uncertainties with Review Plan Topics; (viii) developing an Uncertainty Identification and Resolution Procedure; (ix) commencing expanded CNWRA initiatives on LARP development activities; and (xi) conducting a WSE&I program review with DWM staff and management.

1.3 *External Quality Assurance (EQA)*

One CNWRA QA staff member attended the American Society for Quality Control Energy and Environmental Division Fifth International Environmental and Waste Management Conference April 17-20, 1994. Attendance was motivated because the conference topics were applicable directly to the CNWRA work in the HLW field (a trip report will be written to describe the presentations). In addition, one CNWRA QA staff member attended the NRC/DOE Technical Meeting on the ESF with a CNWRA RDCO staff member April 19-20, 1994. The DOE baseline audit of REECO, conducted May 2-6, 1994, was observed by a CNWRA QA staff member along with an NRC DWM QA staff member (IM 5702-331-409). Work continued on the re-evaluation of appropriate QA requirements for CNWRA activities. A draft report of these activities was completed and underwent internal review during Period 8.

The NRC EQA PEM and the CNWRA QA Director held planning discussions by telephone during this period on anticipated FY94 EQA work, which may include on-site visits, meetings, and observations of the DOE audits and surveillances.

Observation audit activities, including the resulting audit observation reports, are planned for DOE audits of SAIC, Las Vegas, Nevada, May 16-20, 1994 and the Management

& Operations contractor, Vienna, Virginia, from June 6-10, 1994 during the next reporting period. Work will continue on the re-evaluation of CNWRA QA requirements.

1.4 *Geologic Setting (GS)*

Geology and Geophysics

A first draft of the CDM dealing with RRT 3.2.1.10 Evidence of Extreme Erosion (IM 5702-422-403), was completed.

R. Hofmann developed a preliminary matrix of GS CDM efforts. Presently, the matrix is being circulated among GS staff for comment. The matrix lists expected completion dates and tentative technical categories to be addressed in the CDMs. R. Hofmann provided technical review comments on a report concerning the SEISMO code. This code is being used by PA to estimate time of seismic induced canister failure for the IPA.

A response to the NRC requirement for discussing the adequacy of length of time (discussed in Topical Report on Extreme Erosion) required to characterize the Quaternary Period has been developed and will be submitted early in the next period. This is the final part required for completion of CNWRA review of the DOE Erosion Topical Report (IM 5702-441-431).

Work continued for the May 17, 1994 presentation to the ACNW of Tectonic activities conducted for DWM. GIS library development was temporarily deferred to allow development of maps specific to the ACNW presentation.

A formulation for fault displacement versus magnitude was coded into SEISM 1. This modification allows calculation of the fault offset hazard, the annual probability of a given fault offset on a fault plane. Corrections were developed for earthquakes whose fault slip area would not fill the fault zone from the surface to its depth limit when calculating the fault-offset hazard for the upper 300 meters of the fault zone (the repository horizon). A. Bagtzoglou estimated a second correction for various aspect ratios of fault slip areas to help quantify this uncertainty. Plot coding in SEISM 1 was changed to produce a log-log rather than log-linear plot used for acceleration hazard. Additional decades were added to the scales to obtain suitable fault offset hazard plots.

A preliminary fault offset hazard calculation was made with SEISM1 (without error messages) for offsets on the Solitario Canyon Faults. Hazard results plotted properly on the graphs produced. Comparison of results against information in publications and confirmatory hand calculations remain to be performed.

Text and figures in the draft Background Report on Seismic Hazards (IM 5702-411-501) were updated to reflect progress in SEISM 1 code development.

Fault offset probability formulae were discussed by R. Hofmann and G. Stirewalt. A separate fault offset hazard method for use in PA is being developed by G. Stirewalt as part of IPA Phase 3.

Staff from the CNWRA attended the DOE/NRC Site Visit on Fractures and Faulting. A number of new trenches were visited at YM. The temporal coincidence of volcanism and surface rupture was indicated by the identification of basaltic ash in fissures in the trench across the Paintbrush fault at the north end of Alice Ridge. This is the second occurrence of basaltic ash east of Yucca Crest and the sixth trench across a fault in the YMR that contained ash. To date, trenches across the Paintbrush, Bow Ridge, Solitario Canyon, and Windy Wash faults have exposed fissures containing basaltic ash. The Holocene age of the Bare Mountain Fault is being questioned by geologists from the Bureau of Reclamation. Discussions at the exposed Sun Dance fault and observations by the CNWRA staff indicate the interpretation of the fault is still ambiguous.

Continued work in the SRA area is anticipated during the next period. Work will continue on debugging the fault displacement relationships in SEISM 1.1. No reactive work is anticipated.

Geochemistry, Hydrology, and Climatology

A first draft of the CDM was completed for RRT 3.1.4 Climatologic and Meteorological Systems Description (IM 5702-424-405) and forwarded to the NRC for comments. The draft was modified to address NRC comments and concerns and is being used as a model to prepare CDM's for RRT 3.1.2 Hydrologic Systems Description (IM 5702-424-403) and RRT 3.1.3 Geochemical Systems Description (IM 5702-424-404).

M. Miklas and D. Turner worked with N. Coleman on development of a draft CDM for RRT 3.2.4.1 Annual Potential Evapotranspiration (IM 5702-424-402). An initial draft of the CDM was completed by N. Coleman and forwarded to the CNWRA for comment. A. Gureghian and R. Wescott continued work on the CDM for RRT 3.2.2.5 Flooding (IM 5702-424-401).

Mineral chemistry data from Los Alamos reports were entered into the GIS database. Isotopic data for calcite and silica vein minerals and water samples are being entered and should be completed during the next period. A summary assessment of radionuclides was completed and transmitted to the NRC. W. Murphy attended the Program Committee meeting in Lafayette, California to review abstracts and set the program for the Materials Research Society Conference on the Scientific Basis for Nuclear Waste Management XVIII.

Preliminary results of GWTT analyses for the saturated granite and the unsaturated/saturated tuff models were sent to the NRC on May 6, 1994. CNWRA staff participated in a teleconference on May 10, 1994 in which M. Knapp was briefed by J. Pohle on the status of efforts to reduce uncertainty in the Geologic Setting Performance Measure. Earlier boundary condition difficulties in the tuff geologic setting model appear to have been resolved. Simulations of groundwater flow in the saturated/unsaturated tuff and the saturated granite models are ongoing. Additional analyses are required to produce groundwater flow models that are adequate to conduct meaningful particle tracking analyses. The particle tracking analyses will be used to assess concepts of fastest path and disturbed zone. Because of the additional time needed for completion of these analyses the delivery date for the Intermediate Milestone (IM 5702-451-401) has been revised to August 15, 1994.

D. Turner attended the NRC/CNWRA/UA Hydrology meetings and field trips at YM and the NTS on April 19-21, 1994.

To ensure completion of the descriptive and PAC/FC CDMs, work in the SRA will continue at increased levels during the next several periods. Increased effort in the investigative issues is anticipated with additional data entry in future periods. Analyses of GWTT in the saturated/unsaturated tuff and the fully saturated models are continuing.

1.5 *Engineered Barrier Systems (EBS)*

The editorial review of the authors' draft of the Field Engineering Experience for Structural Materials Report (IM 5702-551-430) was completed. The technical review and comment resolution is ongoing.

EBS staff prepared an outline for the MPC review plan and submitted it for consideration by NRC staff.

During this period, the GEM model, which is part of EBSPAC-Models Development FY94 (IM 5702-523-410), was used to analyze diffusion experiments in a cylindrically symmetric crevice. It was found that the experimental data from the IWPE Project took much longer to reach equilibrium (by orders of magnitude) compared to the model predictions. This discrepancy is attributed to the difficulty in maintaining the pH (and other species) fixed at the mouth of the crevice in the experiments. This problem needs to be resolved before corrosion experiments are performed and the results compared with model predictions.

A draft of the SCCEX user's manual was completed. A new IM will be proposed for this report.

An authors' meeting for the review of the draft CNWRA/NRC joint report under preparation titled Role of Colloids in the Release of Radionuclides from Vitrified Waste Forms and Spent Fuel, (IM 5702-523-415) was held in Washington, DC, during the week of April 25, 1994. H. Manaktala was the principal coordinator of the meeting. The discussions at the meeting resulted in rewriting portions of the report leading to increased emphasis on certain aspects and the addition of new materials to several chapters. The title of the report has been changed to Impact of Colloids on the Long-Term Performance of a High-Level Waste (HLW) Repository, to better reflect the content of the report. The draft report is currently being formatted and prepared for editorial review.

P. Nair participated in a staff exchange at the NRC-NMSS on April 25-May 5, 1994. During his stay, a draft staff position on SCC was completed. The draft was reviewed with NRC technical and management staff. The NRC is expected to finalize the nature of guidance to be provided for the clarification of the rule on SCC. Other activities involved CDM development, MPC review plan discussions with NRC staff, and review of progress on the Colloids Report.

In the next period, the technical review of the Field Engineering Experience for Structural Materials Report will be completed through comment resolution. The programmatic review will be conducted with comment resolution completed during the next period as well, and subsequent issuance is expected by the end of May.

EBS staff is planning to have a telephone conference with NRC staff to discuss issues to be considered in the MPC review plan. The development of a detailed review plan from the outline previously submitted for consideration by NRC staff is the main issue under discussion.

The draft Colloids Report will be issued for technical review.

1.6 *Repository Design, Construction, and Operations (RDCO)*

The RDCO Element concentrated on the following activities: (i) work on DBE Rulemaking, (ii) development of CDSs, (iii) development of CDM on Shafts and Ramps Design, (iv) evaluation of computer codes for compliance determination and rock joint model development, (v) conduct of prelicensing interactions, and (vi) performance of ESF design reviews.

Conversations were held with R. Weller to discuss comments on the proposed definition of Important to Safety, which was presented to the Advisory Committee on Nuclear Waste at their April 21, 1994 meeting. Informal written comments on the proposed definition were sent to R. Weller and background materials (NUREG-0800, Section 3.2.2; ANSI/ANS-51.1-1983; and ANSI/ANS-57.9-1984) were discussed to help clarify which structures, systems, and components should be identified as important to safety.

NRC/CNWRA teleconference meetings regarding CDS integration continued. At the direction of the NRC staff, the CNWRA team members for CDS integration prepared a draft CDS integration plan; this plan is being reviewed by the CNWRA management.

The development of the CDM 4.3, Shafts and Ramps Design (IM 5702-622-401-001) continued. Changes to the first team draft of this CDM are being made to address the comments made by the WSE&I staff at the CNWRA. A review for the consistency of CDM 4.3 and CDS 4.3 revealed general consistency, however, minor changes to the CDS may be required to reflect the review procedure agreed upon for the current draft of the CDM. J. Hageman and S. Hsiung will visit the NRC on May 23-27, 1994 to work with NRC team members to prepare the CNWRA/NRC team final.

In this period, the evaluation of the finite element code, ABAQUS, continued. The finite element mesh for the ABAQUS analysis of Problem Set 3, Heated Drift in Fractured Rock, was developed, and an analysis of the excavation phase of the problem was conducted. The temperature history data which will be applied to the drift wall to simulate waste package heating was developed. A description of water dripping in a fracture in unsaturated porous medium, incorporating the effects of gravitational acceleration of the fluid mass, viscous dissipation of energy, and loss of fluid from the unsaturated fracture to the unsaturated matrix, is being developed in this task. Testing of the solvers for the nonlinear partial differential equations governing water movement in the fracture and in the matrix has been completed. The numerical scheme has been verified for a simplified linear imbibition function, for which similarity solutions describing this phenomenon have been found. The computer code incorporating the numerical approximations is being made user friendly, and post-processing capabilities are being incorporated. Effects of interfacial surface tension on water inside the fracture are being incorporated to provide a comprehensive model description of water flow in the fracture in unsaturated porous medium.

Development of a constitutive model to simulate the response of a rock joint under cyclic pseudostatic and dynamic loads, as observed in the experimental results of the Seismic Rock Mechanics Project, is currently under progress. Assuming the surface profile a self-affine fractal, several rough surfaces were generated using the midpoint displacement method. These surfaces are used to verify the computer programs for estimating the dimension of surface fractals. Two methods are presently under investigation: (i) the semi-variogram method and (ii) the two-dimensional FFT. Work is under way to clarify some of the uncertainties associated with representing the roughness of natural surfaces uniquely. An abstract titled On Characterization of Self-Affine Fractal Profiles, by A. Ghosh and S.M. Hsiung, has been prepared for presentation at the session on Uncertainty Evaluations in Geo-Engineering during the 10th ASCE Engineering Mechanics Conference to be held at the University of Colorado at Boulder, May 21-24, 1995.

A. Chowdhury attended the NRC/DOE technical meeting on ESF that was held at NRC Headquarters on April 19, 1994. DOE staff and contractors made presentations, among others, on MGDS Design Control Improvement Plan, ESF Design and Construction Progress, and DOE Administrative Procedure 6.14 Reportable Geologic Conditions. G. Ofoegbu participated in the NRC/DOE site visit on Characterization of Faults and Fractures Near Yucca Mountain, and Stratigraphy, Structure and Rock Properties Along the ESF North Ramp. The activities during this site visit included presentations by the USGS on DOE field work on geologic mapping related to faults and fracture characterization, and rock properties, and a field trip for examination of outcrops, pavements, trenches, and the ESF starter tunnel.

ESF Title II 90% Design for Package 2C was reviewed during this period. This package is for the part of the ESF from the end of the starter tunnel to the Topopah Spring level and included DIE, BFD, and mining, structural, electrical and mechanical designs involving the technical disciplines of mining engineering, rock mechanics, structural geology, seismology, geochemistry, hydrogeology, structural engineering, fire technology, ventilation engineering and electrical engineering. M. Ahola visited the NRC on May 9-13, 1994 to review relevant parts of Design Package 2C with NRC staff. At the CNWRA, the reviews of various sections were conducted by S. Hsiung, A. Ghosh, H. Karimi, G. Ofoegbu, E. Pearcy, V. Kapoor, A. Chowdhury, and A. Parker. All the review comments prepared by the individual reviewers were discussed and revised in a NRC/CNWRA conference call on May 12, 1994. The revised comments were for use by the NRC/CNWRA participants at the NRC/DOE ESF Design Review Package 2C meeting scheduled for May 16-20, 1994 at Las Vegas, Nevada.

During the next period, activities within the RDCO Element will include: (i) continued development of the CDM on Shafts and Ramps Design, (ii) integration of CDSs,

(iii) development of the rock joint model and evaluation of ABAQUS, (iv) coordination of the DBE rulemaking, (v) participation in prelicensing activities, and (vi) work on ESF Title II Design review.

1.7 *Performance Assessment and Hydrologic Transport (PA&HT)*

The PA&HT Element concentrated on the following activities: (i) preparation of a report on the use of expert judgment in PA, (ii) participation in LARP team meetings, (iii) participation in ACNW meeting on IPA, (iv) conduct of auxiliary and detailed analyses for IPA, (v) preparation of a user guide for the SEISMO module, (vi) contribution to an NRC technical paper, (vii) meetings with NRC management, and (viii) participation in a CNWRA QA audit.

A partial manuscript was assembled for the background report on the use of expert judgment in PA. The preparation of the report will require additional time (see Table 3) due to the need to integrate and revise the current rough draft of this multi-author document. The report follows the outline approved by the NRC staff and consists of eight major chapters. The document is intended to support a future NUREG/CR on expert judgment that will be developed and issued later in the year. When completed, the background report will be submitted to fulfill IM 5702-712-405, Background Report on Use of Expert Judgment in PA. This work is being conducted under the scope described in the PA&HT Element Subtask 1.2 of the Operations Plans for the Division of High-Level Waste Management for FY94-95 (OPS).

Participation in the LARP team meetings continued. A. Bagtzoglou and V. Kapoor are the principal contributors to this activity. In addition, a number of the PA staff attended a training session on the development of CDMs. The training covered the TOP-001-13. This work was conducted under the scope described in the PA&HT Element Subtask 2.1 of the OPS Plans.

R. Baca, R. Manteufel, A. DeWispelare, and B. Sagar prepared presentations for the ACNW meeting on IPA, which was held in Bethesda, Maryland. Presentations were given to the ACNW members and consultants on IPA Phase 2 work. The presentations given by the PA staff covered the total-system code, selected auxiliary analyses, and elicitation of expert judgment for the climate scenario. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS Plans.

Work continued on the auxiliary analysis of infiltration phenomena at YM. Computer simulations were performed to model long-term infiltration patterns for various cases of precipitation conditions. In this auxiliary analysis, a simple 1D code is being applied that considers nonisothermal flow of liquid and vapor phases. S. Stothoff and R. Baca, with assistance from A. Nedungadi (SwRI), are conducting the infiltration analysis. V. Kapoor continued work on auxiliary analysis of the SNL conceptual models of fracture flow (WEEPS) and composite-porosity (SEEPS) used in TSPA-91/93. Work continued on the auxiliary analysis dealing with flow around the waste package; P. Lichtner is the lead on this analysis and is assisted by M. Seth and J. Walton (Consultants). As part of this auxiliary analysis, improvements and modifications of the VTOUGH code were made. R. Manteufel, and O. Phillips (Consultant) continued work on an abstracted model of near-field flow to evaluate the thermal protection offered by a zone of hot desiccated rock, created by high thermal loading. The analysis of this phenomena is focusing on evaluating the ability of the dryout zone to inhibit the penetration of liquid dripping in fractures and near the heat source. It is anticipated that J. Firth will participate in the near-field flow analyses as part of his staff exchange assignment at the CNWRA.

A contribution was made to a paper entitled, Some Concepts of Model Uncertainty for Performance Assessment of Nuclear Waste Repositories. B. Sagar and G. Wittmeyer contributed to the paper which was internally reviewed by the CNWRA staff. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS Plans.

The user guide for the SEISMO module of the TPA code was completed. However, transmittal of this document was delayed (see Table 3) in order to permit additional technical review by the NRC staff. The user guide for the SEISMO module will be completed in the next reporting period and submitted to the NRC to fulfill IM 5702-723-421, User Guide for SEISMO Module. Contributing to this activity were R. Janetzke and R. Baca with assistance from C. Freitas (SwRI). In addition, R. Codell and N. Eisenberg contributed to the preparation of the SEISMO user guide and are co-authors of the report with C. Freitas. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS Plans.

R. Baca and R. Manteufel participated in discussions with G. Arlotto during his recent review meetings at the CNWRA. In the meeting, a number of topics were discussed such as the insights gained from IPA Phase 2 activities, relationships between IPA and other CNWRA activities (e.g., development of mechanistic corrosion models in EBS and participation in DECOVALEX), and plans for future work in IPA Phase 3. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS Plans.

R. Baca and R. Manteufel participated in the CNWRA QA Audit 94-01 of the PA Subtask 2.3 on IPA. The audit was conducted by T. Trbovich and B. Mason (SwRI). Overall, the auditors had no major findings regarding the conduct of the IPA activity. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS Plans.

In the next period, the PA&HT Element will direct its efforts in the following areas: (i) continuing the preparation of the background report on use of expert judgment, (ii) continuing work on the auxiliary and detailed analyses, (iii) completing the SEISMO user guide, and (iv) conducting integration meetings with PIs working on research projects.

1.8 *Research*

Research Project 1 - Overall Research

Preparation continues for the Workshop on Rock Mechanics Issues in Repository Design and Performance Assessment. To date about 10 abstracts and more than 15 responses have been received. The abstracts are being reviewed by CNWRA and NRC staff.

The Analogs/Performance Assessment Working Session has been scheduled for June 14–15, 1994 in San Antonio, Texas. Pre-meeting exercises have been identified and are under way. Compilation of pre-meeting background information was completed during this period. Letters of invitation, background information, and descriptions of the pre-meeting exercises were sent to 15 prospective NRC and CNWRA participants.

Drafting of the Subregional Ground-Water Flow and Transport Studies Project plan has begun in response to the SOW.

Receipt of a SOW for the Near-Field Environment Research Project is anticipated for the near future; upon receipt of the SOW, work will begin on development of a project plan. Preparation for the Analogs/Performance Assessment and the Rock Mechanics workshops is anticipated to continue. Writing of the Subregional Ground-Water Flow and Transport Studies Project plan is anticipated to continue.

Research Project 2 - Geochemistry

Following CNWRA technical, programmatic, and format reviews, the Topical Report on Geochemistry (MM 5704-014-094-002) was submitted to the NRC on April 29, 1994. The report consists of an introductory section, three technical sections respectively addressing: (i) ion exchange between clinoptilolite and aqueous solutions; (ii) analcime and clinoptilolite dissolution, growth, and solubility; and (iii) conceptual and numerical modeling of YM geochemistry, and a final section identifying achievement of project objectives and relations between research results and regulatory requirements. The report was also submitted, with review instructions, to three external peer reviewers.

A presentation by J. Wood of Michigan Technological University was attended which consisted of research results on calcite deposition on borehole casing walls from the Salton Sea geothermal field and in fractures at the Elk Hills, California, oil field, and their hypothetical relations to seismic pumping.

The final report for the Geochemistry Research Project will be revised based on comments from the NRC and peer reviewers and will be submitted by the end of the fiscal year to terminate the project.

Research Project 3 - Thermohydrology

In this reporting period, activity was concentrated in three areas: (i) preparation and conduct of laboratory-scale experiments, (ii) calculation of hydraulic properties of the test media, and (iii) development of analytical and mathematical models of physical mechanisms associated with moisture redistribution in isothermal and non-isothermal media.

The Test 6 series of coupled effects experiments has continued with the current test using a test cell with a ceramic medium. The final stage of the experiment with the heat source set at the highest temperature resulted in dryout of the region closest to the heater element. Measurements of the test cell at full and zero saturation are ongoing.

A cylindrical container with a cement medium has been loaded into the x-y densitometer for the conduct of the gas-gradient experiments. The required safety documents have been completed which will allow loading the Cs-137 source into the x-y densitometer and the start of the test cell baseline measurements. Results from the gas-gradient experiments will be used to assess theories developed through dimensional analysis of heat and mass transfer in unsaturated fractured rock. This work is being conducted by R. Green and S. Svedeman, L. Bishop, and F. Dodge (SwRI).

Hydraulic characterization of media used in the laboratory-scale experiments are continuing. These media include the ceramic used in the Test 6 series of experiments, cement mixtures to be used in the gas-gradient tests, and alumina powders used in several completed experiments. Preliminary moisture release curve measurements of one of the cement slurries indicate a relatively high amount of water (i.e., 20%) is retained in the matrix at relatively high matric potentials (i.e., 800 bars). This may be an indication that longer equilibrium times are required between each matric potential measurement. This work is being conducted by K. Meyer, G. James, and R. Green.

Work continued on the dimensional analyses for the mixed-gas model. The new mixed-gas model is being formulated that incorporates aspects of both the dry-gas and wet-gas models. This new analysis will include the incorporation of a liquid flow component when completed. An abstract of this work was submitted for presentation at the September 1994 Chapman Conference on Aqueous Phase and Multiphase Transport in Fractured Rock. This work is being conducted by F. Dodge and R. Green.

Work continued on the development of simple mathematical models to represent flow phenomenon referred to as the thermosyphon effect. Analysis of gas flow through media under the imposition of a heat load has also continued. This work is being conducted by R. Manteufel, H. Castellaw, and L. Bishop (SwRI).

In the next period, work will continue in four areas: (i) initiation of the gas-gradient series of tests using a cement slurry as the test medium; (ii) conduct of hydraulic property measurement experiments of cement mixture, ceramic, and alumina; (iii) continuation of the Test 6 series with a ceramic and a cement mixture; and (iv) preliminary applications of the dimensional analysis approach and preferential flow theory.

Research Project 4 - Seismic Rock Mechanics

The Seismic Rock Mechanics Research Project has nine tasks. Among these tasks, Task 1, Focused Literature Search; Task 2, Laboratory Characterization of Jointed Rock; and Task 3, Assessment of Analytical Models/Computer Codes, are complete. Task 6, YM

Scoping Analysis, has been delayed pending the availability of the data associated with YM. Active tasks for the remaining FY94 include: Task 4, Rock Dynamics Laboratory and Field Studies; Task 5, Groundwater Hydrology Field Studies; Task 7, Technical Report; Task 8, Semi-Annual Research Reports; and Task 9, DECOVALEX Modeling and Laboratory Studies. In this reporting period, primary effort was devoted to: (i) the laboratory study of a small-scale jointed rock mass physical model for Task 4, (ii) mechanical-hydrological laboratory study and DECOVALEX Phase III modeling for Task 9, (iii) mechanical properties testing of the Lucky Friday Mine rock specimens for Task 5, and (iv) report preparation for Tasks 5 and 7.

The construction activities for small-scale model tests of jointed rock mass using a shaking table continued. A detailed procedure for the assemblage of the jointed rock mass components of the small-scale model was developed and the assemblage was initiated during this period. Pretest UDEC simulations of the small-scale model tests using scaled earthquake velocity signals (calculated from the acceleration response recorded from the Guerrero accelerograph array for the earthquake of September 19, 1985, in Mexico) under various peak velocity amplitudes were completed. The results of these simulations are being used to prepare the details for conducting the small-scale model tests. These details include selection of: (i) the interface between the rock mass specimen and the steel frame supporting it and (ii) the magnitude of simulated earthquake signal associated with each test of the specimen with the aim of quantifying the cumulative effects of repetitive seismic motions. Instruments to be used for measurements of joint normal and shear displacements, cable loads, and excavation closure are at various stages of calibration. The scaled earthquake signal to be used for generating the seismic motion of the shaking table was developed and tested to compare the generated input signal with the measured input signal.

The activities associated with the coupled MH experiments continued. In the primary apparatus, experiments were continued under normal load using water as the saturating fluid. This included determination of the length of time the system needed to reach the steady state condition for fluid flow. However, the fluctuation of the normal load during conduct of the experiments significantly influenced the experimental results. The fluctuation of normal load was attributed to instrumentation error which has been identified and corrected. The leak in the parallel experiment apparatus was detected and fixed. Steady state pressure drops were measured at various flow rates while water occupied the whole matrix and fracture. Two differential pressure transducers (0–25 in. and 0–5 in. water) were used and, the readings from the 0–25 in. range transducer was deemed unsuitable for the experiment because of extremely low pressure drop. Iterative experiments were conducted until comparable pressure drops were obtained while increasing and decreasing the flow rates. The fully saturated steady-state experiment using this apparatus is complete. The positive displacement pump has developed a new problem. Communication has been established with the manufacturer to replace the malfunctioning part. Preliminary modeling of Test Case 3 (TC3), Big Ben experiment, of DECOVALEX Phase III using the ABAQUS finite element code was completed and a draft report is being prepared for the 4th DECOVALEX workshop to be held in

Oxford, England on May 30-June 3, 1994. Modeling of the MH experiments, whose specifications have been transmitted to the DECOVALEX Secretariat for use in the DECOVALEX Phase III study, continued during this period. Preparation of the presentation packages for the DECOVALEX workshop was initiated during this period.

The preparation of the Report for Groundwater Hydrology Field Studies (MM 5704-035-094-002) and the Final Project Report for the Seismic Rock Mechanics Research Project (MM 5704-037-094-002) continued during this period. Testing of cylindrical specimens to determine mechanical properties of the Lucky Friday Mine rocks is being conducted.

During the next period, activities within the Seismic Rock Mechanics Research Project will include: (i) assembly and instrumentation of jointed rock mass specimens in preparation for conducting laboratory tests during period 10; (ii) laboratory work on determination of mechanical properties of Lucky Friday Mine rock cores and preparation of the Report for Groundwater Hydrology Field Studies (MM 5704-035-094-002); (iii) DECOVALEX modeling and experiments and participation at the 4th DECOVALEX workshop in Oxford, England; (iv) preparation of the Final Project Report for the Seismic Rock Mechanics Research Project (MM 5704-037-094-002) to document the results obtained from the Seismic Rock Mechanics Research Project and make recommendations on use of these results; and (v) organizing the Rock Mechanics workshop.

Research Project 5 - Integrated Waste Package Experiments (IWPE)

Control experiments on the radial crevice cell continued and were compared to the GEM model predictions. Initially, large discrepancies with the model predictions of the pH and chloride transients were observed, with the experiments indicating a much slower response than the model. This was thought to be due to a large diffusion layer at the boundary external to the crevice. Further measurements of the bulk pH at several locations confirmed this hypothesis. The bulk solution was then stirred to minimize the diffusion layer in the bulk. The subsequent pH transients showed significantly improved agreement with the model predictions, although these results must be considered preliminary in nature. The experimental results are being analyzed for further comparison to the model predictions.

Crevice corrosion repassivation potential tests were performed on alloy 825 and compared to previously generated data for pitting corrosion. The results generated thus far indicate that the repassivation potential for crevice corrosion of low depth is the same as the repassivation potential for deep pits. This confirms the assumption made in SCCEX code calculations regarding the commonality of repassivation potential for these two phenomena.

Long-term localized corrosion testing is continuing for the eighth month. No localized corrosion has been observed on the specimen held 100 mV below the repassivation potential.

Slow strain rate tests of type 316L SS were continued in 1 M NaCl solution at 95 °C, with the pH adjusted to 4.0, under galvanostatic conditions. A PTFE crevice-forming device was placed on the gage length of the tensile specimens. Two specimens, galvanostatically held at 30 and 70 μA, failed in a ductile manner but were accompanied by some pitting corrosion. No indication of stress corrosion cracking was observed. New tests are being initiated for the purpose of comparing the results of the slow strain rate tests to those of the constant-deflection tests. Tensile specimens of 316L SS will be tested under constant load conditions in a 1000 ppm chloride solution containing 10^{-2} molar thiosulfate. Stress corrosion cracking has previously been observed in constant-deflection tests conducted in this environment.

Constant-deflection tests using U-bend specimens of alloy 825 in highly concentrated chloride solutions are continuing. To date, no stress corrosion cracking has been observed in these environments after 5 months, while cracking was detected on type 316L SS specimens in less than 15 days. Double U-bend specimens of type 316L SS and alloy 825 were acquired. Tests will be conducted for the purpose of determining whether cracks can be more easily initiated by the presence of a crevice in the highly stressed region of the inner U-bend sample.

Boiling nitric acid tests are currently being conducted on thermally treated mill-annealed, solution-annealed, and cold-worked specimens of alloy 825 to determine the effect of heat treatment temperature and time on grain boundary precipitation and the related intergranular corrosion.

The long-term localized corrosion and stress corrosion cracking tests will continue. Additional crevice corrosion repassivation tests will be conducted in order to compare the results to the previously generated data on pitting corrosion repassivation. Crevice corrosion chemistry experiments will be conducted with 304L SS specimens. Modeling of chemical transport in this cell will continue, and comparisons with experimental results will be made. Slow strain rate tests of specimens under conditions in which U-bend specimens were observed to fail by stress corrosion cracking will continue. Double U-bend tests will be initiated to study the relationship between stress corrosion cracking and the repassivation potential for crevice corrosion. Thermal stability of alloy 825 will continue to be evaluated through intergranular corrosion tests in boiling nitric acid.

Research Project 6 - Stochastic Analysis of Large-Scale Flow and Transport in Unsaturated Fractured Rock (Stochastic)

During this reporting period, the research activities focused on the following: (i) preparation of the technical report entitled Stochastic Analyses of Large-Scale Unsaturated Flow and Transport in Layered Heterogeneous Media, (ii) preparation for and presentation of Stochastic Project results to the NRC staff, and (iii) preparation for the IHLRWM conference paper presentations.

The peer-review of the report on effective properties is progressing. T. Rasmussen (University of Georgia) has completed his review. Comment resolution and modifications to the report will commence after the review by A. Journel (Stanford University) is received.

During his visit to the NRC, A. Bagtzoglou gave a full-day presentation to the NRC staff regarding the recent findings of the Stochastic Project. The presentation was well received, and fruitful technical discussions took place between NRC staff, the PI, and S. Neuman (UA). In addition, the PI participated in a coordination meeting addressing the recently issued SOW for the Subregional Ground-Water Flow and Transport Project, and more specifically Task 7 dealing with CNWRA/UA interactions regarding the Apache Leap Tuff Site field studies.

The interdisciplinary team of the Subregional Project has been formed and preparation of the project plan has commenced.

During the next reporting period the activities will concentrate on incorporating the internal review comments for the technical report on Large Scale Flow and Transport. Work on incorporation and comment resolution of the peer-reviewed report on effective properties will also commence.

Research Project 7 - Geochemical Analogs

Alpha spectrometry was initiated to determine U and Th isotopic activities of whole rock samples from Level +10. Samples for these analyses were collected along a traverse that crosses the northern limit of anomalous U concentrations at the Nopal I deposit. Preliminary results indicate that most $^{234}U/^{238}U$ ratios are above 1.0, suggesting preferential partitioning of ^{234}U into an aqueous phase and subsequent transport during the last 1 Ma. Gamma counting of Level +00 Nopal samples to measure U distributions continues.

Preliminary results of electron microprobe analyses of samples of iron oxide-filled fractures from Level +10 of the Nopal I deposit were received and indicate that U is concentrated mostly in or on crystalline iron oxides (hematite and goethite). Amorphous iron oxides (possibly including some clay) contain lower U concentrations, and jarosite in the fractures contained no detectable U. XRD analysis continued to determine clay mineralogy and secondary mineral formation along fractures in samples from the altered vitrophyre juxtaposed with the Nopal I deposit on Level +00.

Selective leaching of tuff and packed earth samples from the Akrotiri analog site and atomic absorption analysis to determine metal concentrations of leachates continued. Elements measured include Cu, Ag, Co, Fe, Mn, Sn, Pb, and Zn. These samples were collected as vertical profiles beneath the discovery location of bronze artifacts in area Delta 3.

Preliminary calculations of unsaturated flow at the Akrotiri site were performed with PORFLOW using hydrologic property data from the site and approximated from literature data and analyses.

A summary of the status of the Geochemical Analog Project was provided by informal briefing to G. Arlotto. Preparations for a talk at the IHLRWM conference on CNWRA Peña Blanca and Akrotiri analog studies included participation in an organizing committee meeting in Albuquerque, New Mexico for the Natural Systems Plenary session and drafting of slides and text.

A Topical Report on contaminant transport at Peña Blanca (IM 5704-065-094-006), underwent technical review, programmatic review, and format review and was revised in response to those reviews.

During the next period, activities within the Geochemical Analog Research Project are anticipated to include: (i) continued gamma spectrometry analyses of Nopal I samples, (ii) continued petrographic study of Nopal I samples, (iii) continued modeling of flow and transport at the Akrotiri site, (iv) continued leachate analyses of the tuff from the Akrotiri site, and (v) submission of the Topical Report (IM 5704-065-094-006).

Research Project 8 - Sorption Modeling

Experiments studying ^{233}U sorption on quartz sand have been initiated. In addition to kinetics studies, the experiments will investigate the effects of pH and solid-mass to solution-volume ratio (initial U = 50 ppb, solid-mass to solution-volume ratio = 0.1 g to 50 ml and 1.0 g to 50 ml). The ^{233}U-quartz experiments will be conducted in polycarbonate bottles. Results of preliminary control sorption experiments conducted at 5 and 50 ppb ^{233}U in Teflon-FEP and polycarbonate containers show that polycarbonate sorbs significantly less U at near neutral pH values.

Surface complexation modeling of actinide sorption continued using the DLM, CCM, and TTM. Models for uranium sorption on goethite were refined and a set of weighted binding constants were developed to predict observed sorption behavior. Part of this information will be used to develop information on fracture retardation in the Analogs/PA Working Session to be held at the CNWRA from June 14–15, 1994. Surface complexation binding constants have been calculated using available data for Np, Am, Pu, U, and Th sorption on different minerals and are being compiled to produce a uniform database for future sorption modeling. Models continue to be refined for U-montmorillonite sorption results from the CNWRA. The predictive results have been good for variations in solid/liquid ratios. Additional predictions were made for order of magnitude reductions in solid concentrations.

M. Lupkowski (SwRI) continued molecular dynamics simulations of U-sorption, adding water molecules to the simulations.

A summary of the status of the Sorption Research Project was provided by informal briefing to G. Arlotto.

Uranium sorption experiments on montmorillonite and quartz will continue. Experiments at elevated pCO_2 (U sorption on montmorillonite) are planned upon completion of modifications to the atmosphere controlled glove box. Additional experiments at uranium concentrations of 5 and 500 ppb will be started to investigate the effects of concentration dependence of uranium sorption on quartz. Modifications to the laboratory facilities are in progress.

Modeling of existing sorption data will continue, with the results being compiled to provide a uniform database for sorption modeling. Additional modeling of data generated from the Task 3 experimental work will continue as they become available. Particular attention will be focused on the U-quartz sorption data.

Research Project 9 - Performance Assessment (PA)

In this reporting period, the technical staff concentrated on: (i) completing a technical report on a new fracture flow model, (ii) conducting and documenting analyses of tuff core data, (iii) documenting a new infiltration model for IPA, and (iv) initiating a study of data filtering.

The CNWRA report entitled Water Film in a Fracture in Unsaturated Porous Medium was completed. The technical report, which is authored by V. Kapoor, describes a new approach for modeling water flow in a porous medium with a discrete fracture. The development of this new approach was motivated by the need to evaluate the applicability of the current approaches (i.e., equivalent porous media, dual continuum, and dual permeability) used to model water flow at YM. This document will be submitted to the NRC to fulfill IM 5704-191-094-002, Study of Water Film Flow in a Fracture with Imbibition. As agreed to by the NRC project officer, the CNWRA document will be put through external peer review and then subsequently issued as a NUREG/CR report. This work is being conducted under the scope described in Task 1 of the PA Research Project Plan for FY94-95.

The analysis of the unsaturated hydraulic properties of rock samples collected from the Peña Blanca Natural Analog site continued. Work continued on a draft technical report entitled Analysis of Hydraulic Characteristics of Hydrothermally-Altered Tuff (IM 5704-191-094-004). This work is being conducted under the scope described in Task 1 of the PA Research Project Plan for FY94-95.

A new model was developed for the purpose of predicting time-dependent infiltration phenomena at the YM site. The new model is implemented in a finite element computer code referred to as BREATH. The new model is designed to model the dynamics of both liquid and vapor flow under nonisothermal conditions. Development of the new model was motivated by the need to support the IPA auxiliary analysis on infiltration. S. Stothoff is preparing a CNWRA report to document the theory, computational techniques, and user instructions for use of the code. This report will be a new deliverable entitled Infiltration Model for IPA Auxiliary Analysis (IM 5704-192-094-005). This work is being conducted under the scope described in Task 2 of the PA Research Project Plan for FY94-95.

With the agreement of the NRC project officer, a new activity was initiated under Task 3 on Model Validation. The activity, which is being performed by G. Wittmeyer, entails a study of data filtering and its impact on model predictions. Hydrologic data for the Las Cruces trench is being used to evaluate unsaturated flow model predictions. The aim of the activity is to gain insights regarding the degree to which predictive reliability is dependent on the amount of available data. This activity was conducted under the scope described in Task 3 of the PA Research Project Plan for FY94-95.

A 2-day seminar was organized and presented to the NRC staff on the PORFLOW computer code. The purpose of the seminar was to train the NRC staff in the use of the code to model fluid flow, heat transfer, and mass transport in porous media. B. Sagar and A. Runchal (consultant) gave the seminar on May 11-12, 1994 at the NRC offices in Rockville, Maryland. The conduct of this seminar fulfilled IM 5704-112-0C8-000, Technology Transfer - PORFLOW Code.

In the next reporting period, work will be directed to: (i) continuing documentation of the infiltration model, (ii) continuing work on a report on the near-field conceptual and mathematical models, (iii) continuing the work on data filtering, (iv) formatting the previous CNWRA technical report on review of scenario selection methodologies into NUREG/CR format, and (iv) continuing work on determination of fractured tuff properties.

Research Project 10 - Volcanic Systems of the Basin and Range

Data compilation continued on the Death Valley Volcanic Field and the Pisgah-Amboy-Dish Hill volcanoes of California. Additional geologic maps and USGS open-file reports were ordered to supplement the sparse literature available for this volcanic field.

Work continued to expand the outline for the Data Review Results Report Including Uncertainties (MM 5704-123-020). Three main areas of uncertainty were identified which can be summarized as: (i) uncertainty in numerical parameters (e.g., dates, compositions), (ii) subjective data uncertainties associated with volcanic processes (e.g., vent locations, vent alignments, volume estimates), and (iii) conceptual model uncertainties (e.g., relationship between fault and dike, extensional faulting and magmatism, and spatial controls on volcano locations). These uncertainties all exist at regional, local, and individual volcano scales.

The outline for peer-review of the Volcanic Systems of the Basin and Range Project was finalized. The review panel will likely consist of five volcanology experts and will convene in late September 1994 in San Antonio, Texas. The goals of the panel are to (i) validate the objectives and approaches of CNWRA volcanism research and its application to licensing issues at the proposed YMHLW repository site; (ii) improve research scope and methodologies, and investigate new issues that may not be part of the original research plans, and; (iii) evaluate interpretations of the available data and explore alternative hypotheses. About 70 experts in various fields of volcanology are being solicited for their recommendations for panel membership.

Work during the next period will concentrate on selection of members for the peer review panel. The recommendations solicited from the 70 volcanology experts will be tabulated and leading candidates will be contacted to ascertain their willingness and availability to participate in the review panel. Work will continue on the Data Review Results Report Including Uncertainties (MM 5704-123-020) with the goal of completing an expanded outline by the end of June 1994. Data will continue to be collated and entered into the Volcanism GIS for the Death Valley and Pisgah-Amboy-Dish Hill volcanic fields of California.

Research Project 11 - Tectonic Processes

During this period, Tectonics research staff was involved in a 4-day DOE/NRC technical exchange on fractures and faulting at YM and the immediate vicinity. An additional day of reconnaissance fieldwork was conducted in the Spring Mountains and primarily focused on deformation style in the Paleozoic carbonate rocks. A major emphasis during this reporting period was also placed on preparation for the review of the NRC Tectonics Research Program by the ACNW which occurred on May 17, 1994.

The world stress database that was acquired last period from M. Zoback (USGS) was converted into an ARC/INFO coverage during this period. Initial work on generating an ARC/INFO coverage for the CAI data, acquired from A. Harris (USGS) during the last reporting period, has begun. Appropriate means of displaying the CAI data are being explored.

As part of ongoing integration of Regional Tectonics Research and Regional Hydrology Research, a preliminary compilation of groundwater flow vectors and maximum horizontal stress data from the world stress database has been completed. Though the compilation illustrates a strong need for additional data for both *in situ* stress and groundwater flow, a fairly distinct relationship between the flow directions and maximum horizontal stress is evident. A compilation of outcrop patterns (those digitized to date) for the regional carbonate aquifer and other Paleozoic hydrostratigraphic units was generated and combined with locations of water wells and oil and gas wells that penetrate the Paleozoic hydrostratigraphy.

Work on the Tectonics GIS database during the next period will include continued manipulation of the CAI thermal maturation data. Additional CAI data from A. Harris for the NTS, Bare Mountain, and surrounding areas will have been published by the end of the next period and will be sought for incorporation into the GIS database. Compilation of data and planning of tectonic models of the central Basin and Range and the YMR will continue during the next reporting period. Evaluation of earthquake hypocenters in 3D will continue to focus on clustering and relationships between earthquakes and surface faults. Integrated work between the Regional Tectonic and Regional Hydrology Research Projects will continue during the next period, with a continued emphasis on constraining in 3D the upper surface of the regional carbonate aquifer in the Death Valley region. Additional sources of *in situ* stress data will be pursued.

Research Project 12 - Field Volcanism

Additional heavy-mineral separates were prepared for most Quaternary Crater Flat basaltic volcanoes. Individual crystals of olivine and amphibole were separated from the surrounding rock matrix by crushing and sieving bulk samples to 0.5 and 0.35 mm fractions and passing the samples through high-density liquid (sodium polytungstate, density 2.9 g/cm^3). Fresh olivine separates were selected for electron- and ion-microprobe analyses for melt inclusion compositions and water contents. Amphibole is present as a minor phase at Little Cone SW, Little Cone NE, and Red Cone and as a trace phase at Black Cone and Buckboard Mesa.

Work continued on the Geophysics Review—Topical Report (MM 5704-144-001). Simulated magnetic anomalies over buried basaltic dikes and volcanoes were calculated and methods to enhance these small-magnitude anomalies were explored. Previously reported aeromagnetic anomalies in the Amargosa Valley can be modeled as a complex of small, buried dikes or cinder cones. Magnetic anomalies associated with thin (1–5 m), buried (100–500 m) dikes in unconsolidated alluvium are extremely small. However, similar magnitude anomalies are present in ground magnetic surveys in the Fortymile Wash area.

Detailed calculations for magma density and viscosity were performed for representative YMR basalts and basalts from historically active volcanoes at Tolbachik, Russia; Cerro Negro, Nicaragua; and Parícutin, Mexico. Using reported compositions and molecular volumes and assuming a magma temperature of 1100 °C, Quaternary YMR basalts have densities of around 2.7 g/cm^3. Assuming these magmas were 3 percent crystalline and crystal diameters were about 0.5 mm, log viscosities are between 3.3 and 3.8 poise. Under similar physical conditions, Tolbachik magmas are 2.6–2.7 g/cm^3 and 2.8–3.5 poise, Cerro Negro is about 2.7 g/cm^3 and 3.3–3.7 poise, and Parícutin is 2.5–2.6 g/cm^3 and 4.0–4.9 poise. This comparison demonstrates that proposed analog volcanoes have densities and viscosities that are comparable to YMR basaltic volcanoes.

Advanced logistical planning was completed for extended field work in Kamchatka during July 1994. Most of the basic camp supplies (food, tents, cooking equipment) can be purchased or provided in Petropavolovsk-Kamchatsky, but most of the scientific supplies for gas sampling and petrology studies will have to be brought from San Antonio, Texas. A detailed topographic map is being digitized and reproduced at different scales with the Volcanism GIS. A suite of rock samples from the earliest stages of the 1975 Tolbachik eruption was provided by Y. Doubik (Institute of Volcanic Geology and Geochemistry in Petropavolovsk-Kamchatsky). These samples will be sent to the Smithsonian Institution for detailed analyses after petrographic, granulometric, and ash-leachate studies are completed at the CNWRA.

Work during the next period will focus on completion of the Geophysics Review—Topical Report (MM 5704-144-001) and the detailed logistics of field work in Kamchatka, Russia. Work will likely commence on quantitative vesiculation studies of basaltic cinders, using the OPTIMAS image analysis system and cinder samples from YMR volcanoes.

Research Project 13 - Regional Hydrogeologic Processes

In this reporting period, the level of effort on Task 1 (Literature Review and Data Collection) was reduced because of staff commitments to DWM activities. However, some progress was made in the construction of maps showing: (i) the location of surface hydrographic boundaries, (ii) general directions of regional flow, and (iii) the location of surface outcrops of geologic units comprising the Paleozoic carbonate aquifer. A map of regional flow directions, regional contemporary stress, and the location of major faults was also constructed. These and other similar maps will be used to construct conceptual flow models for the region. K. Spivey, D. Ferrill, and B. Henderson (SwRI) are the principal contributors to this work.

In Task 2 (Conceptual Model Development) of the project, progress continues to be made on digitizing the surface exposure of those units comprising the Paleozoic carbonate aquifer. K. Spivey has completed digitizing the geologic maps of Lincoln County and northern Clark County, Nevada. Most of the geologic quad maps which cover southern Nye County, Nevada and the NTS have also been digitized. Efforts are being made to correlate the surface exposure of the Paleozoic carbonate units with measurements of the depth to, and thickness of, the lower carbonate aquifer obtained from water and oil wells, as well as from emplacement holes at NTS. These correlations will be used to construct geologic and hydrostratigraphic cross-sections.

Within Task 1, two water level maps will be constructed for the region which reflect the estimated steady-state potentiometric surfaces in the lower carbonate aquifer and the upper Cenozoic aquifer. Work will be initiated on a report summarizing existing conceptual models of the Death Valley region, and the data which have been gathered in this project in order to construct new conceptual models. Efforts at correlating the major and minor principal components of the contemporary stress field in the Death Valley region with known directions of preferential flow in the Paleozoic carbonate aquifer will also continue to be pursued.

1.9 *Waste Solidification Systems (WSS)*

P. Nair and E. Tschoepe attended the kickoff meeting for the WVDP, Vitrification Plant Hot Operations and High Level Waste Interim Storage Final Safety Analysis Report (SAR-003) in Buffalo and West Valley, New York, on May 10–12, 1994. The meeting included presentations on SAR-003, although the SAR-003 was not provided at the meeting. The draft SAR-003 is expected to be issued on May 23, 1994. The kickoff meeting was also attended by the DOE Technical Review Board that reviews all West Valley Operations and three other DOE groups. A tour of the Vitrification Plant and support facilities was also conducted to assist in identifying the scope of SAR-003 with respect to hardware. Preliminary comments on the draft SAR are due to be completed by early August 1994.

In the next period, the draft version of SAR-003 is expected to be available for review by June 1, 1994. The first step in the review will be to identify referenced documents which are not on hand and which will be requested from WVDP by NRC staff. The review of this draft SAR-003 is expected to be completed by August.

1.10 *Monitored Retrievable Storage (MRS)*

During this period, no work assignment was received from the NRC.

The CNWRA will await further work assignment on MRS from the NRC.

2. MANAGEMENT ISSUES

None.

3. MAJOR PROBLEMS

None.

4. SUMMARY OF SCHEDULE CHANGES

Schedule changes that have become necessary are summarized in Table 3. This table provides formal documentation of: (i) schedule changes for IMs that occurred during the preceding period or are anticipated to occur during the subsequent period, and (ii) schedule changes for MMs that are anticipated to occur during subsequent periods. Each item listed has been discussed with the cognizant NRC PEM and other parties, as appropriate. In the case of MMs, the matter has been discussed with the NRC Contracting Officer and/or the designated representative of DCPM.

5. SUMMARY FINANCIAL STATUS

Table 4 indicates the financial status of the CNWRA in the context of authorized funds established by the NRC. Total commitments of the CNWRA are $405,648. Appendix A displays planned and actual costs to date, without allowance for fee, on both a per-period and a cumulative basis. In addition, these data do not include commitments, and variances are shown on both a dollar and percentage basis. Pertinent information is provided for the CNWRA program as a whole, the DWM JC, the RES DRA JC, the DIMNS JC, and the DFCSS JC, as well as for each Program Element and Project. This information is provided in both graphical and tabular form.

Cost variances over the past three reporting periods suggest distinct trends between DWM and RES projects. Specifically, the DWM spending reflects a consistent underrun of about 7 percent whereas the RES spending now shows a more stable underrun of about 8 percent. Although the composite CNWRA cost underrun has been fairly stable in the preceding three periods, it continues to steadily decrease on a percentage basis. Combined, the DWM 5.8 percent underrun is attributed principally to EQA and PA activities that have been postponed, slow in progressing, and/or not scheduled to start until the fourth quarter. The COPS, WSE&I, EBS, and RDCO Elements continue to adhere to the estimated spending levels. The GS Element has been consistently overspent due to a high level of effort in the Investigative Issues subtask area (SEISM 1) and in the reactive work (ACNW tectonics meeting, NRC/DOE site visit). DWM spending is expected to accelerate as IPA Phase 3 planning is finalized, auxiliary analyses are started, and prelicensing activities are conducted. Based on last quarter spending, the DWM elements will probably spend approximately 3 percent less than the total budget for this current fiscal year.

Concerning RES projects, the Volcanic Systems of Basin and Range and PA Research show a continued pattern of below-estimates spending. This underspending is primarily due to continued utilization of key technical staff on DWM activities (e.g., unplanned reactive work, IPA, SRA). Spending in both projects will accelerate over the next several periods as a result of preparation for, and implementation of, peer reviews and employment of student scientists during the summer months. In addition, the Subregional Hydrology Project is expected to begin in the latter quarter of the fiscal year. RES projects currently overspending are Geochemistry, Stochastic Analysis of Large-Scale Flow and Transport in Unsaturated Fractured Rock, and Tectonic Processes. With completion of the Topical Report (MM 5704-014-094-002) on the Geochemistry project, spending is expected to decrease significantly for the next several periods. The use of the peer review process coupled with greater complexities of the computational analyses will occasion the Stochastic Analysis of Large-Scale Flow and Transport in Unsaturated Fractured Rock project to remain overspent through the end of this fiscal year. There has been a consistent decrease in the overall spending for the Tectonic Processes Research Project since Period 2, and continued management and monitoring of all spending should permit actual expenditures to more closely follow current estimates.

All other RES projects are closely tracking the projected spending. Based on last quarter spending, the RES projects in the aggregate will be generally underspent by about 8 to 10 percent at the end of this current fiscal year.

The aggregate underspending of 7.6 percent in the COPS Element reflects the accumulation of both the old and new work breakdown structure account numbers (071-076 and 151-156). For FY94 to date, all subtasks are under projected expenditure levels, including both series of work breakdown structure account numbers, except Management Support and Planning (Subtask 151) and DWM Computer Systems Support (Subtask 155). All costs associated with TDOCS Development (Subtask 156) prior to Period 7 remained in Subtask 155, since all activities related to TDOCS were resident in that subtask. Actual has not surpassed estimated spending in Subtasks 151 and 155 since Period 5 and Period 6 respectively, and such actual spending is not expected to exceed each period's revised estimates for the balance of this fiscal year. Expenditures for Subtask 153 during Periods 7 and 8 represent the CNWRA staff's participation in DWM budgeting exercises. Spending for the following periods will reflect the costs related to the development and production of the FY95 operations plans. As anticipated, Subtask 154 costs have not only exceeded Period 7 estimates but will also surpass the revised estimates for Periods 8 and 9 due to the preparation for and conduct of the CNWRA QA audit as well as the actual auditing and report writing scheduled. Period 10 expenditures should reflect the norm for CNWRA QA internal operations. Actual spending in Subtask 156, TDOCS Development, will remain under budget at least for the next two fiscal periods.

The WSE&I Element was 2.0 percent underspent at the end of this period. This represents a 1.7 percent increase in spending from the previous period and reflects the increased use of additional SwRI staff for RPD development. This increased spending will continue and is expected to result in a temporary overspending condition prior to completion of RPD Phase II implementation in June 1994. Subsequent to this, use of non-CNWRA labor will be significantly reduced.

Actual costs for the EQA Element are currently 42.9 percent below the estimated spending plan. This underrun is due to postponement of DOE audits and generally lower activity costs than estimated for this period. Starting with Period 8, a series of nine separate DOE QA audits are scheduled before the end of September, which provides an indication of how the DOE audit schedule has changed to be biased toward the end of the current fiscal year. It is anticipated that with the increase in observation audits, the underrun condition will be significantly reduced.

The GS Element was 14.5 percent overspent at the end of Period 8. This reflects a 55.5 percent overrun in the Geology and Geophysics area and a 32.3 percent underrun in the Hydrology, Geochemistry, and Climatology area. The overrun in the Geology and Geophysics area reflects a large reactive effort in support of the NRC and DOE Site Visit in early May. In addition, effort went into the preparation for the May ACNW meeting. The underrun in the Hydrology, Geochemistry, and Climatology area is the result of a lower than anticipated level of work on CDM development and in the investigative issues related to hydrology, geochemistry and climatology, but was offset by an increased level of effort in GWTT.

The expenditures through Period 8 for the EBS Element are 6.9 percent below the planned costs. Expenditures are expected to increase in future periods and remain close to planned levels.

Costs incurred to date for the RDCO Element are 5.1 percent below those planned. Costs will increase as the DBE rulemaking, CDS development, and prelicensing activities continue.

In the PA&HT Element, the cost variance for the DWM activities continued to decrease. At the end of Period 8, the spending was 17.4 percent under the projected amount. A significant cost variance change is expected in the next reporting period as progress is made on various auxiliary analyses and the expert judgment study, as well as new tasking on the EPA standard. In addition, new activities on CDS integration and consistency reviews are planned.

The actual cost through Period 8 for the RES JC is 8.4 percent below the estimated cost. All of the projects, except Geochemistry, Stochastic Analysis of Large-Scale Flow and Transport in Unsaturated Fractured Rock, and Tectonic Processes, show cost underruns which are explained in the following paragraphs.

Costs incurred to date for the Overall Research Project were 4.9 percent below projected costs. Future costs are anticipated to closely follow planned values.

Spending for the Geochemistry Research Project is presently 6.1 percent in excess of the budgeted amount submitted with the revised project plan in March 1994. The rate of expenditure will decrease now that the major milestone topical report has been submitted to the NRC.

Actual costs for the Thermohydrology Research Project are 6.9 percent below estimated costs. The reduction in actual spending is attributed to recent requirements by key project personnel on other projects. The spending rate will increase over the next months during periods of high project activity associated with the completion of the experimental portion and the final analyses of the project.

Seismic Rock Mechanics Research Project costs incurred to date are 0.2 percent less than the planned expenditure. Expenditures are expected to remain close to planned levels.

The IWPE Research Project costs to date are 4.9 percent less than planned. Activities in the IWPE Research Project have increased in this reporting period and will continue to be close to the project plan in the future periods.

At the end of Period 8, the Stochastic Research Project was 26.4 percent over the projected costs. The corrective measures continued to have an effect on the budget during this last period, and they reduced the aggregate overspending by approximately 4 percent since Period 6. However, the total project costs are expected to exceed the budgeted amount because of unexpected costs related to the required peer reviews.

At the end of Period 8, the Geochemical Natural Analog Research Project was 0.6 percent under planned costs. Project costs for the remainder of the fiscal year should approximate planned amounts. Occasional, short-term cost deviations corresponding largely to field research expenses are anticipated.

At the end of Period 8, the Sorption Modeling for HLW Performance Assessment Project was 2.5 percent under planned costs. With the initiation of additional batch experiments, spending levels should increase slightly during the next periods and approximate planned values.

The Volcanic Systems of the Basin and Range Research Project currently is underspent by 19.2 percent. Spending during Period 8 continued to be at a slower rate than anticipated, due to increased efforts in the Field Volcanism project towards completing the Geophysics Review - Topical Report (MM 5704-144-001) and preparation for field studies in Kamchatka, Russia. Spending will increase significantly during the end of FY94 as a result of the peer review.

As of the end of Period 8, the Regional Hydrology Research Project continues to reasonably track the projected spending curve as indicated by the cost variance of 9.0 percent. Actions taken to reduce the spending rate have clearly been successful.

The Field Volcanism Research Project currently is underspent by 2.0 percent. Spending during Period 8 increased relative to Period 7, due to additional contractor work on the Geophysics Review—Topical Report (MM 5704-144-001) and initial purchases of equipment and supplies for Kamchatka field work. Spending will likely increase during Period 9 due to further purchases of equipment and supplies for Kamchatka field work.

The Tectonics Research Project was 20.0 percent overspent at the end of Period 8. This is a slight improvement in the overall downward trend of the overrun. Contractual commitments to a sub-contractor have been completed. This will reduce future costs. Future commitments are being examined to identify additional cost saving areas.

At the end of Period 8, the PA Research Project costs were 19.9 percent under the projected amount. This cost variance is primarily due to limited activity in Tasks 2 and 3. However, this variance will decrease rapidly over the next two periods because of a focused effort on completion of major deliverables and initiation of new work in all three tasks.

The expenditures in the WSS Project are 32.7 percent below the planned level. The nature of the tasks in this program element reflect the dependence on several documents to be received from the DOE. Recently, the NRC has received several new documents from the DOE. The review of these documents has been initiated. Activities related to the review of the DOE documents will increase in the next few periods. Significant activities will develop in this project once the draft of the Vitrification Safety Analysis Report is made available by the DOE.

In the MRS Project, no work was assigned to the CNWRA by the NRC. Costs incurred to date for the MRS project are 36.9 percent below those planned. E. Shum has indicated that the CNWRA may not receive additional work assignments until an MRS site is identified.

TABLE 1. CNWRA CORE STAFF - HIRING PROFILE AND STATUS (05/13/94)

EXPERTISE/EXPERIENCE	FISCAL YEAR (PLANNED) FY94 1Q	2Q	3Q	4Q	FY95	FY96	FY97	FY98	OPEN THIS YEAR
ADMINISTRATION	5	5	5	5	5	5	5	5	0
CODE ANALYSIS/DEVELOPMENT	2	3	3	3	3	3	3	3	0
DATABASE MANAGEMENT & DATA PROCESSING	2	2	2	2	2	2	2	2	0
ELECTROCHEMISTRY	1	1	1	1	1	1	1	1	0
ENGINEERING GEOLOGY/GEOLOGICAL ENGNG	1	1	1	1	1	1	1	1	0
ENVIRONMENTAL SCIENCES	1	1	1	1	1	1	1	1	0
GEOCHEMISTRY	5	6	6	6	6	6	6	6	0
GEOHYDROLOGY/HYDROGEOLOGY	5	5	6	6	7	7	7	7	0
GEOLOGY	2	2	2	2	3	3	3	3	0
HEALTH PHYSICS	1	1	1	1	1	1	1	1	0
INFORMATION MANAGEMENT SYSTEMS	2	2	2	2	2	2	2	2	0
MATERIAL SCIENCES	4	4	4	4	4	4	4	4	0
MECHANICAL, INCLUDING DESIGN & FABRICATION	1	1	1	1	1	1	1	1	0
MINING ENGINEERING	1	1	1	1	1	1	1	1	0
NUCLEAR ENGINEERING	1	1	1	1	1	1	1	1	0
NUMERICAL MODELING/HP (a)	1	1	1	1	1	1	1	1	1
PERFORMANCE ASSESSMENT	4	5	5	6	6	6	6	6	0
QUALITY ASSURANCE	2	2	2	2	2	2	2	2	0
RADIOISOTOPE GEOCHEMISTRY (e)	1	1	1	1	1	1	1	1	0
REGULATORY ANALYSIS	1	1	1	1	1	1	1	1	0
ROCK MECHANICS	3	3	4	4	4	4	4	4	0
SEISMOLOGY	1	1	1	1	1	1	1	1	0
SOURCE-TERM/SPENT FUEL DEGRAD.	1	1	1	1	1	1	1	1	0
STRUCTURAL GEOLOGY/SEISMO-TECTONICS	3	3	3	3	3	3	3	3	0
SYSTEMS ENGINEERING	1	1	1	1	1	1	1	1	0
VOLCANOLOGY/IGNEOUS PROCESSES	2	2	2	2	2	2	2	2	0
TOTAL CORE STAFF PLANNED	54	57	59	60	62	62	62	62	1

Staffing Summary

	Professional	Support	Total
Current	53	16	69
Limited Term	1	0	1
Offers Made	0	0	0
Planned This Date	54	16	70
Planned End of FY94	54	16	70

(a) Interview scheduled next period
(b) Resumes being solicited
(c) Offer made
(d) Offer pending
(e) Offer accepted

TABLE 2. CNWRA CORE STAFF - CURRENT PROFILE (05/13/94)

EXPERTISE/EXPERIENCE	
ADMINISTRATION	J.LATZ, W.PATRICK, H.GARCIA, P.MACKIN, J. RUSSELL, B. SAGAR
CODE ANALYST	R.JANETZKE, R.MARTIN
DATABASE MANAGEMENT AND DATA PROCESS	A.JOHNSON, A.JACOB
ELECTROCHEMISTRY	G.CRAGNOLINO
ENGINEERING GEOLOGY/GEOLOGICAL ENGNG	G.OFOEGBU
ENVIRONMENTAL SCIENCES	P.LaPLANTE
GEOCHEMISTRY	W.MURPHY, R.PABALAN, E.PEARCY, J.PRIKRYL, D.TURNER, P.BERTETTI*
GEOHYDROLOGY/HYDROGEOLOGY	A.BAGTZOGLOU, R.GREEN, S.STOTHOFF, G.WITTMEYER, V.KAPOOR, S.MOHANTY
GEOLOGY	L.McKAGUE, M.MIKLAS
HEALTH PHYSICS	J.HAGEMAN
INFORMATION MANAGEMENT SYSTEMS	R.JOHNSON, R.MARSHALL
MATERIAL SCIENCES	P.NAIR, H.MANAKTALA, N.SRIDHAR, D.DUNN
MECHANICAL, INCLUDING DESIGN & FABRICATION	C.TSCHOEPE
MINING ENGINEERING	S-M.HSIUNG
NUCLEAR ENGINEERING	H.KARIMI
NUMERICAL MODELING/SIMULATION	
PERFORMANCE ASSESSMENT	R.BACA, A.B.GUREGHIAN, R.MANTEUFEL
QUALITY ASSURANCE	B.MABRITO, R.BRIENT
RADIOISOTOPE GEOCHEMISTRY	D.PICKETT (Start date 6/20/94)
REGULATORY ANALYSIS	S.SPECTOR (law)
ROCK MECHANICS	A.CHOWDHURY, M AHOLA, A.GHOSH
SEISMOLOGY	R.HOFMANN
SOURCE-TERM/SPENT FUEL DEGRAD	P.LICHTNER
STRUCTURAL GEOLOGY/SEISMO-TECTONICS	G.STIREWALT, S.YOUNG, D.FERRILL
SYSTEMS ENGINEERING	A.DeWISPELARE
VOLCANOLOGY/IGNEOUS PROCESSES	C.CONNOR, B.HILL

*LIMITED TERM

TABLE 3. SUMMARY OF SCHEDULE CHANGES

Milestone Number	Type	Description	Original Date	Revised Date	Rationale for Change
5702-251-401	IM	Procedure for Uncertainty Identification and Resolution	6/30/94	9/30/94	Reflects revised schedules and priorities subsequent to DWM reorganization and special assignments
5702-451-401	IM	Letter Report of GWTT Analysis Results	6/15/94	8/15/94	Additional time for particle tracking analyses
5702-712-405	IM	Background Report on Use of Expert Judgment in PA	6/30/94	8/31/94	Delayed due to competing utilization of technical staff
5702-712-410	MM	NUREG/CR Document on Expert Elicitation Guidance	9/30/94	11/31/94	Delayed due to linkage to IM 5702-712-405
5702-723-421	IM	User Guide for SEISMO Module	4/30/94	6/6/94	Delayed to accommodate technical review by NRC staff
5702-723-430	IM	Letter Report on Demonstration of a GUI and Centralized Database for TPA Code	6/30/94		Change in milestone title only
5704-053-094-001	MM	Large-Scale Simulation of Flow and Transport in Heterogeneous Fractured Rock: Results and Analyses	6/03/94	6/30/94	Additional time required for internal review process

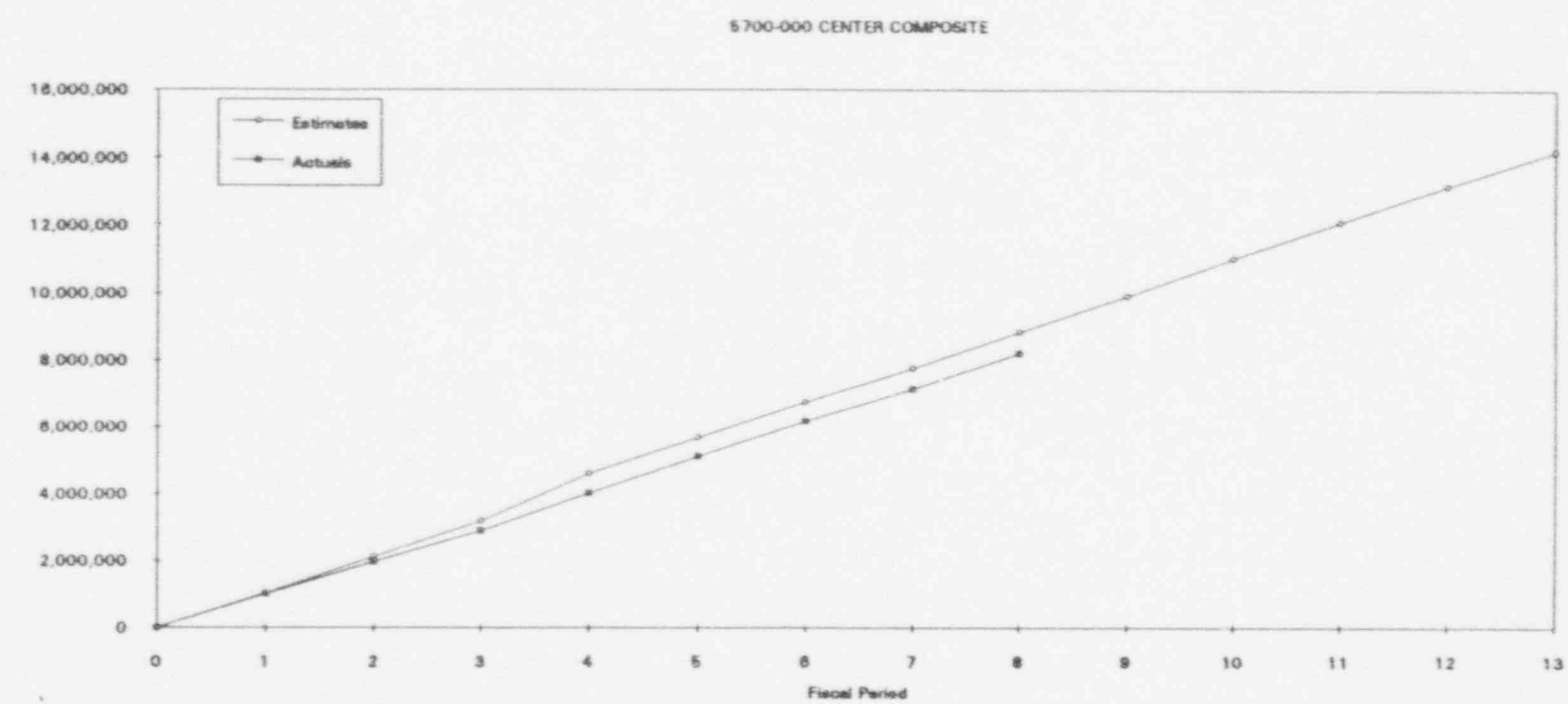
TABLE 4. FINANCIAL STATUS

	Funds Authorized*	Funds Costed to Date**	Funds Uncosted	Commitments
GS	3,567,399	2,051,048.31	1,516,350.69	14,826.18
EBS	2,376,992	1,263,696.01	1,113,295.99	28,562.52
RDCO	1,206,199	1,605,635.56	(399,436.56)	24,097.20
WSEI	2,582,731	2,213,869.84	368,861.16	10,052.65
EQA	1,284,454	158,934.20	1,125,519.80	3,166.00
PA	2,480,853	2,203,614.23	277,238.77	213,233.28
COPS	4,329,800	3,457,572.49	872,227.51	17,037.00
HLW	17,828,428	12,954,370.64	4,874,057.36	310,974.83
OVERALL	466,856	321,565.11	145,290.89	1,201.28
GEOCHEM	388,410	361,189.51	27,220.49	0.00
THERMO	924,236	616,218.47	308,017.53	3,709.60
SEISMIC	1,208,067	785,597.50	422,469.50	41,787.54
IWPE	1,377,499	885,108.35	492,390.65	710.00
STOCH	510,727	433,128.54	77,598.46	1,200.00
ANALOGS	1,069,663	662,698.13	406,964.87	4,325.00
SORPTION	996,066	651,449.39	344,616.61	7,450.35
RES PA	795,113	786,420.31	8,692.69	20,533.74
VOLCAN (R)	427,348	444,464.41	(17,116.41)	5.20
VOLCAN (FLD)	774,382	360,857.54	413,524.46	8,071.80
REG HYDRO	774,545	184,861.84	589,683.16	0.00
TECTONIC	1,236,738	516,420.63	720,317.37	2,678.71
RES	10,949,650	7,009,979.73	3,939,670.27	91,673.22
WSS	235,392	135,017.36	100,374.51	3,000.00
MRS	56,231	16,107.48	40,123.52	0.00
TOTAL	29,069,701	20,115,475.21	8,954,225.66	405,648.05

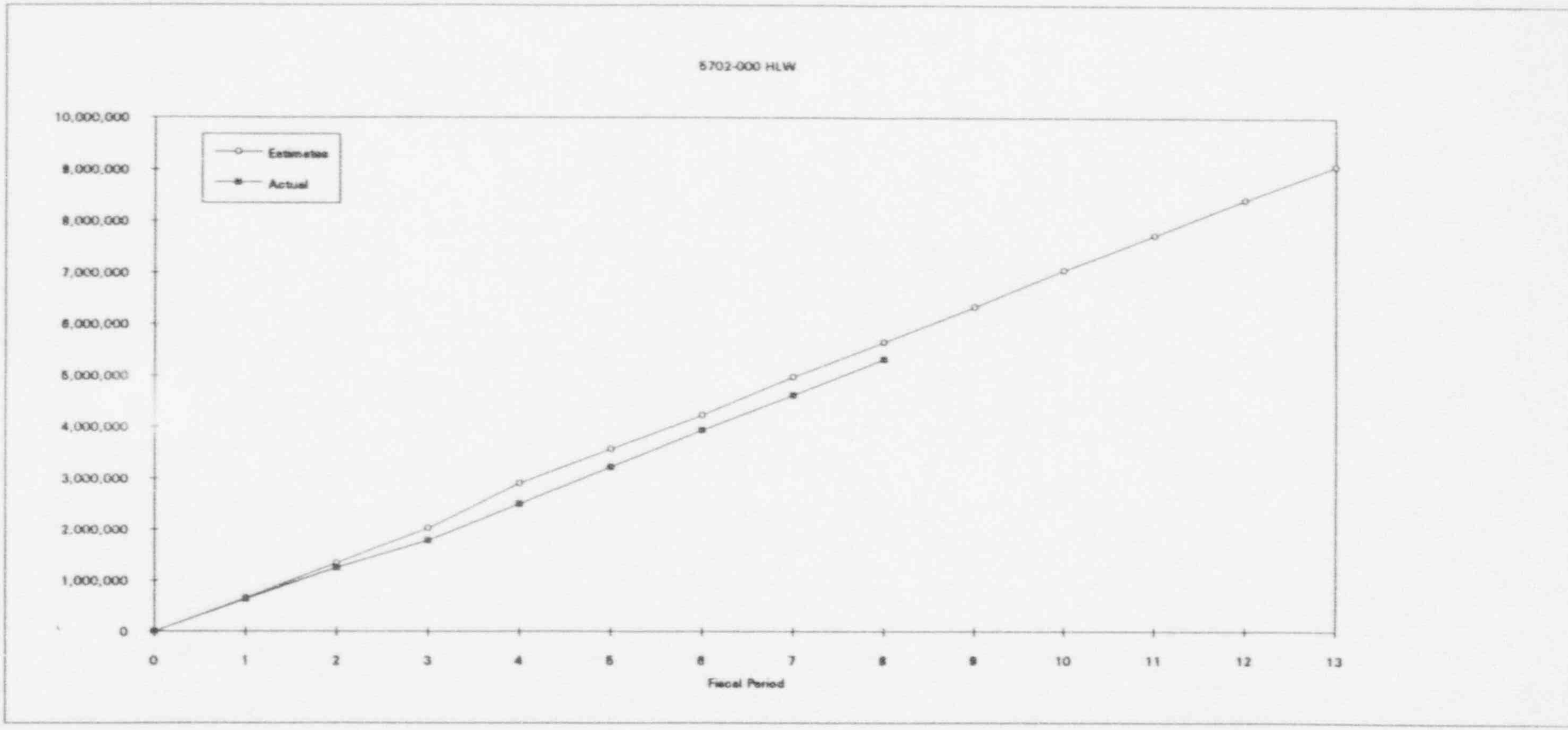
* Additional Authorized Funds of $2,576,788 for HLW and $314,325 for RES have not been allocated.
** Costed to Date includes Base Fee. Additional fee awarded is not included. Amount authorized includes carryover.

APPENDIX A

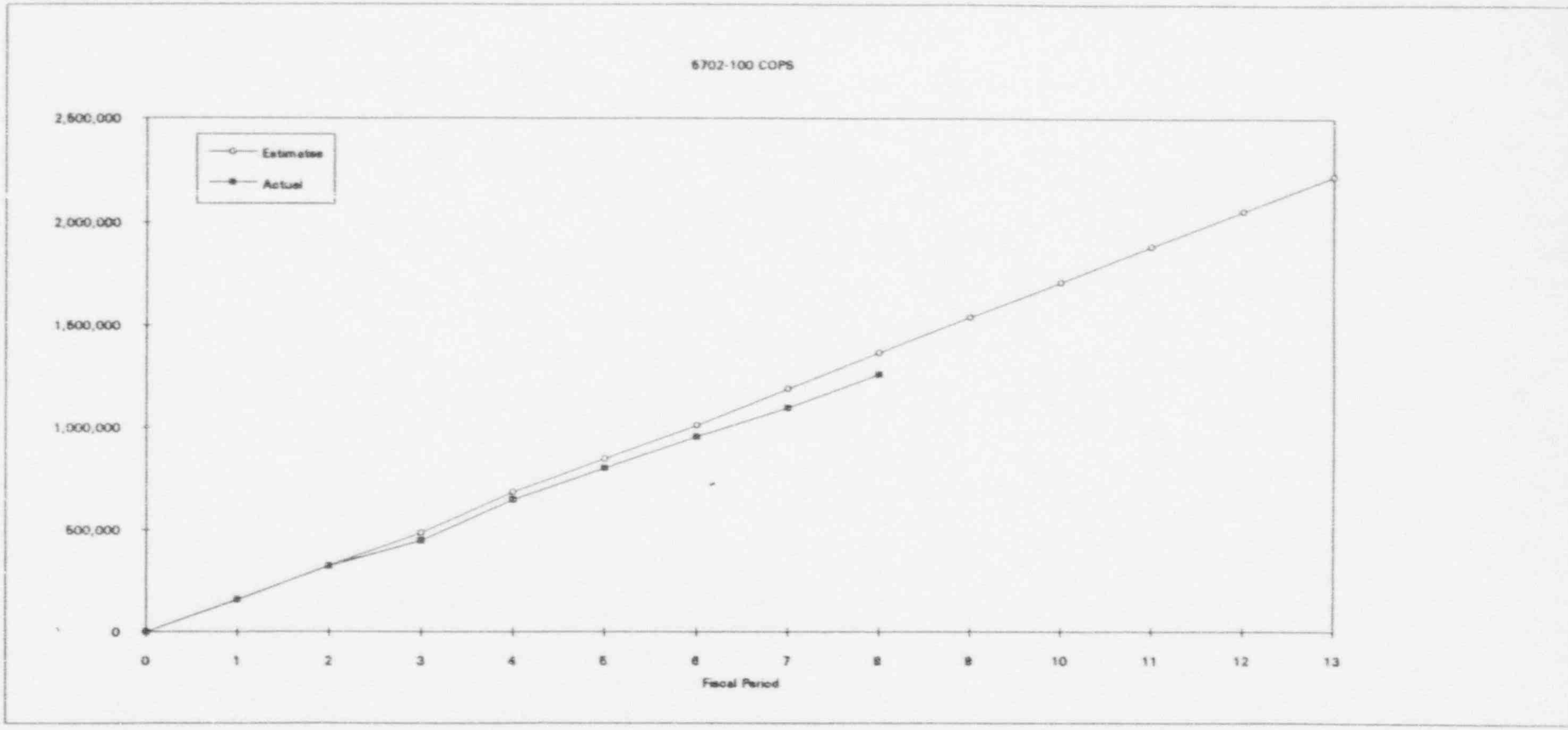
PLANNED AND ACTUAL COSTS, AND COST VARIANCES



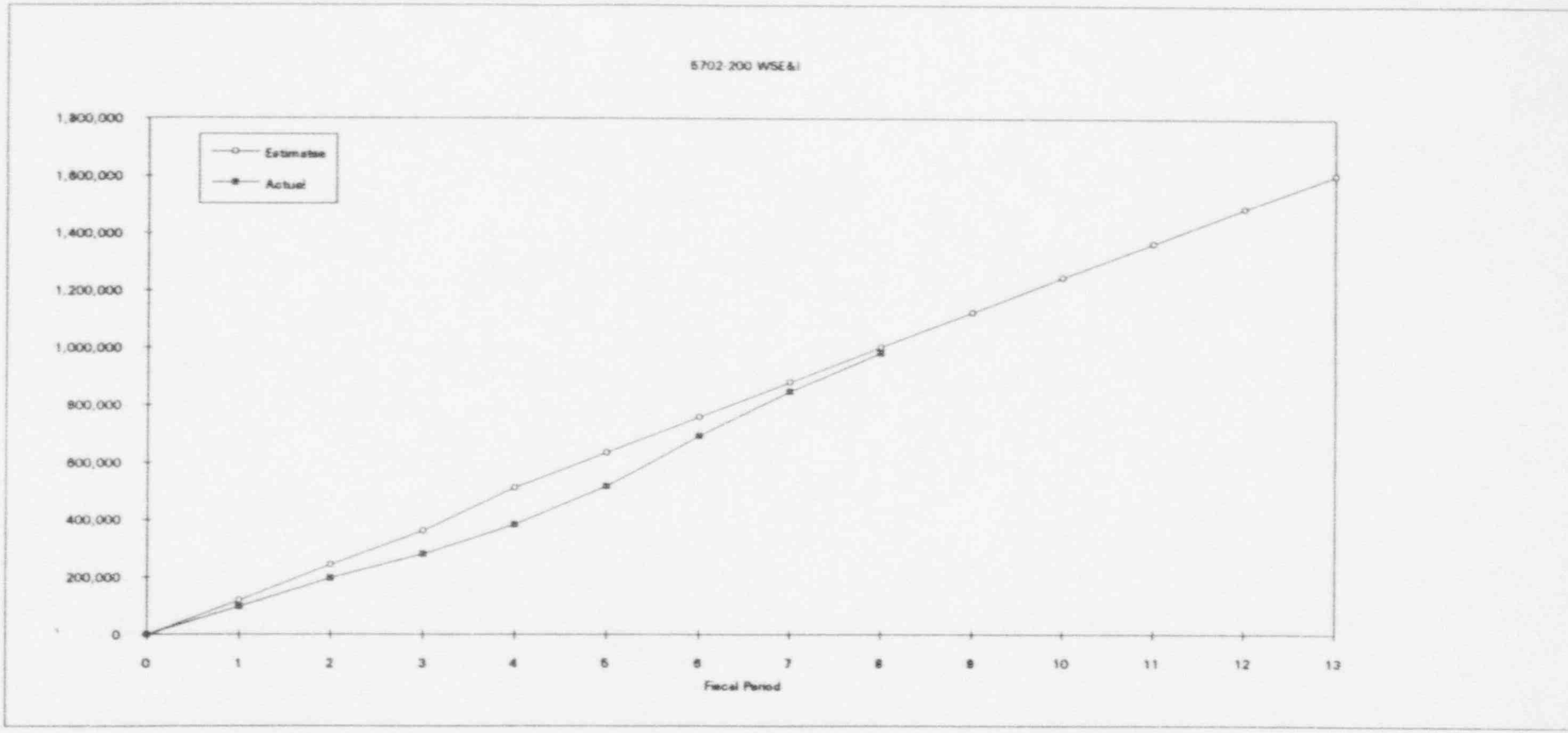
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	1,036,251	1,078,946	1,059,336	1,414,291	1,078,045	1,071,882	1,014,150	1,072,881	1,074,638	1,129,355	1,058,997	1,070,915	1,024,255	8,825,782
ACT. PERIOD COST	988,990	968,936	933,235	1,128,970	1,078,151	1,053,022	982,940	1,080,961	0	0	0	0	0	8,215,204
VARIANCE, $	47,261	110,010	126,101	285,321	(106)	18,860	31,210	(8,080)	0	0	0	0	0	610,578
VARIANCE, %	4.6%	10.2%	11.9%	20.2%	0.0%	1.8%	3.1%	-0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	6.9%
EST. FY CUMUL	1,036,251	2,115,197	3,174,533	4,588,824	5,666,869	6,738,751	7,752,901	8,825,782	9,900,420	11,029,775	12,088,772	13,159,687	14,183,942	
ACTUAL FY CUMUL	988,990	1,957,925	2,891,160	4,020,130	5,0[illegible],281	6,151,304	7,134,244	8,215,204	0	0	0	0	0	
PERCENT COMPLETE	7.0%	13.8%	20.4%	28.3%	35.9%	43.4%	50.3%	57.9%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	47,261	157,272	283,373	568,694	568,588	587,447	618,657	610,578	0	0	0	0	0	
VARIANCE, %	4.6%	7.4%	8.9%	12.4%	10.0%	8.7%	8.0%	6.9%	0.0%	0.0%	0.0%	0.0%	0.0%	



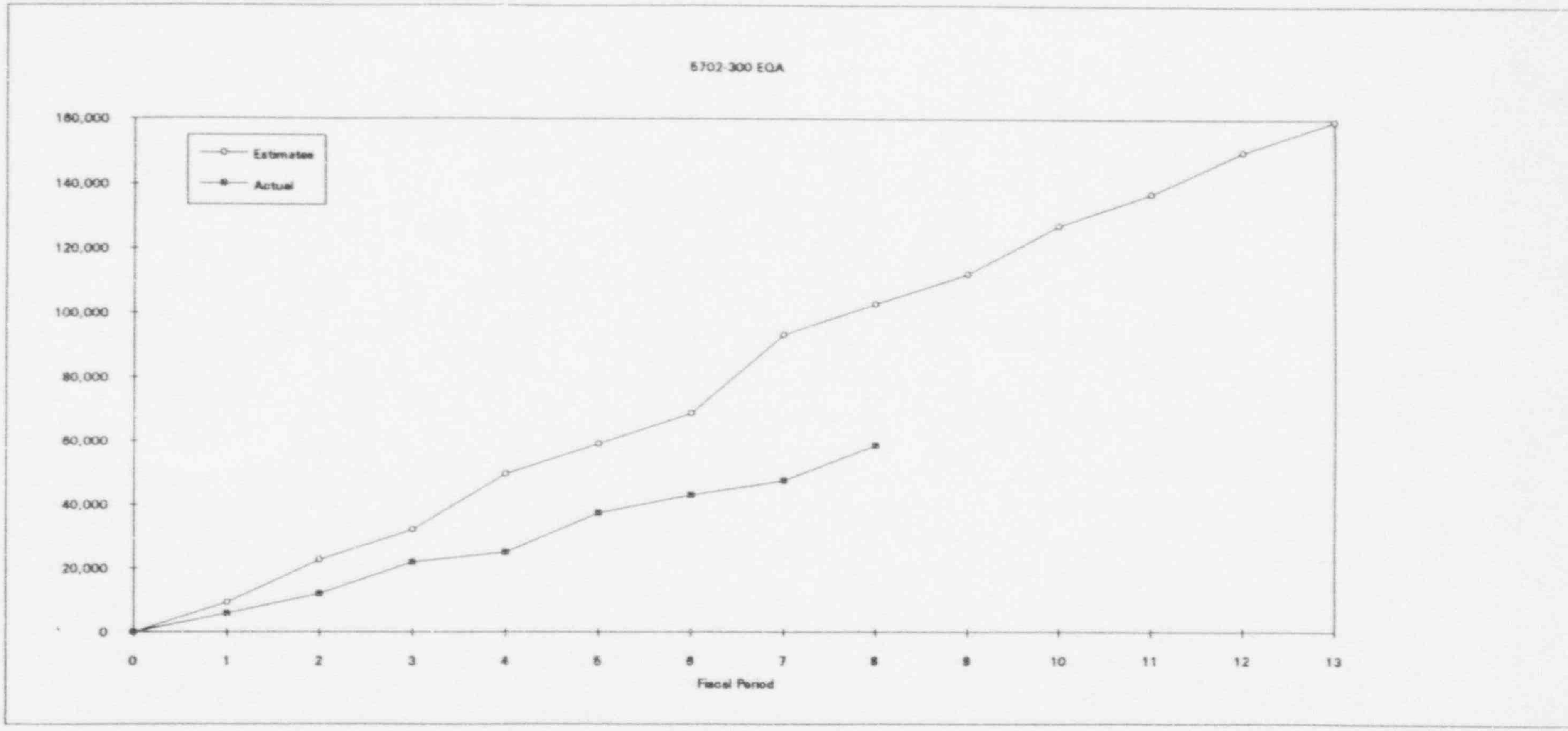
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	657,900	683,467	673,276	876,775	670,044	664,041	747,693	677,579	681,092	713,118	681,421	685,782	664,624	5,650,775
ACT. PERIOD COST	644,178	600,899	531,606	721,653	723,345	715,068	673,816	711,145	0	0	0	0	0	5,321,710
VARIANCE, $	13,722	82,568	141,670	155,122	(53,301)	(51,027)	73,877	(33,566)	0	0	0	0	0	329,065
VARIANCE, %	2.1%	12.1%	21.0%	17.7%	-8.0%	-7.7%	9.9%	-5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.8%
EST. FY CUMUL	657,900	1,341,367	2,014,643	2,891,418	3,561,462	4,225,503	4,973,196	5,650,775	6,331,867	7,044,985	7,726,406	8,412,188	9,076,812	
ACTUAL FY CUMUL	644,178	1,245,077	1,776,683	2,498,336	3,221,681	3,936,749	4,610,565	5,321,710	0	0	0	0	0	
PERCENT COMPLETE	7.1%	13.7%	19.6%	27.5%	35.5%	43.4%	50.8%	58.6%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	13,722	96,290	237,960	393,082	339,781	288,754	362,631	329,065	0	0	0	0	0	
VARIANCE, %	2.1%	7.2%	11.8%	13.6%	9.5%	6.8%	7.3%	5.8%	0.0%	0.0%	0.0%	0.0%	0.0%	



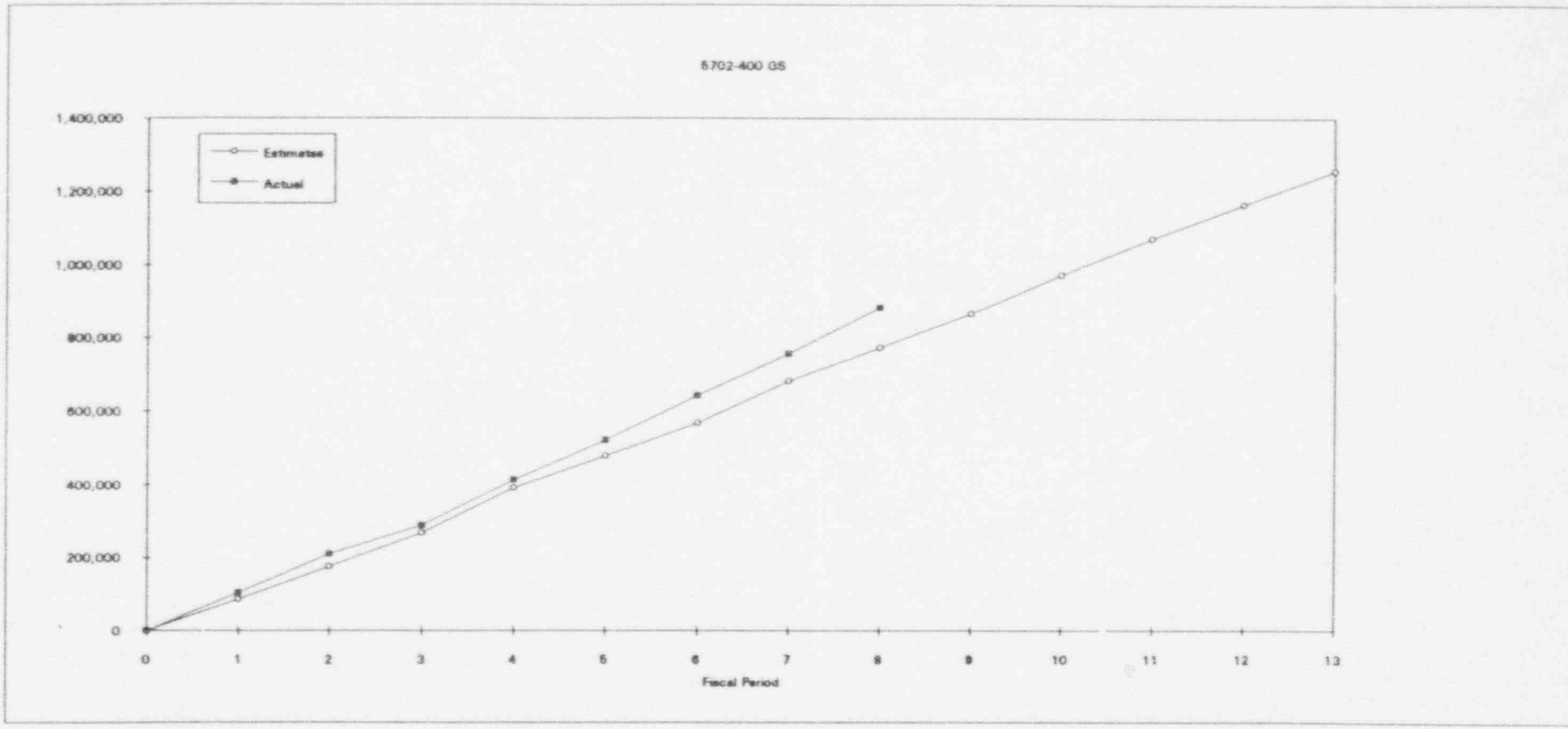
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	158,237	166,818	158,580	204,037	160,928	161,388	181,456	172,949	174,616	171,415	170,141	172,223	168,862	1,364,393
ACT. PERIOD COST	160,035	161,950	125,227	202,472	155,313	150,826	141,954	163,030	0	0	0	0	0	1,260,806
VARIANCE, $	(1,798)	4,868	33,353	1,565	5,615	10,562	39,502	9,919	0	0	0	0	0	103,587
VARIANCE, %	-1.1%	2.9%	21.0%	0.8%	3.5%	6.5%	21.8%	5.7%	0.0%	0.0%	0.0%	0.0%	0.0%	7.6%
EST. FY CUMUL	158,237	325,055	483,635	687,672	848,600	1,009,988	1,191,444	1,364,393	1,539,009	1,710,424	1,880,565	2,052,788	2,221,650	
ACTUAL FY CUMUL	160,035	321,985	447,211	649,683	804,996	955,822	1,097,776	1,260,806	0	0	0	0	0	
PERCENT COMPLETE	7.2%	14.5%	20.1%	29.2%	36.2%	43.0%	49.4%	56.8%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(1,798)	3,070	36,424	37,989	43,604	54,166	93,668	103,587	0	0	0	0	0	
VARIANCE, %	-1.1%	0.9%	7.5%	5.5%	5.1%	5.4%	7.9%	7.6%	0.0%	0.0%	0.0%	0.0%	0.0%	



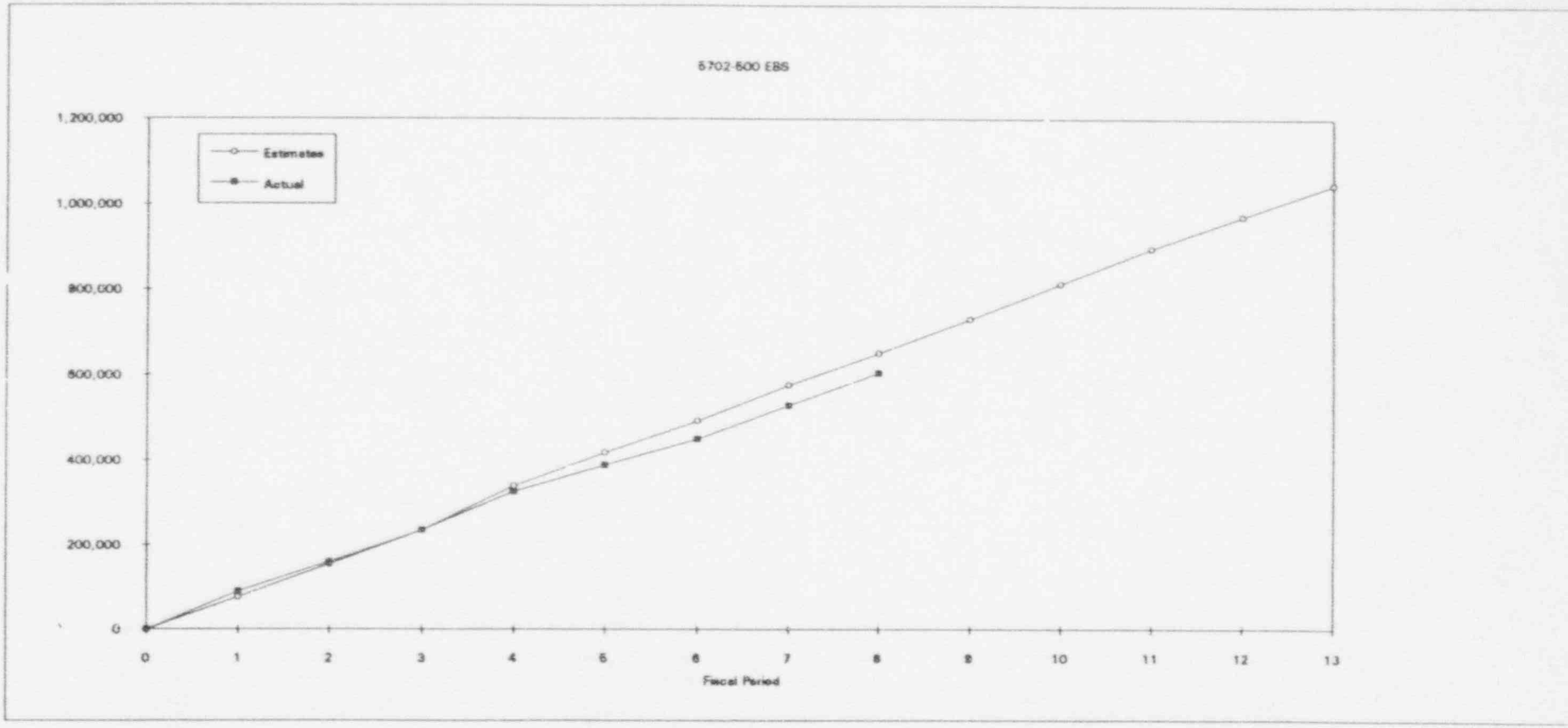
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	119,827	123,641	118,376	151,465	121,502	121,740	122,552	122,722	120,476	122,817	118,103	123,956	117,767	1,001,825
ACT. PERIOD COST	98,078	98,795	83,026	102,918	135,074	173,506	154,749	135,897	0	0	0	0	0	982,043
VARIANCE, $	21,749	24,846	35,350	48,547	(13,572)	(51,766)	(32,197)	(13,175)	0	0	0	0	0	19,782
VARIANCE, %	18.1%	20.1%	29.9%	32.1%	-11.2%	-42.5%	-26.3%	-10.7%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%
EST. FY CUMUL	119,827	243,468	361,844	513,309	634,811	756,551	879,103	1,001,825	1,122,301	1,245,118	1,363,221	1,487,177	1,604,944	
ACTUAL FY CUMUL	98,078	196,874	279,900	382,818	517,891	691,397	846,146	982,043	0	0	0	0	0	
PERCENT COMPLETE	6.1%	12.3%	17.4%	23.9%	32.3%	43.1%	52.7%	61.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	21,749	46,594	81,944	130,491	116,920	65,154	32,957	19,782	0	0	0	0	0	
VARIANCE, %	18.1%	19.1%	22.6%	25.4%	18.4%	8.6%	3.7%	2.0%	0.0%	0.0%	0.0%	0.0%	0.0%	



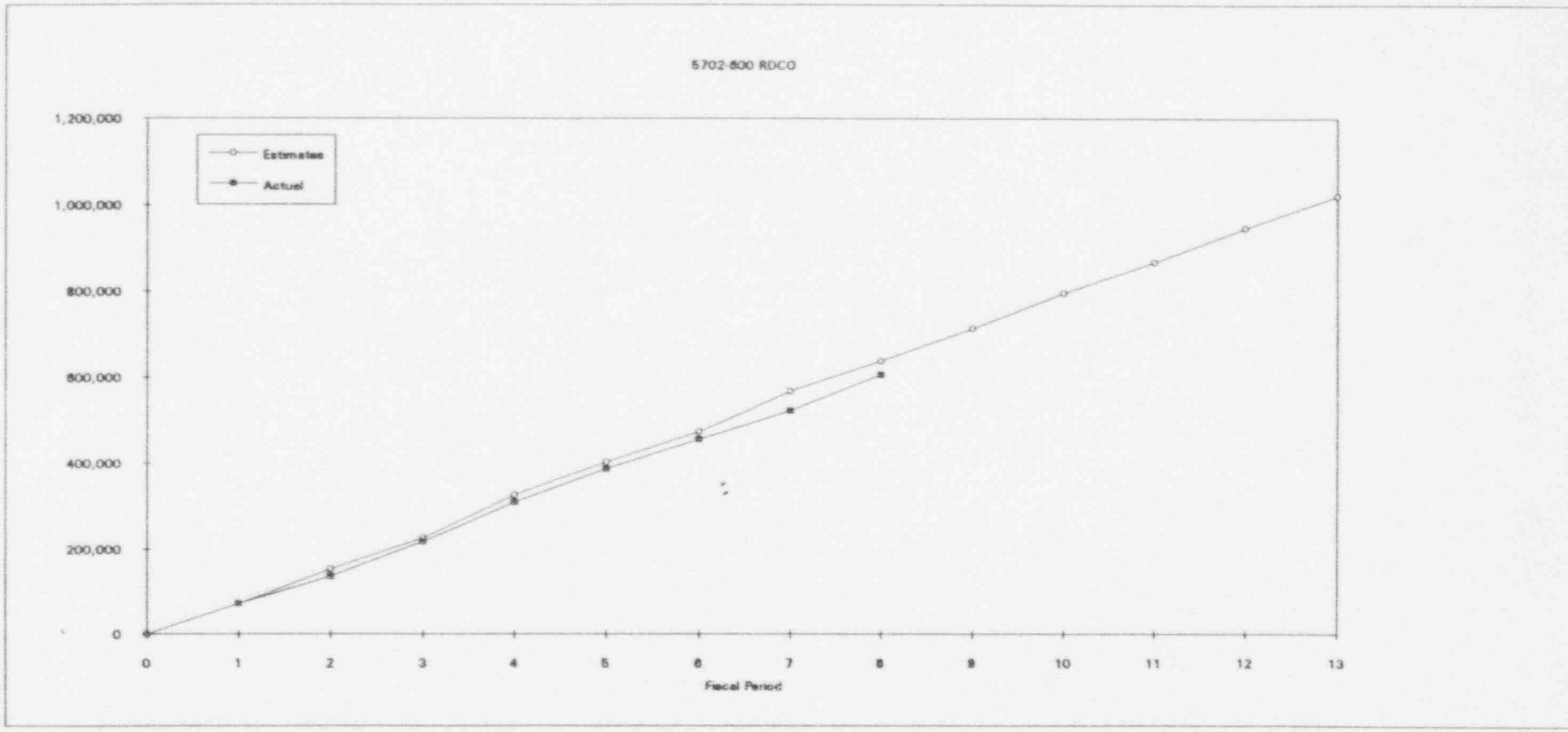
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	9,472	13,130	9,619	17,387	9,419	9,745	24,398	9,543	9,395	15,020	9,619	13,130	9,543	102,713
ACT. PERIOD COST	5,931	6,298	9,795	3,003	12,542	5,524	4,459	11,051	0	0	0	0	0	58,601
VARIANCE, $	3,541	6,834	(176)	14,384	(3,123)	4,221	19,939	(1,508)	0	0	0	0	0	44,112
VARIANCE, %	37.4%	52.0%	-1.8%	82.7%	-33.2%	43.3%	81.7%	-15.8%	0.0%	0.0%	0.0%	0.0%	0.0%	42.9%
EST. FY CUMUL	9,472	22,602	32,221	49,608	59,027	68,772	93,170	102,713	112,108	127,128	136,747	149,877	159,420	
ACTUAL FY CUMUL	5,931	12,227	22,022	25,025	37,567	43,091	47,550	58,601	0	0	0	0	0	
PERCENT COMPLETE	3.7%	7.7%	13.8%	15.7%	23.6%	27.0%	29.8%	36.8%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	3,541	10,375	10,199	24,583	21,460	25,681	45,620	44,112	0	0	0	0	0	
VARIANCE, %	37.4%	15.9%	31.7%	49.6%	36.4%	37.3%	49.0%	42.9%	0.0%	0.0%	0.0%	0.0%	0.0%	



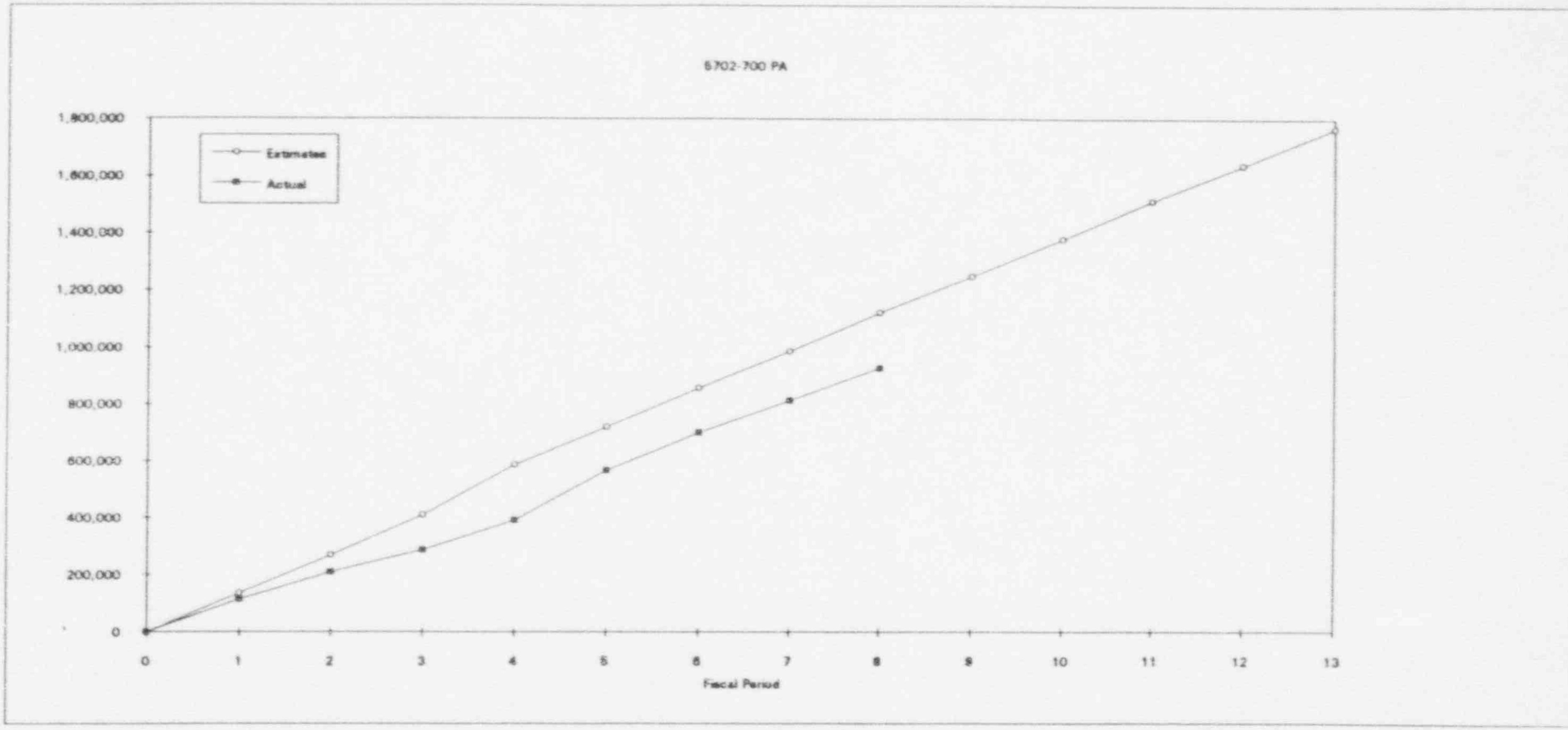
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	85,199	89,534	91,76[illegible]	124,743	88,111	88,443	112,570	90,681	94,493	108,147	96,917	94,226	91,166	771,050
ACT. PERIOD COST	103,969	104,642	78,620	126,025	107,488	120,307	113,676	127,81[illegible]	0	0	0	0	0	882,639
VARIANCE, $	(18,770)	(15,108)	13,149	(1,282)	(19,377)	(31,864)	(1,106)	(37,230)	0	0	0	0	0	(111,589)
VARIANCE, %	-22.0%	-16.9%	14.3%	-1.0%	-22.0%	-36.0%	-1.0%	-41.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-14.5%
EST. FY CUMUL	85,199	174 733	266,502	391,245	479,356	567,799	680,369	771,050	865,543	973,690	1,070,607	1,164,833	1,255,999	
ACTUAL FY CUMUL	103,969	208,611	287,232	413,257	520,745	641,052	754,728	882,639	0	0	0	0	0	
PERCENT COMPLETE	8.3%	16.6%	22.9%	32.9%	41.5%	51.0%	60.1%	70.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(18,770)	(33,878)	(20,730)	(22,012)	(41,389)	(73,253)	(74,359)	(111,589)	0	0	0	0	0	
VARIANCE, %	-22.0%	-19.4%	-7.8%	-5.6%	-8.6%	-12.9%	-10.9%	-14.5%	0.0%	0.0%	0.0%	0.0%	0.0%	



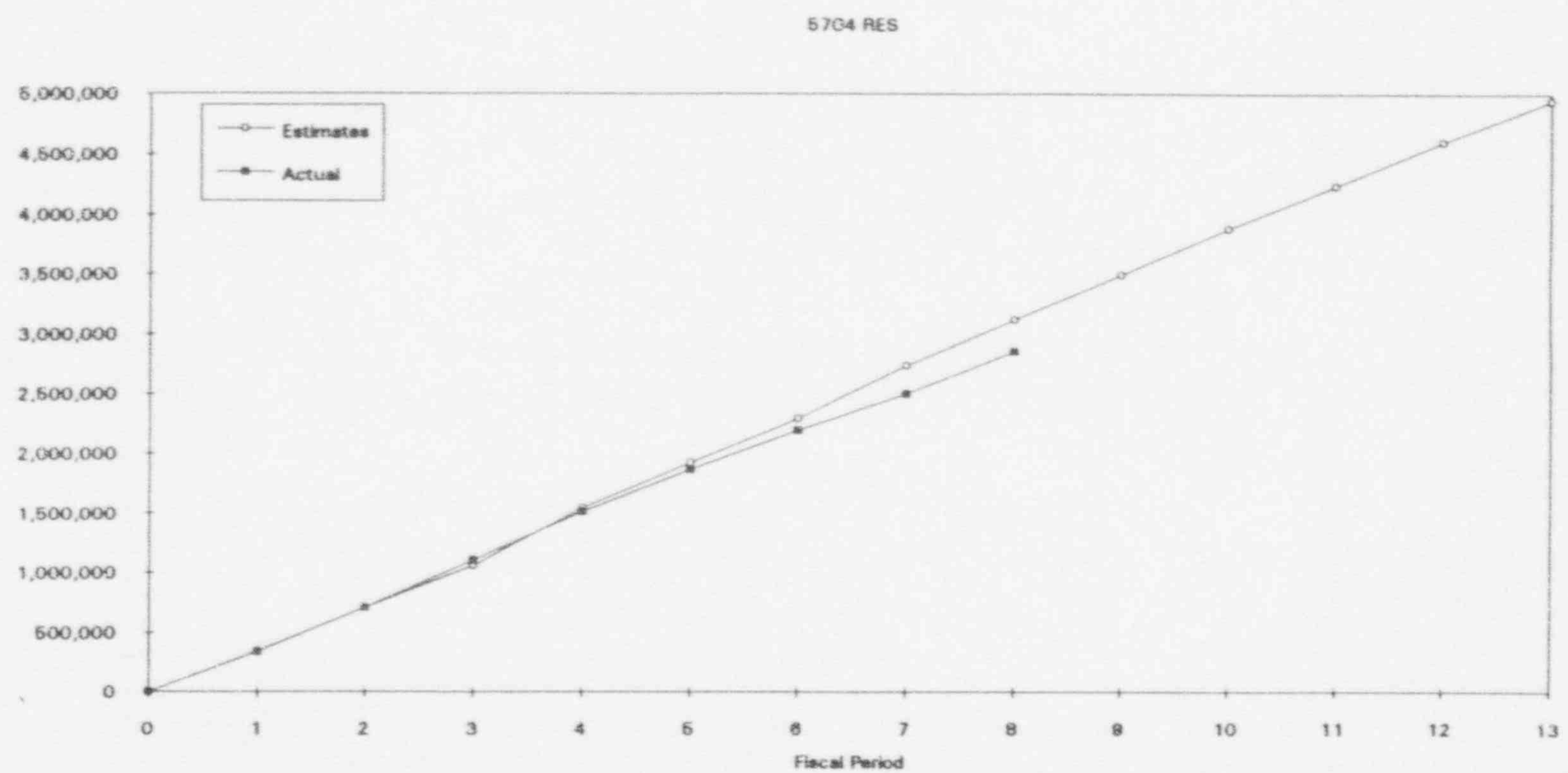
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	76,356	76,589	81,729	103,642	77,971	75,208	84,524	74,539	79,238	84,381	81,687	75,658	75,384	850,558
ACT. PERIOD COST	89,924	68,848	76,194	90,429	62,146	61,174	80,174	76,556	0	0	0	0	0	605,446
VARIANCE, $	(13,568)	7,741	5,535	13,213	15,825	14,034	4,350	(2,017)	0	0	0	0	0	45,112
VARIANCE, %	-17.8%	10.1%	6.8%	12.7%	20.3%	18.7%	5.1%	-2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	6.9%
EST. FY CUMUL	76,356	152,945	234,674	338,3[illegible]6	416,287	491,495	576,019	650,558	729,796	814,177	895,864	971,522	1,046,906	
ACTUAL FY CUMUL	89,924	158,773	234,967	325,396	387,542	448,716	528,890	605,446	0	0	0	0	0	
PERCENT COMPLETE	8.6%	15.2%	22.4%	31.1%	37.0%	42.9%	50.5%	57.8%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(13,568)	(5,828)	(293)	12,920	28,745	42,779	47,130	45,112	0	0	0	0	0	
VARIANCE, %	-17.8%	-3.8%	-0.1%	3.8%	6.9%	8.7%	8.2%	6.9%	0.0%	0.0%	0.0%	0.0%	0.0%	



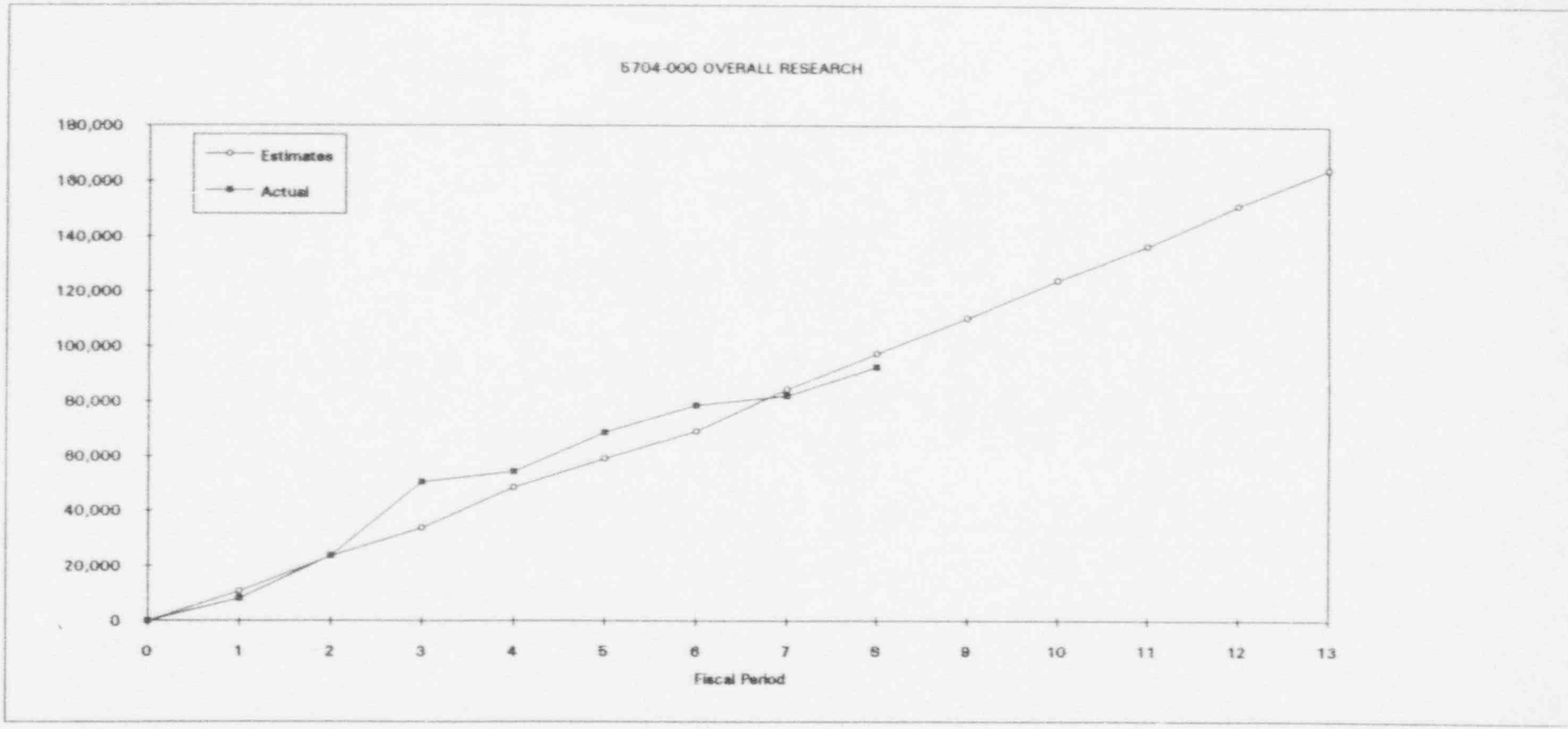
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	72,685	80,430	73,220	99,845	76,147	72,059	93,419	70,965	75,924	80,708	72,414	79,689	72,757	638,770
ACT. PERIOD COST	72,067	64,548	81,312	92,428	76,019	69,791	67,524	82,685	0	0	0	0	0	606,375
VARIANCE, $	618	15,882	(8,092)	7,417	128	2,268	25,895	(11,720)	0	0	0	0	0	32,395
VARIANCE, %	0.8%	19.7%	-11.1%	7.4%	0.2%	3.1%	27.7%	-16.5%	0.0%	0.0%	0.0%	0.0%	0.0%	5.1%
EST. FY CUMUL	72,685	153,115	226,335	326,180	402,327	474,386	567,805	638,770	714,694	795,402	867,816	947,505	1,020,262	
ACTUAL FY CUMUL	72,067	136,615	217,927	310,355	386,374	456,165	523,689	606,375	0	0	0	0	0	
PERCENT COMPLETE	7.1%	13.4%	21.4%	30.4%	37.9%	44.7%	51.3%	59.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	618	16,500	8,408	15,825	15,953	18,221	44,116	32,395	0	0	0	0	0	
VARIANCE, %	0.8%	10.8%	3.7%	4.9%	4.0%	3.8%	7.8%	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	



ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST. PERIOD COST	136,124	133,325	139,983	175,656	135,966	135,458	128,774	136,180	128,950	130,630	132,540	126,900	129,145	1,121,466
ACT. PERIOD COST	114,173	95,819	77,432	104,378	174,763	133,941	111,280	114,014	0	0	0	0	0	925,799
VARIANCE, $	21,951	37,506	62,551	71,278	(38,797)	1,517	17,494	22,166	0	0	0	0	0	195,667
VARIANCE, %	16.1%	28.1%	44.7%	40.6%	-28.5%	1.1%	13.6%	16.3%	0.0%	0.0%	0.0%	0.0%	0.0%	17.4%
EST. FY CUMUL	136,124	269,449	409,432	585,088	721,054	856,512	985,298	1,121,466	1,248,416	1,379,046	1,511,586	1,638,486	1,767,631	
ACTUAL FY CUMUL	114,173	209,992	287,424	391,802	566,565	700,505	811,785	925,799	0	0	0	0	0	
PERCENT COMPLETE	6.5%	11.9%	16.3%	22.2%	32.1%	39.6%	45.9%	52.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	21,951	59,457	122,008	193,286	154,489	156,007	173,501	195,667	0	0	0	0	0	
VARIANCE, %	16.1%	22.1%	29.8%	33.0%	21.4%	18.2%	17.6%	17.4%	0.0%	0.0%	0.0%	0.0%	0.0%	

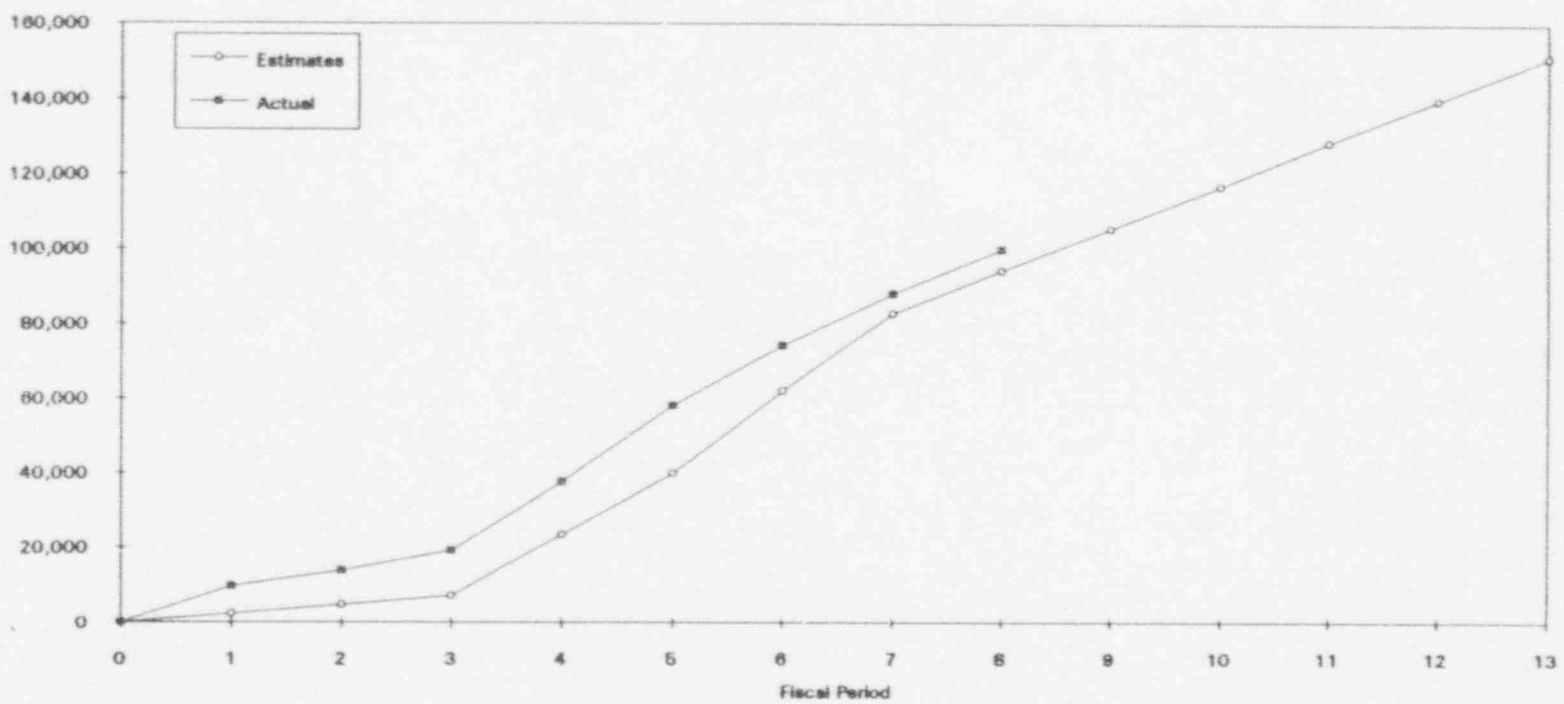


ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	345,037	360,641	350,759	489,674	373,097	375,287	443,430	378,904	371,967	391,344	357,089	365,466	343,321	3,116,829
ACT. PERIOD COST	342,323	364,760	399,889	404,182	350,424	330,940	305,497	356,554	0	0	0	0	0	2,854,569
VARIANCE, $	2,714	(4,119)	(49,130)	85,492	22,673	44,347	137,933	22,350	0	0	0	0	0	262,260
VARIANCE, %	0.8%	-1.1%	-14.0%	17.5%	6.1%	11.8%	31.1%	5.9%	0.0%	0.0%	0.0%	0.0%	0.0%	8.4%
EST. FY CUMUL	345,037	705,678	1,056,437	1,546,111	1,919,208	2,294,495	2,737,925	3,116,829	3,488,796	3,880,140	4,237,229	4,602,695	4,946,016	
ACTUAL FY CUMUL	342,323	707,083	1,106,972	1,511,154	1,861,578	2,192,518	2,498,015	2,854,569	0	0	0	0	0	
PERCENT COMPLETE	6.9%	14.3%	22.4%	30.6%	37.6%	44.3%	50.5%	57.7%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	2,714	(1,405)	(50,535)	34,957	57,630	101,977	239,910	262,260	0	0	0	0	0	
VARIANCE, %	0.8%	-0.2%	-4.8%	2.3%	3.0%	4.4%	8.8%	8.4%	0.0%	0.0%	0.0%	0.0%	0.0%	

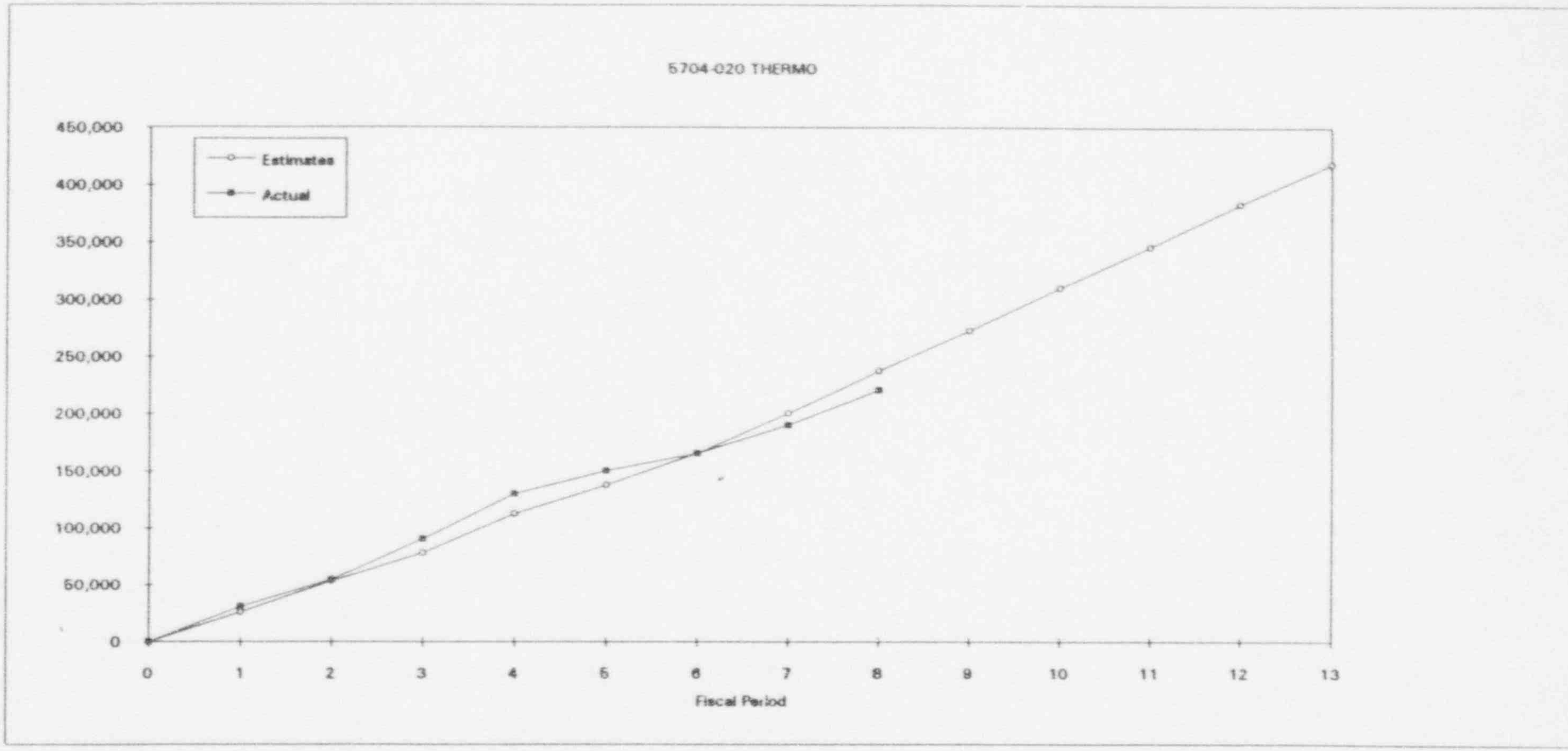


ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	10,705	12,830	10,214	14,593	10,754	9,785	15,443	13,077	12,921	13,823	12,357	14,972	12,920	97,401
ACT. PERIOD COST	8,084	15,638	26,636	3,894	14,289	9,817	3,571	10,693	0	0	0	0	0	92,622
VARIANCE, $	2,621	(2,808)	(16,422)	10,699	(3,535)	(32)	11,872	2,384	0	0	0	0	0	4,779
VARIANCE, %	24.5%	-21.9%	-160.8%	73.3%	-32.9%	-0.3%	76.9%	18.2%	0.0%	0.0%	0.0%	0.0%	0.0%	4.9%
EST. FY CUMUL	10,705	23,535	33,749	48,342	59,096	68,881	84,324	97,401	110,322	124,145	136,502	151,474	164,394	
ACTUAL FY CUMUL	8,084	23,721	50,357	54,252	68,541	78,358	81,929	92,622	0	0	0	0	0	
PERCENT COMPLETE	4.9%	14.4%	30.6%	33.0%	41.7%	47.7%	49.8%	56.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	2,621	(186)	(16,608)	(5,910)	(9,445)	(9,477)	2,395	4,779	0	0	0	0	0	
VARIANCE, %	24.5%	-0.8%	-49.2%	-12.2%	-16.0%	-13.8%	2.8%	4.9%	0.0%	0.0%	0.0%	0.0%	0.0%	

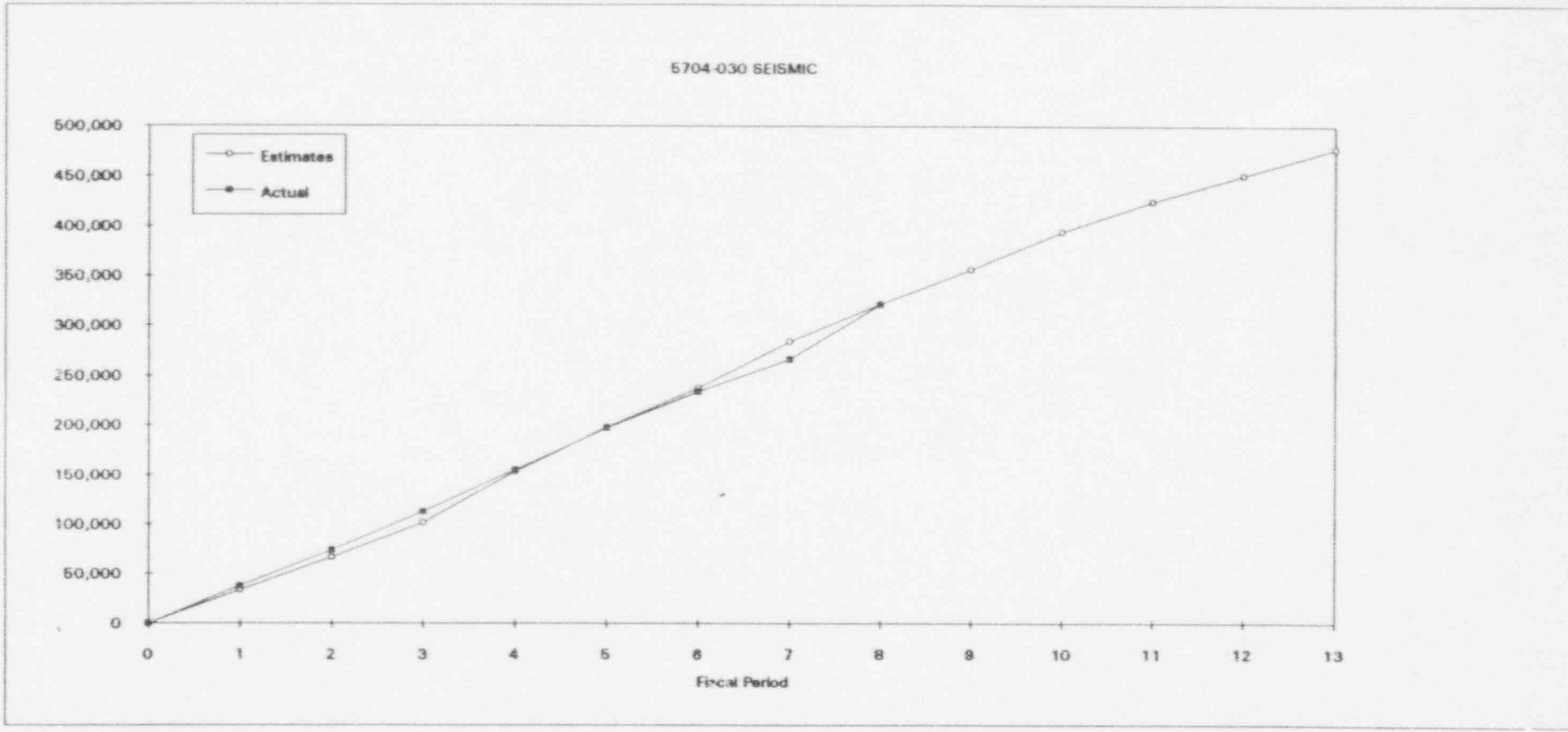
5704-010 GEOCHEMISTRY



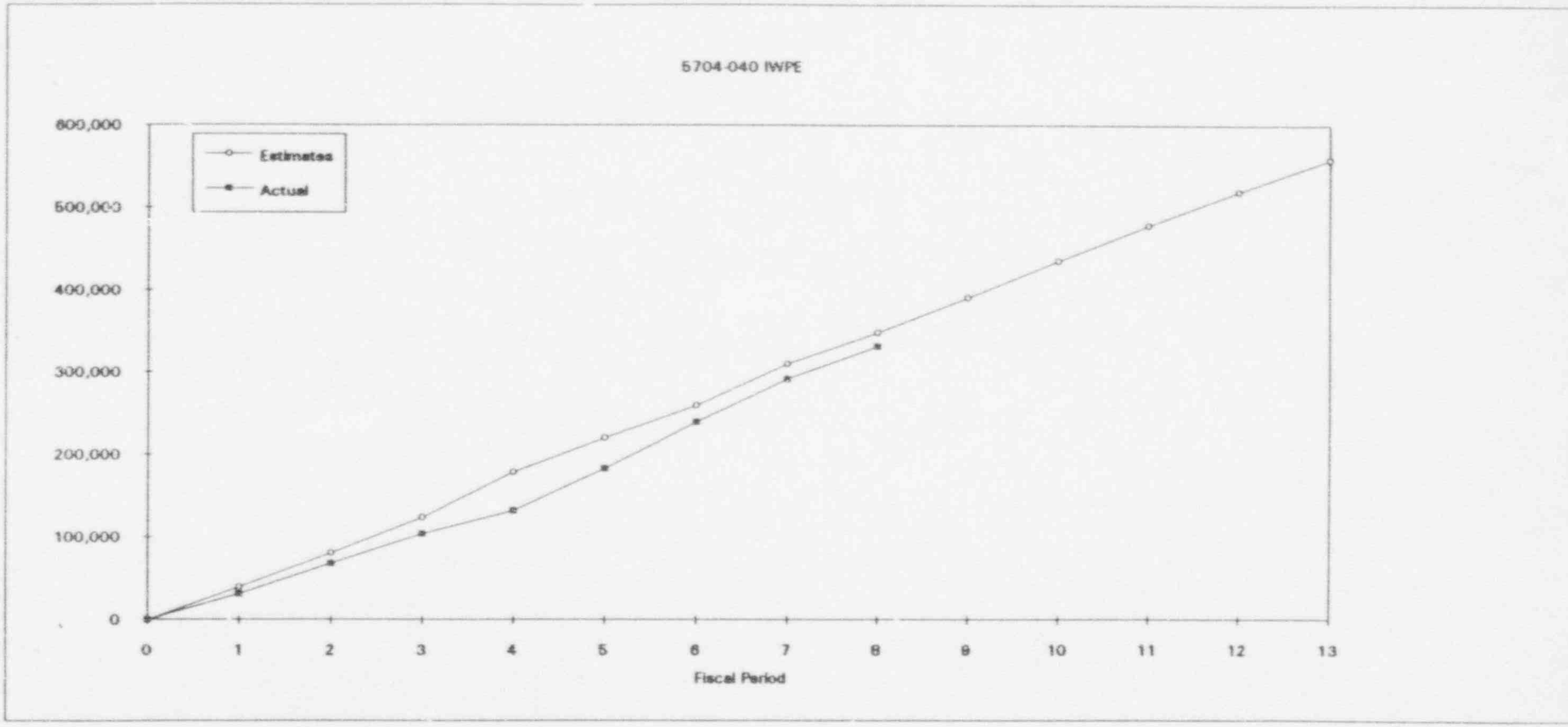
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	2,381	2,292	2,502	16,354	16,354	21,997	20,844	11,366	11,366	11,366	11,461	11,461	11,463	94,090
ACT. PERIOD COST	9,570	4,153	5,451	18,497	20,566	15,808	13,968	11,840	0	0	0	0	0	99,853
VARIANCE, $	(7,189)	(1,861)	(2,949)	(2,143)	(4,212)	6,189	6,877	(474)	0	0	0	0	0	(5,763)
VARIANCE, %	-301.9%	-81.2%	-117.9%	-13.1%	-25.8%	28.1%	33.0%	-4.2%	0.0%	0.0%	0.0%	0.0%	0.0%	-6.1%
EST. FY CUMUL	2,381	4,673	7,175	23,529	39,883	61,880	82,724	94,090	105,456	116,822	128,283	139,744	151,207	
ACTUAL FY CUMUL	9,570	13,723	19,174	37,671	58,238	74,045	88,013	99,853	0	0	0	0	0	
PERCENT COMPLETE	6.3%	9.1%	12.7%	24.9%	38.5%	49.0%	58.2%	66.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(7,189)	(9,050)	(11,999)	(14,142)	(18,355)	(12,165)	(5,289)	(5,763)	0	0	0	0	0	
VARIANCE, %	-301.9%	-193.7%	-167.2%	-60.1%	-46.0%	-19.7%	-6.4%	-6.1%	0.0%	0.0%	0.0%	0.0%	0.0%	



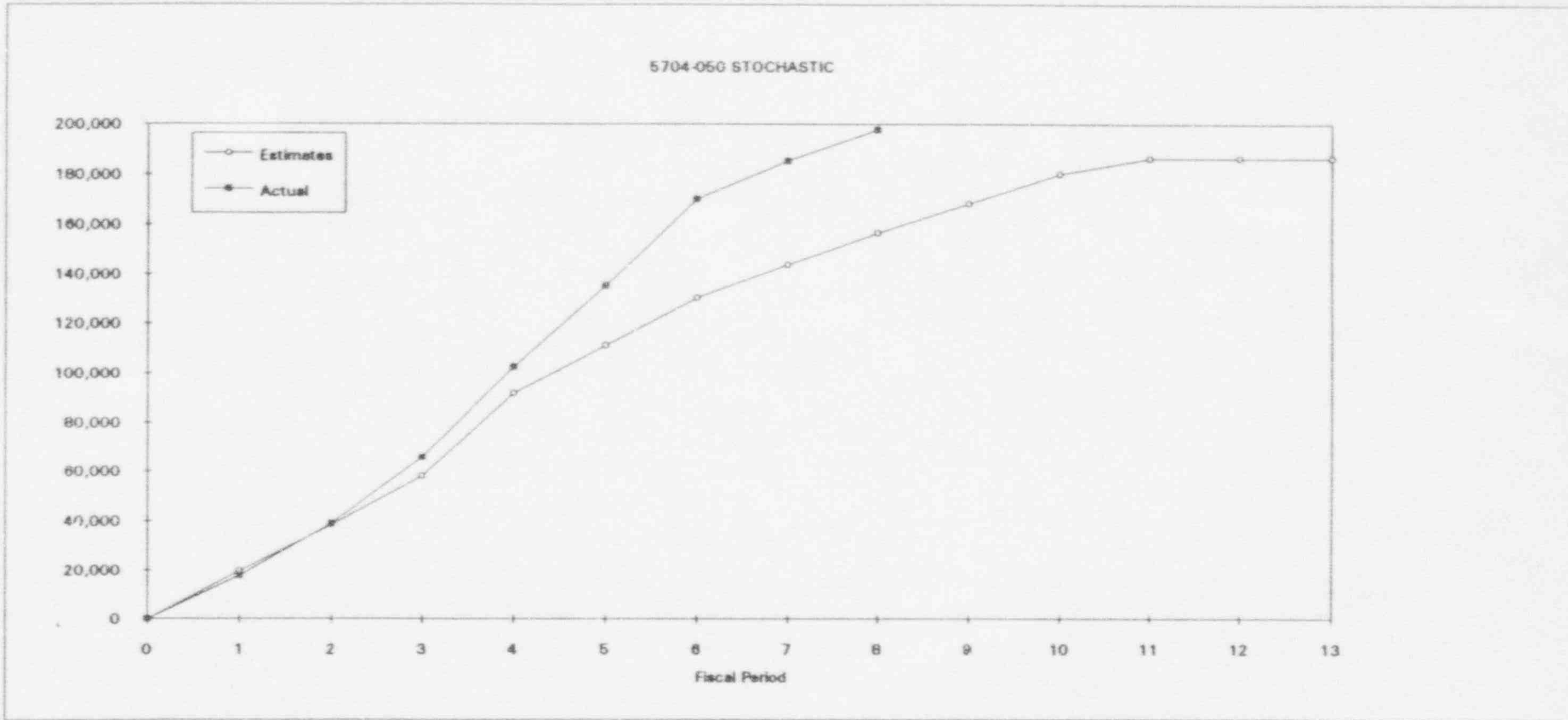
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	25,828	27,200	25,454	33,994	24,997	27,909	34,995	37,396	35,396	37,360	35,467	37,064	35,700	237,773
ACT. PERIOD COST	30,464	24,159	35,990	39,219	20,617	15,183	24,777	30,868	0	0	0	0	0	221,276
VARIANCE, $	(4,636)	3,041	(10,536)	(5,225)	4,380	12,726	10,218	6,528	0	0	0	0	0	16,497
VARIANCE, %	-18.0%	11.2%	-41.4%	-15.4%	17.5%	45.6%	29.2%	17.5%	0.0%	0.0%	0.0%	0.0%	0.0%	6.9%
EST. FY CUMUL	25,828	53,028	78,482	112,476	137,473	165,382	200,377	237,773	273,169	310,529	345,996	383,060	418,760	
ACTUAL FY CUMUL	30,464	54,623	90,613	129,832	150,449	165,632	190,408	221,276	0	0	0	0	0	
PERCENT COMPLETE	7.3%	13.0%	21.6%	31.0%	35.9%	39.6%	45.5%	52.8%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(4,636)	(1,595)	(12,131)	(17,356)	(12,976)	(250)	9,969	16,497	0	0	0	0	0	
VARIANCE, %	-18.0%	-3.0%	-15.5%	-15.4%	-9.4%	-0.2%	5.0%	6.9%	0.0%	0.0%	0.0%	0.0%	0.0%	



ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	33,622	33,080	34,675	51,591	45,249	39,412	46,631	37,487	34,798	37,497	30,447	26,518	26,679	321,747
ACT. PERIOD COST	37,662	36,655	38,201	42,511	42,271	36,476	32,597	54,679	0	0	0	0	0	321,052
VARIANCE, $	(4,040)	(3,575)	(3,526)	9,080	2,978	2,936	14,034	(17,192)	0	0	0	0	0	695
VARIANCE, %	-12.0%	-10.8%	-10.2%	17.6%	6.6%	7.4%	30.1%	-45.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
EST. FY CUMUL	33,622	66,702	101,377	152,968	198,217	237,629	284,260	321,747	356,545	394,042	424,489	451,007	477,686	
ACTUAL FY CUMUL	37,662	74,317	112,518	155,028	197,299	233,776	266,3[illegible]	321,052	0	0	0	0	0	
PERCENT COMPLETE	7.9%	15.6%	23.6%	32.5%	41.3%	48.9%	55.8%	67.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(4,040)	(7,615)	(11,141)	(2,060)	918	3,853	17,887	695	0	0	0	0	0	
VARIANCE, %	-12.0%	-11.4%	-11.0%	-1.3%	0.5%	1.6%	6.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	

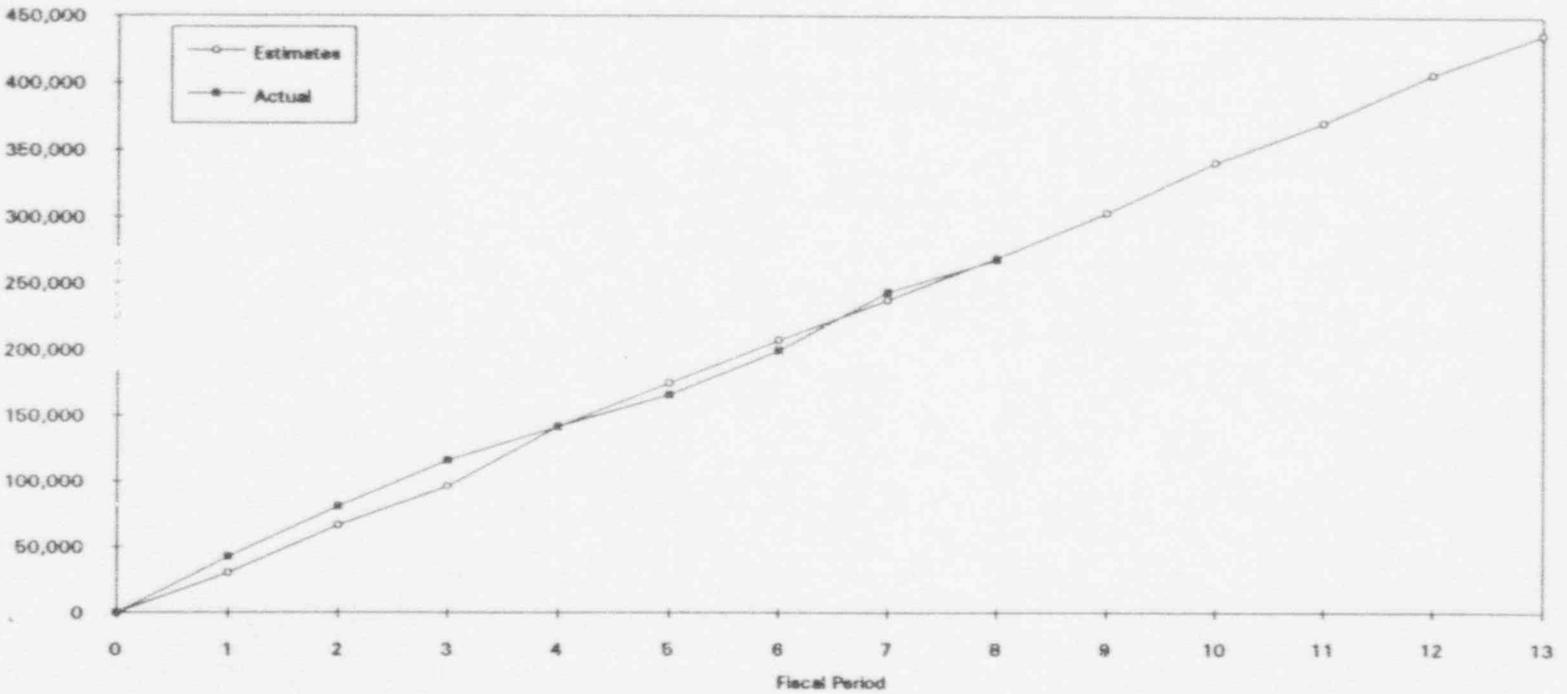


ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	39,126	41,310	43,232	54,736	41,652	38,840	50,775	38,681	42,344	44,233	43,218	41,167	39,654	348,352
ACT. PERIOD COST	31,353	36,368	35,843	28,347	50,692	56,819	51,580	40,435	0	0	0	0	0	331,436
VARIANCE, $	7,773	4,942	7,389	26,389	(9,040)	(17,979)	(805)	(1,754)	0	0	0	0	0	16,916
VARIANCE, %	19.9%	12.0%	17.1%	48.2%	-21.7%	-46.3%	-1.6%	-4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	4.9%
EST. FY CUMUL	39,126	80,436	123,668	178,404	220,056	258,896	309,671	348,352	390,696	434,929	478,147	519,314	558,968	
ACTUAL FY CUMUL	31,353	67,721	103,564	131,911	182,603	239,422	291,001	331,436	0	0	0	0	0	
PERCENT COMPLETE	5.6%	12.1%	18.5%	23.6%	32.7%	42.8%	52.1%	59.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	7,773	12,715	20,104	46,493	37,453	19,474	18,670	16,916	0	0	0	0	0	
VARIANCE, %	19.9%	15.8%	16.3%	26.1%	17.0%	7.5%	6.0%	4.9%	0.0%	0.0%	0.0%	0.0%	0.0%	

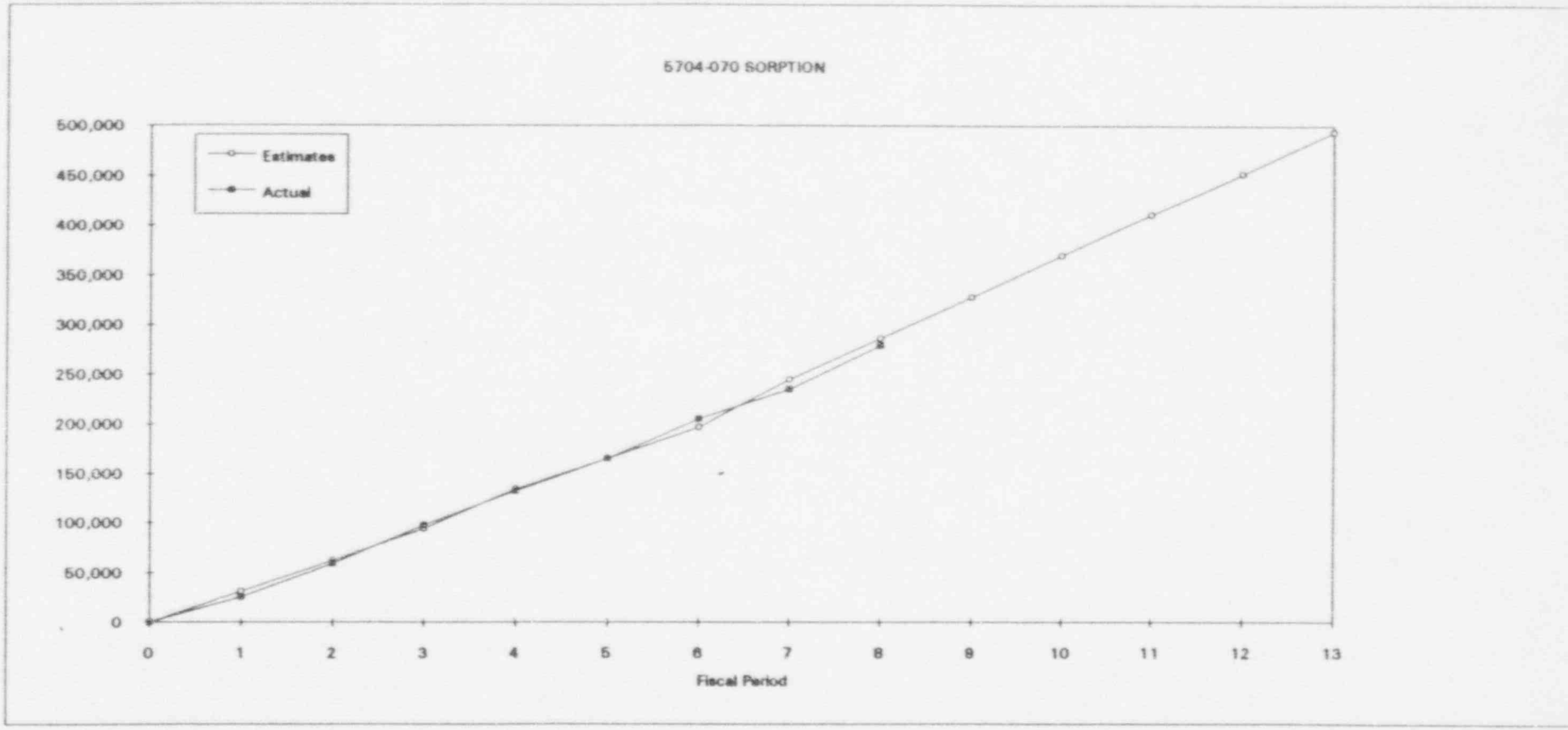


ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	19,575	18,792	19,603	33,801	19,404	19,049	13,384	12,796	11,900	11,900	6,297	0	0	156,410
ACT. PERIOD COST	17,707	21,171	26,808	36,731	32,646	34,990	15,381	12,314	0	0	0	0	0	197,747
VARIANCE, $	1,868	(2,379)	(7,197)	(2,930)	(13,242)	(15,941)	(1,997)	482	0	0	0	0	0	(41,337)
VARIANCE, %	9.5%	-12.7%	-36.7%	-8.7%	-68.2%	-83.7%	-14.9%	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	-26.4%
EST. FY CUMUL	19,575	38,367	57,976	91,777	111,181	130,230	143,614	156,410	168,310	180,210	186,507	186,507	186,507	
ACTUAL FY CUMUL	17,707	38,878	65,684	102,415	135,062	170,052	185,433	197,747	0	0	0	0	0	
PERCENT COMPLETE	9.5%	20.8%	35.2%	54.9%	72.4%	91.2%	99.4%	106.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	1,868	(511)	(7,708)	(10,638)	(23,881)	(39,822)	(41,819)	(41,337)	0	0	0	0	0	
VARIANCE, %	9.5%	-1.3%	-13.3%	-11.6%	-21.5%	-30.6%	-29.1%	-26.4%	0.0%	0.0%	0.0%	0.0%	0.0%	

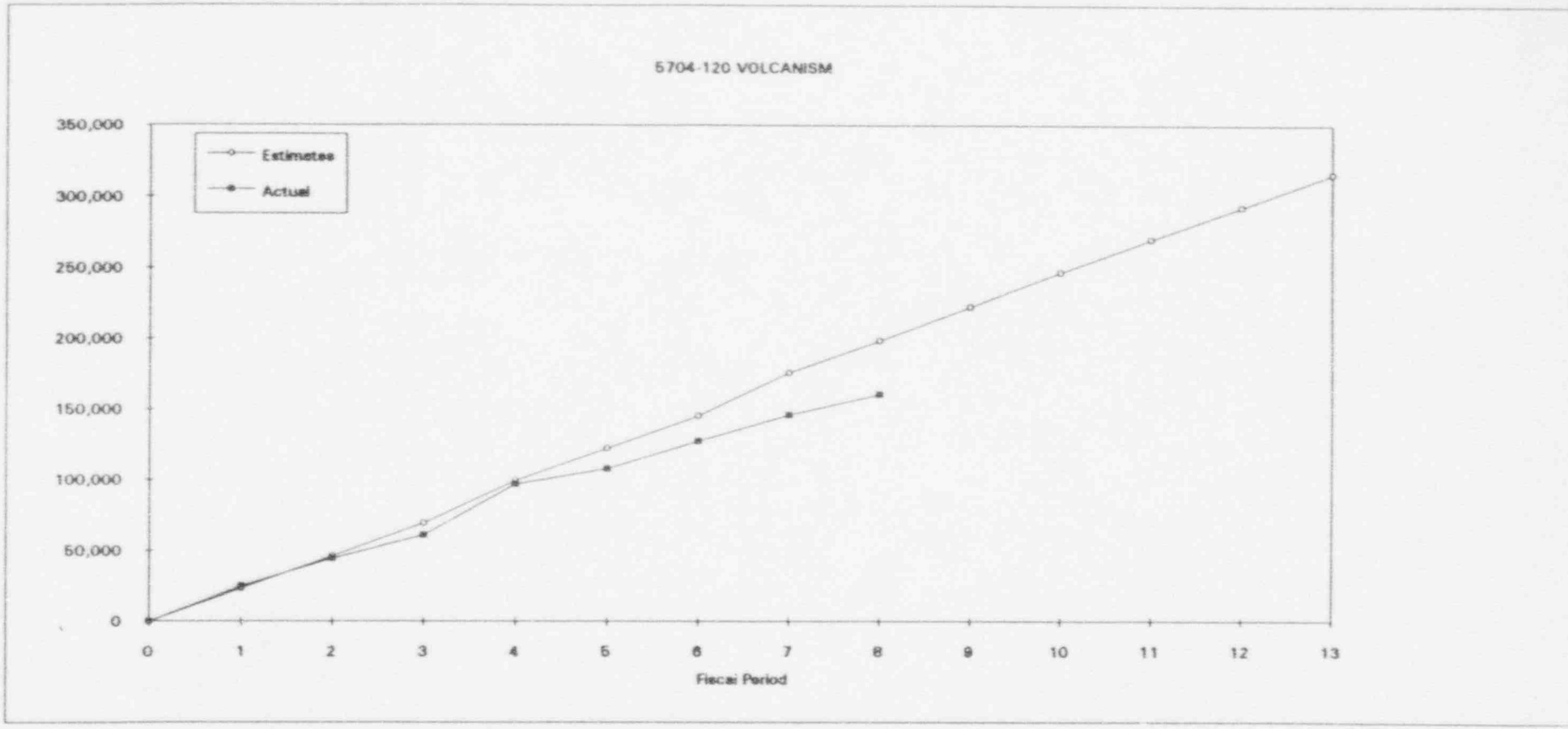
5704-060 ANALOGS



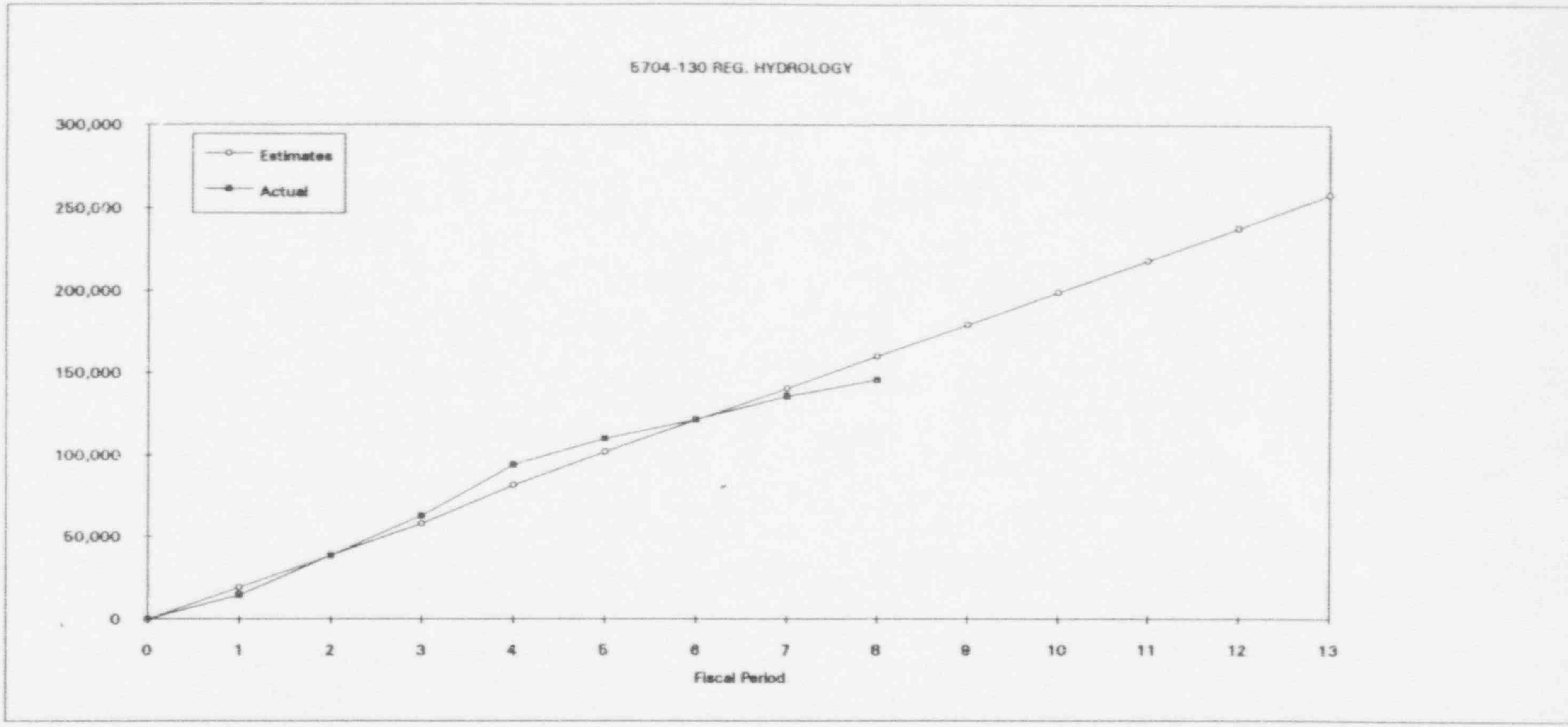
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	30,481	35,818	29,786	45,606	33,067	32,420	30,166	32,428	33,275	38,121	29,862	35,818	29,841	269,752
ACT. PERIOD COST	42,584	37,938	35,406	25,782	24,303	33,431	44,233	24,442	0	0	0	0	0	268,098
VARIANCE, $	(12,103)	(2,120)	(5,620)	19,824	8,764	(1,011)	(14,067)	7,987	0	0	0	0	0	1,654
VARIANCE, %	-39.7%	-5.9%	-18.9%	43.5%	26.5%	-3.1%	-46.6%	24.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%
EST. FY CUMUL	30,481	66,279	96,065	141,671	174,738	207,158	237,324	269,752	303,027	341,148	371,010	408,826	436,669	
ACTUAL FY CUMUL	42,584	80,502	115,908	141,690	165,992	199,424	243,656	268,098	0	0	0	0	0	
PERCENT COMPLETE	9.7%	18.4%	26.5%	32.4%	38.0%	45.7%	55.8%	61.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(12,103)	(14,223)	(19,843)	(19)	8,746	7,734	(6,332)	1,654	0	0	0	0	0	
VARIANCE, %	-39.7%	-21.5%	-20.7%	0.0%	5.0%	3.7%	-2.7%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	



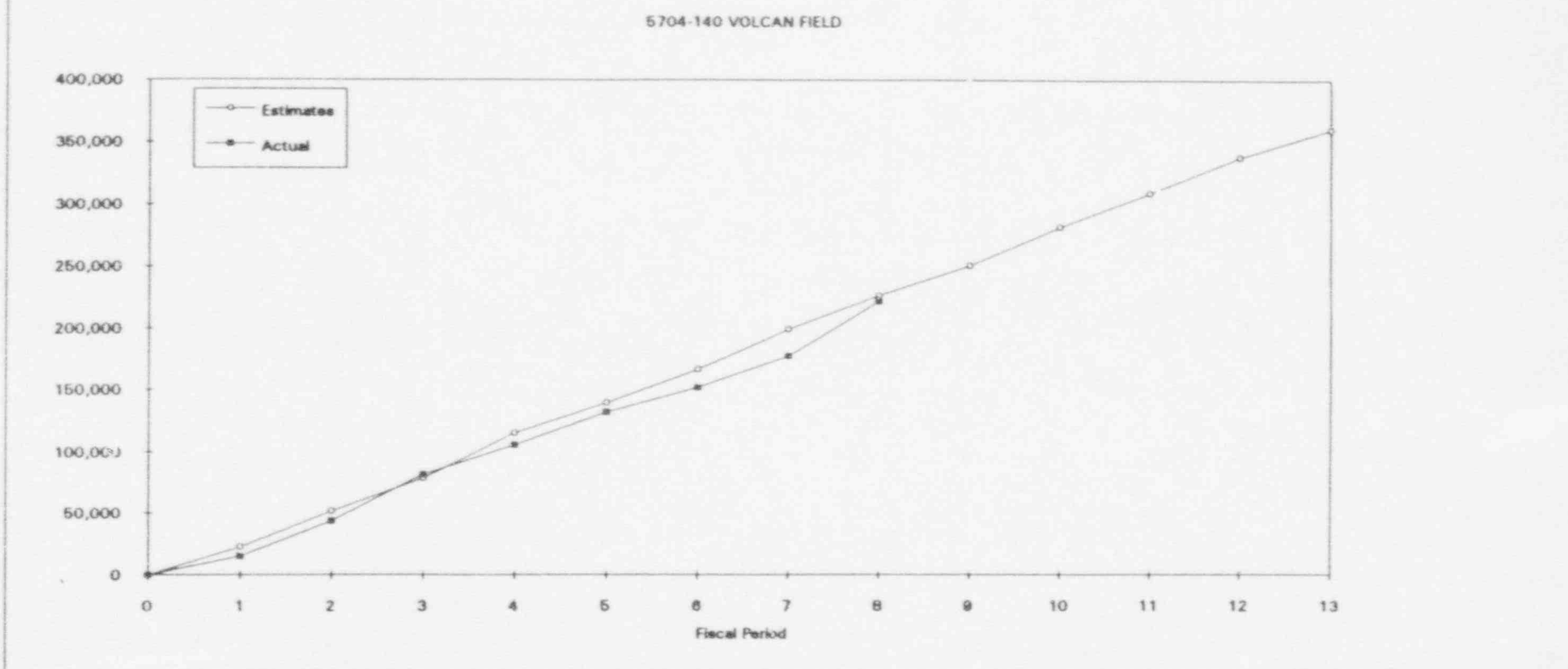
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	31,291	31,043	31,271	41,047	30,992	31,141	47,926	41,408	41,699	41,383	41,647	41,500	41,778	286,119
ACT. PERIOD COST	25,722	33,108	38,493	35,263	33,063	39,302	30,134	43,846	0	0	0	0	0	278,931
VARIANCE, $	5,569	(2,065)	(7,222)	5,784	(2,071)	(8,161)	17,792	(2,438)	0	0	0	0	0	7,188
VARIANCE, %	17.8%	-6.7%	-23.1%	14.1%	-6.7%	-26.2%	37.1%	-5.9%	0.0%	0.0%	0.0%	0.0%	0.0%	2.5%
EST. FY CUMUL	31,291	62,334	93,605	134,652	165,644	196,785	244,711	286,119	327,818	369,201	410,848	452,348	494,126	
ACTUAL FY CUMUL	25,722	58,830	97,323	132,586	165,649	204,951	235,085	278,931	0	0	0	0	0	
PERCENT COMPLETE	5.2%	11.9%	19.7%	26.8%	33.5%	41.5%	47.6%	56.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	5,569	3,504	(3,71[illegible]	2,066	(5)	(8,166)	9,626	7,188	0	0	0	0	0	
VARIANCE, %	17.8%	5.6%	-4.0%	1.5%	0.0%	-4.1%	3.9%	2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	



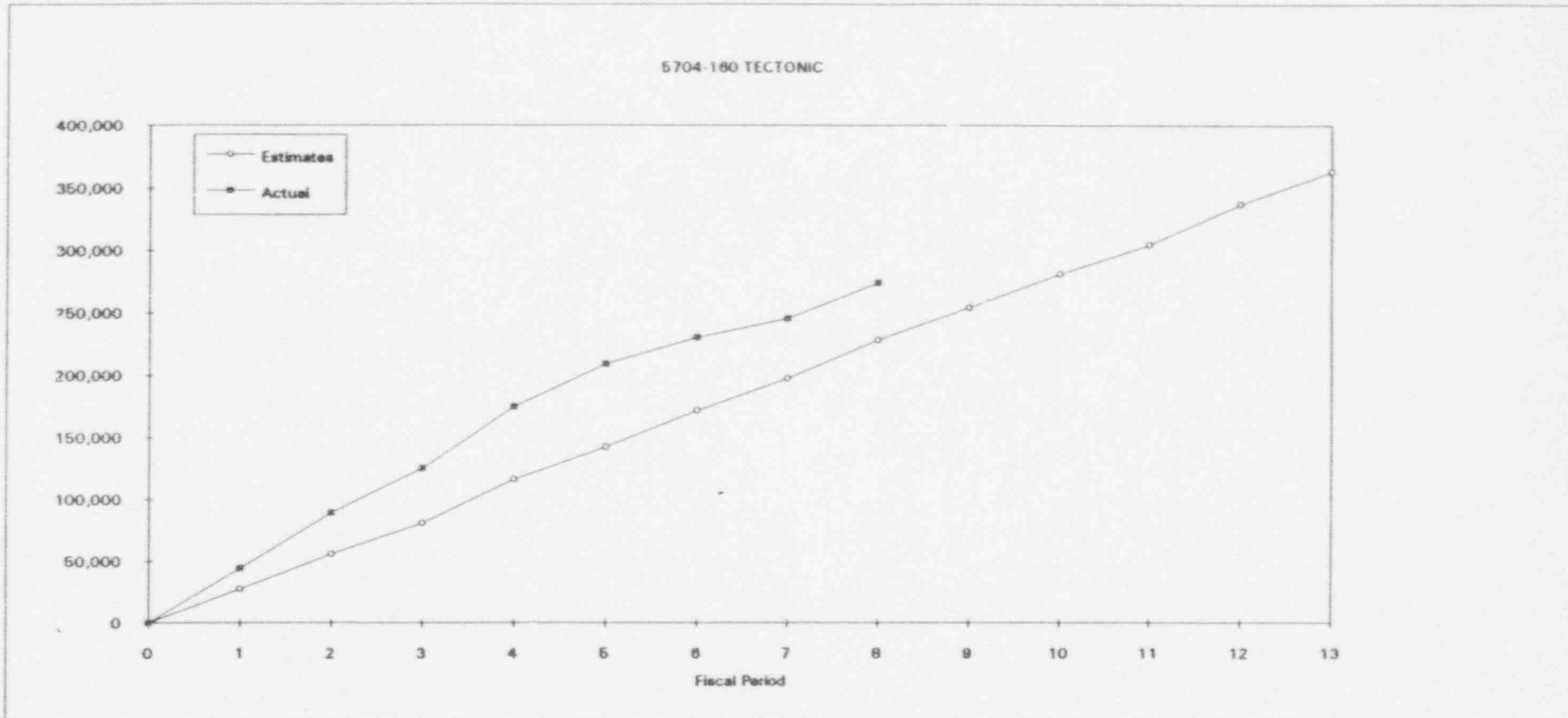
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	23,268	22,780	23,376	29,743	23,388	22,798	30,359	22,761	23,696	24,298	23,188	23,091	23,054	198,473
ACT. PERIOD COST	25,208	19,156	16,566	35,830	11,197	19,485	18,454	14,519	0	0	0	0	0	160,412
VARIANCE, $	(1,938)	3,624	6,810	(6,087)	12,191	3,313	11,905	8,242	0	0	0	0	0	38,061
VARIANCE, %	-8.3%	15.9%	29.1%	-20.5%	52.1%	14.5%	39.2%	36.2%	0.0%	0.0%	0.0%	0.0%	0.0%	19.2%
EST. FY CUMUL	23,268	46,048	69,424	99,167	122,555	145,353	175,712	198,473	222,169	246,467	269,655	292,746	315,800	
ACTUAL FY CUMUL	25,208	44,363	60,928	96,758	107,955	127,440	145,894	160,412	0	0	0	0	0	
PERCENT COMPLETE	8.0%	14.0%	19.3%	30.6%	34.2%	40.4%	46.2%	50.8%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(1,938)	1,685	8,496	2,409	14,600	17,913	29,818	38,061	0	0	0	0	0	
VARIANCE, %	-8.3%	3.7%	12.2%	2.4%	11.9%	12.3%	17.0%	19.2%	0.0%	0.0%	0.0%	0.0%	0.0%	



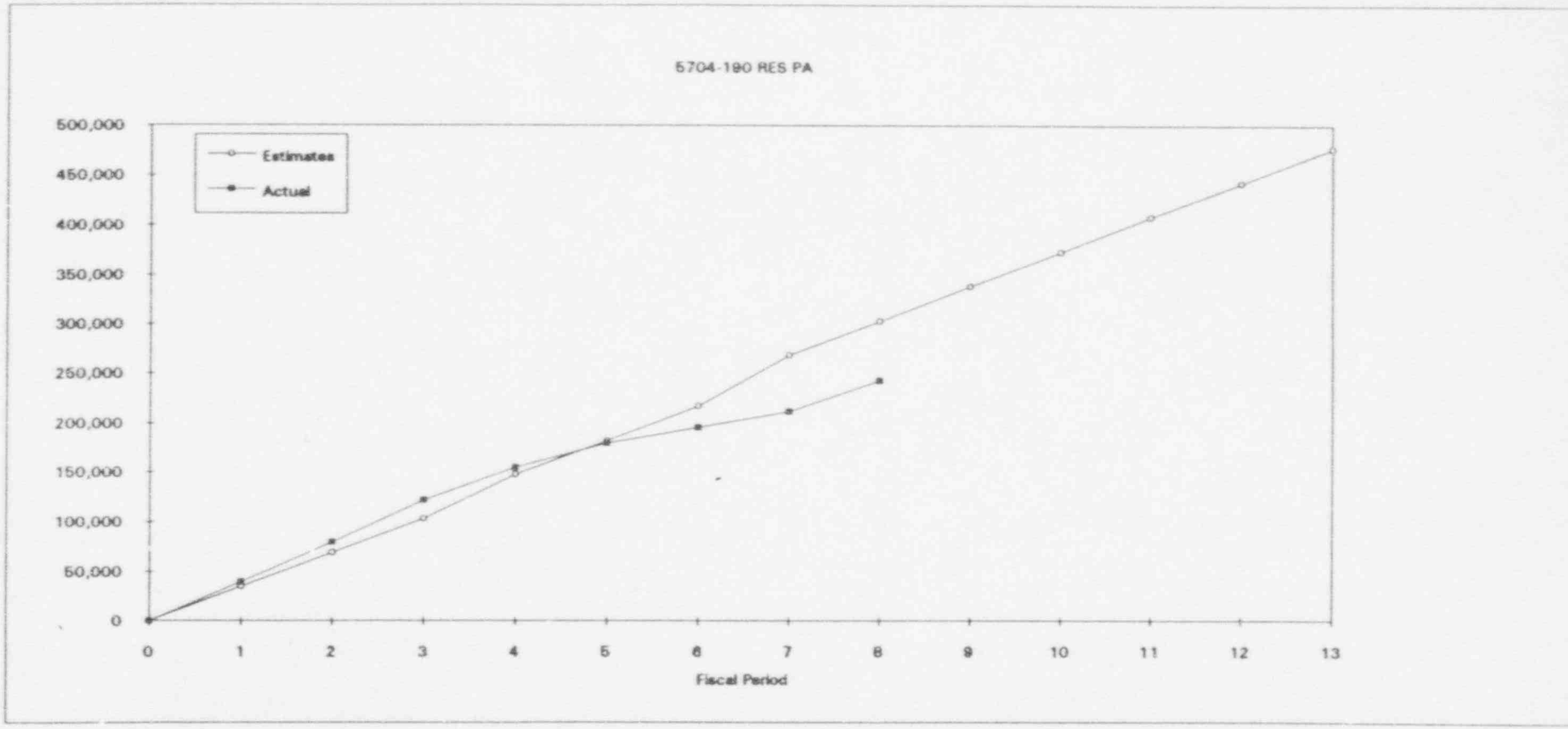
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	19,414	19,303	19,200	23,909	19,954	19,506	18,991	19,560	19,402	19,653	19,199	19,756	19,958	159,837
ACT. PERIOD COST	14,792	23,858	24,068	31,288	15,783	11,944	13,985	9,746	0	0	0	0	0	145,462
VARIANCE, $	4,622	(4,555)	(4,868)	(7,379)	4,171	7,562	5,006	9,814	0	0	0	0	0	14,375
VARIANCE, %	23.8%	-23.6%	-25.3%	-30.9%	20.9%	38.8%	26.4%	50.2%	0.0%	0.0%	0.0%	0.0%	0.0%	9.0%
EST. FY CUMUL	19,414	38,717	57,917	81,826	101,780	121,286	140,277	159,837	179,239	198,892	218,091	237,847	257,805	
ACTUAL FY CUMUL	14,792	38,650	62,716	94,004	109,787	121,731	135,716	145,462	0	0	0	0	0	
PERCENT COMPLETE	5.7%	15.0%	24.3%	36.5%	42.6%	47.2%	52.6%	56.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	4,622	67	(4,799)	(12,178)	(8,007)	(445)	4,561	14,375	0	0	C	0	0	
VARIANCE, %	23.8%	0.2%	-8.3%	-14.9%	-7.9%	-0.4%	3.3%	9.0%	0.0%	0.0%	0.0%	0.0%	0.0%	



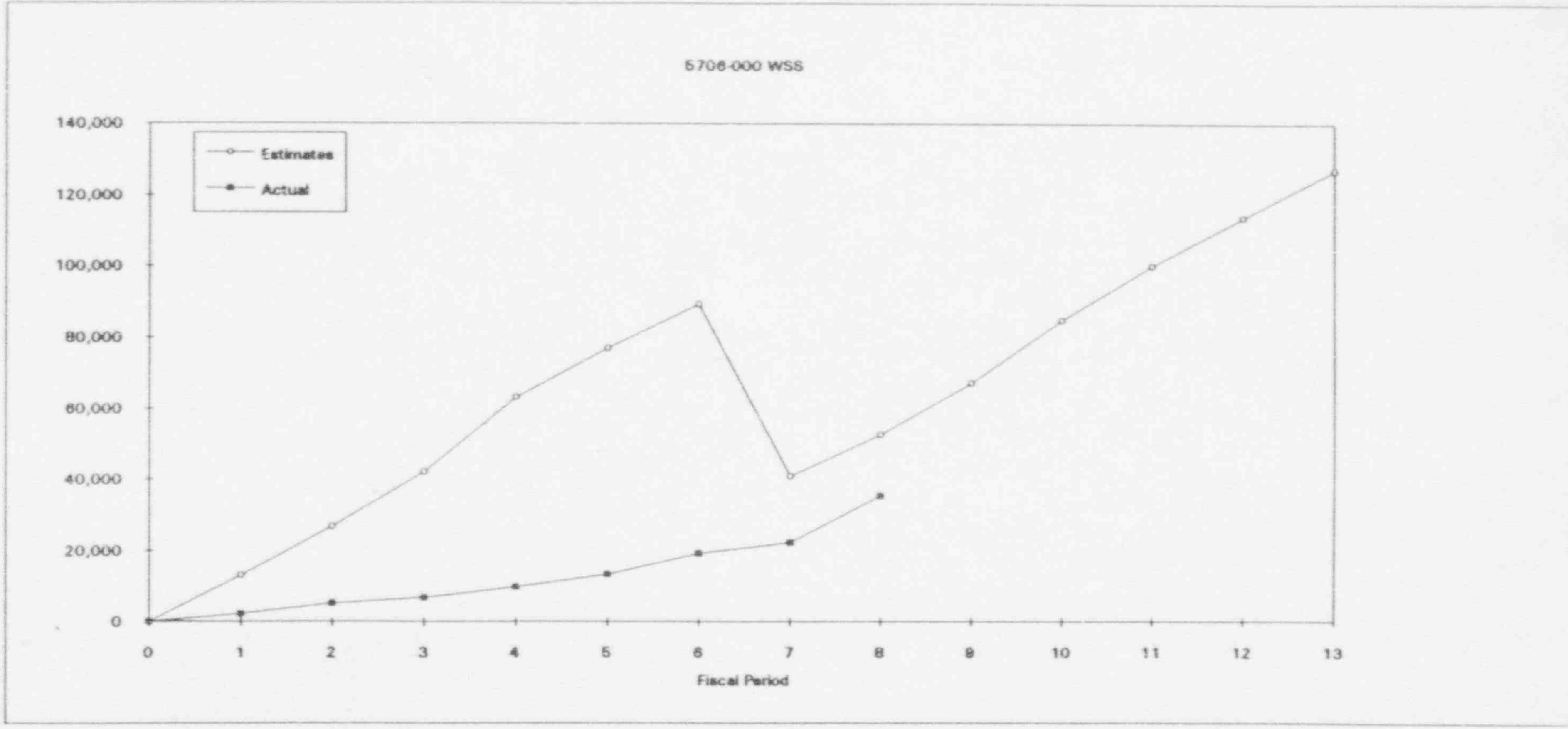
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	22,326	28,953	27,013	36,633	24,212	27,076	33,095	26,535	24,703	31,069	27,013	28,953	22,337	225,843
ACT. PERIOD COST	15,217	28,385	37,962	24,061	25,858	20,159	25,554	44,181	0	0	0	0	0	221,357
VARIANCE, $	7,109	568	(10,949)	12,573	(1,646)	6,917	7,541	(17,626)	0	0	0	0	0	4,486
VARIANCE, %	31.8%	2.0%	-40.5%	34.3%	-6.8%	25.5%	22.8%	-66.4%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%
EST. FY CUMUL	22,326	51,279	78,292	114,925	139,137	166,213	199,308	225,843	250,546	281,615	308,628	337,581	359,918	
ACTUAL FY CUMUL	15,217	43,602	81,564	105,625	131,483	151,643	177,196	221,357	0	0	0	0	0	
PERCENT COMPLETE	4.2%	12.1%	22.7%	29.3%	36.5%	42.1%	49.2%	61.5%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	7,109	7,677	(3,272)	9,300	7,654	14,570	22,112	4,486	0	0	0	0	0	
VARIANCE, %	31.8%	15.0%	-4.2%	8.1%	5.5%	8.8%	11.1%	2.0%	0.0%	0.0%	0.0%	0.0%	0.0%	



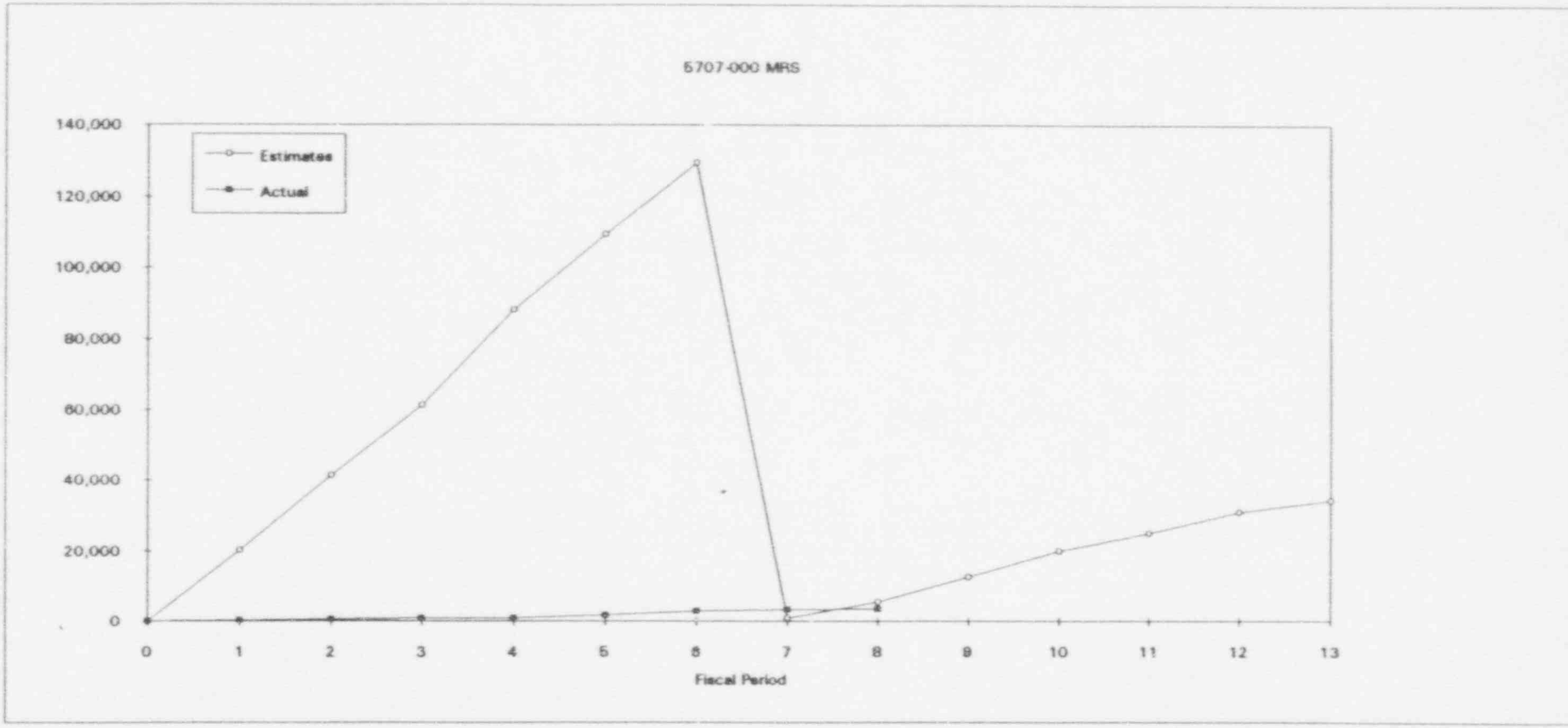
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	27,357	28,497	24,920	35,059	26,639	28,942	25,930	30,833	25,862	26,797	23,611	32,879	26,162	228,177
ACT. PERIOD COST	44,248	44,712	36,034	49,680	34,211	21,432	15,253	28,308	0	0	0	0	0	273,876
VARIANCE, $	(16,891)	(16,215)	(11,114)	(14,621)	(7,572)	7,510	10,677	2,525	0	0	0	0	0	(45,699)
VARIANCE, %	-61.7%	-56.9%	-44.6%	-41.7%	-28.4%	25.9%	41.2%	8.2%	0.0%	0.0%	0.0%	0.0%	0.0%	-20.0%
EST. FY CUMUL	27,357	55,854	80,774	115,833	142,472	171,414	197,344	228,177	254,039	280,836	304,447	337,326	363,488	
ACTUAL FY CUMUL	44,248	88,960	124,994	174,673	208,884	230,316	245,569	273,876	0	0	0	0	0	
PERCENT COMPLETE	12.2%	24.5%	34.4%	48.1%	57.5%	63.4%	67.6%	75.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(16,891)	(33,106)	(44,220)	(58,840)	(66,412)	(58,902)	(48,225)	(45,699)	0	0	0	0	0	
VARIANCE, %	-61.7%	-59.3%	-54.7%	-50.8%	-46.6%	-34.4%	-24.4%	-20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	



ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	34,787	33,902	34,624	44,272	34,767	34,597	50,874	34,725	35,348	34,540	35,052	34,253	35,392	302,548
ACT. PERIOD COST	39,733	39,459	42,436	33,080	24,928	16,094	16,012	30,705	0	0	0	0	0	242,446
VARIANCE, $	(4,946)	(5,557)	(7,812)	11,192	9,839	18,503	34,862	4,020	0	0	0	0	0	60,102
VARIANCE, %	-14.2%	-16.4%	-22.6%	25.3%	28.3%	53.5%	68.5%	11.6%	0.0%	0.0%	0.0%	0.0%	0.0%	19.9%
EST. FY CUMUL	34,787	68,689	103,313	147,585	182,352	216,949	267,823	302,548	337,896	372,436	407,488	441,741	477,133	
ACTUAL FY CUMUL	39,733	79,192	121,627	154,708	179,635	195,729	211,74[illegible]	242,446	0	0	0	0	0	
PERCENT COMPLETE	8.3%	16.6%	25.5%	32.4%	37.6%	41.0%	44.4%	50.8%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	(4,946)	(10,503)	(18,314)	(7,123)	2,717	21,220	56,082	60,102	0	0	0	0	0	
VARIANCE, %	-14.2%	-15.3%	-17.7%	-4.8%	1.5%	9.8%	20.9%	19.9%	0.0%	0.0%	0.0%	0.0%	0.0%	



ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	13,040	13,732	15,343	21,070	13,720	12,282	(48,252)	11,730	14,498	17,559	15,343	13,732	13,071	52,665
ACT. PERIOD COST	2,192	2,956	1,534	3,099	3,547	5,854	3,070	13,199	0	0	0	0	0	35,450
VARIANCE, $	10,848	10,776	13,809	17,971	10,173	6,429	(51,322)	(1,469)	0	0	0	0	0	17,215
VARIANCE, %	83.2%	78.5%	90.0%	85.3%	[illegible]	52.3%	106.4%	-12.5%	0.0%	0.0%	0.0%	0.0%	0.0%	32.7%
EST. FY CUMUL	13,040	26,772	42,115	63,185	[illegible]	89,187	40,935	52,665	67,163	84,722	100,065	113,797	126,868	
ACTUAL FY CUMUL	2,192	5,148	6,682	9,780	13,327	19,181	22,250	35,450	0	0	0	0	0	
PERCENT COMPLETE	1.7%	4.1%	5.3%	7.7%	10.5%	15.1%	17.5%	27.9%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	10,848	21,624	35,433	53,405	63,578	70,006	18,685	17,215	0	0	0	0	0	
VARIANCE, %	83.2%	80.8%	84.1%	84.5%	82.7%	78.5%	45.6%	32.7%	0.0%	0.0%	0.0%	0.0%	0.0%	



ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST. PERIOD COST	20,274	21,106	19,958	26,772	21,184	20,272	(128,721)	4,668	7,081	7,334	5,144	5,935	3,239	5,513
ACT. PERIOD COST	297	321	206	37	835	1,160	558	63	0	0	0	0	0	3,476
VARIANCE, $	19,977	20,785	19,752	26,736	20,349	19,112	(129,279)	4,605	0	0	0	0	0	2,037
VARIANCE, %	98.5%	98.5%	99.0%	99.9%	96.1%	94.3%	100.4%	98.7%	0.0%	0.0%	0.0%	0.0%	0.0%	36.9%
EST. FY CUMUL	20,274	41,380	61,338	88,110	109,294	129,566	845	5,513	12,594	19,928	25,072	31,007	34,246	
ACTUAL FY CUMUL	297	618	824	860	1,696	2,856	3,414	3,476	0	0	0	0	0	
PERCENT COMPLETE	0.9%	1.8%	2.4%	2.5%	5.0%	8.3%	10.0%	10.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
VARIANCE, $	19,977	40,762	60,514	87,250	107,598	126,710	(2,569)	2,037	0	0	0	0	0	
VARIANCE, %	98.5%	98.5%	98.7%	99.0%	98.4%	97.8%	-304.0%	36.9%	0.0%	0.0%	0.0%	0.0%	0.0%	