Rec'd w/ WRM letter dtd 7/22/94

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

For The Fiscal Reporting Period

June 11, 1994—July 8, 1994

PMPR No. 94-10

July 22, 1994

426.1

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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
AD	Administrative Item
AECL	Atomic Energy Canada Limited
AES	Atomic Emission Spectrometry
AGU	American Geophysical Union
AML	Arc Macro Language
AP	Administrative Procedure
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	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

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
CNWRA	Center for Nuclear Waste Regulatory Analyses
COI	Conflict of Interest
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

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
EPA	U.S. Environmental Protection Agency
EPR	Electrochemical Potentiokinetic Reactivation
EPRI	Electric Power Research Institute
EQA	External Quality Assurance
EROS	Earth Resource Observation System
ESF	Exploratory Studies Facility
FAC	Favorable Condition
FCRG	Format and Content Regulatory Guide
FD&SHA	Fault Displacement and Seismic Hazard Analysis
FEM	Finite Element Method
FFT	Fast Fourier Transform
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
GUI	Graphics User Interface
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

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
INEL	Idaho National Engineering Laboratory
INTRAVAL	International Code Validation
I/O	Input/Output
IPA	Iterative Performance Assessment
IRM	Office of Information Resources Management
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
LHS	Latin Hypercube Sampling
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

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
NMSS	Office of Nuclear Material Safety & Safeguards
NOAA	National Oceanographic and Atmospheric Administration
NRC	U.S. Nuclear Regulatory Commission
NSRRC	Nuclear Safety Research Review Committee
NTS	Nevada Test Site
NWPA	Nuclear Waste Policy Act, as amended
NWTRB	Nuclear Waste Technical Review Board
OBES	Office of Basic Energy Sciences
OCRWM	Office of Civilian Radioactive Waste Management
OGC	Office of General Counsel
OITS	Open Item Tracking System
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
PPA	Proposed Program Approach
PRA	Probabilistic Risk Assessment

LIST OF ABBREVIATIONS (cont'd)

ABBREVIATION	DESCRIPTION
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
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

ABBREVIATION	DESCRIPTION
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
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
TWFN	Two White Flint North
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

ABBREVIATION	DESCRIPTION
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
WSS	Waste Solidification Systems
WTSO	Washington Technical Support Office
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.S.	United States
USDA	United States Department of Agriculture
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WIPP	Waste Isolation Pilot Plant
WMB	Waste Management Branch
WP	Waste Package
WSE&I	Waste Systems Engineering and Integration
WSS	Waste Solidification Systems
WTSO	Washington Technical Support Office
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

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

TITLE: Center for Nuclear Waste Regulatory Analyses

CONTRACTOR: Southwest Research Institute
6220 Culebra Road, San Antonio, Texas 78228-0510

CONTRACT NO: NRC-02-93-005

FIN: D1035-8

NRC CNWRA PROGRAM MANAGER: John J. Linehan, (301) 415-7780

NRC CNWRA DEPUTY PROGRAM MANAGER: Shirley L. Fortuna, (301) 415-7804

CNWRA PRESIDENT: Wesley C. Patrick, (210) 522-5158

ESTIMATED BUDGET: $89,898,141

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

PERIOD OF THIS REPORT: 06/11/94 - 07/08/94

1. TECHNICAL

1.1 *CNWRA Operations (COPS)*

The NRC and 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 engaged in discussions relative to: (i) review of COI procedures (AP-001), (ii) preparations for participating in the DOE Proposed Program Approach (PPA) meeting scheduled for late July, (iii) revision of NRC contract clauses as a general contract modification, and (iv) review of policies for CNWRA or SwRI conducting work for other U.S. Government agencies as well as foreign governments.

CNWRA staff continued participation with the DWM in various budget-related discussions and meetings, especially in preparation for the modification of existing project plans and the development and presentation of new project plans for RES.

The potential for implementing an electronic version of the PMPR still remains under consideration, and the unavailability of suitable software precludes the implementation at this time.

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

The internal audit report of the CNWRA QA program identified five CARs, and corrective actions have been initiated. Two of the CARs, one dealing with procurement of analytical services and the other with interdivisional work orders, have been addressed, and the corrective actions are complete. An extensive surveillance plan to address the use of scientific notebooks was initiated in response to one internal audit CAR relating to the current use of such books by CNWRA Principal Investigators. The purpose of these particular surveillances are to review and make corrections of CNWRA scientific notebooks in cases where they do not meet the requirements of the Scientific Notebook Quality Assurance Procedure (QAP-001). Corrective actions are taking place to address the other two CARs relating to existing data not qualified or exempted, and calibration control deficiencies that were identified during the audit. The special task to reevaluate the appropriate QA requirements for CNWRA activities based on lessons learned and development of the HLW program is about 60 percent complete.

Last period, CNWRA staff requested that priority be given to discussions of alternatives for TDOCS security measures. The DWM and IRM submitted several alternatives for CNWRA consideration and set a deadline of August 1, 1994, for implementation. Discussions commenced immediately with both the DWM and IRM, and CNWRA chose the option of implementing a Firewall System to protect against Internet intrusion at the CNWRA. However, since this option could not be implemented by the August 1 deadline, CNWRA proposed that IRM consider passing only cc:Mail data packets and Netbios protocols for communications with the DWM and the CNWRA WTSO over the leased line until the IRM approved the installation of a Firewall System safe from Internet intrusion at the CNWRA. The IRM agreed to evaluate and implement these specific filters, if possible, on their CISCO routers supporting the leased line to the CNWRA as soon as possible.

Meanwhile, development continued on the TDOCS System Implementation (IM 5702-155-402) and a draft User's Guide to meet the scheduled delivery date of August 15, 1994. The TDI Report (IM 5702-151-440) will be cancelled and the report content incorporated into the TDOCS System Implementation deliverable. There are ongoing discussions about the timing and approach for completing a design and implementing a TDOCS server in the DWM. The CNWRA delivered a report (AD 5702-156-405) with its TDOCS Scanner recommendations on July 1, 1994.

The following activities are expected to occur during the next period.

The CNWRA will pursue resolution of outstanding management issues, and it will continue responding to *ad hoc* requests for information on CNWRA operations.

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

After receipt of final guidance from the NRC staff, work will begin on the development of FY95 Operations Plans for the Division of Waste Management. The modifications to the FY95 Project Plans for the Office of Nuclear Regulatory Research will be delivered in Period 11.

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

The CNWRA will continue development of the TDOCS system and the related draft User's Guide. The CNWRA will take whatever action may be necessary in response to the IRM-sponsored modification to the leased line between the NRC and the CNWRA to make it more secure. Further, the CNWRA will analyze the proposed options for the installation of a Firewall System at the CNWRA in addition to other TDOCS options being discussed at the present time. The recommended scanner for TDOCS that was accepted and approved by the NRC will be procured and implemented at the CNWRA. 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. So far work has been limited to reviewing public comments submitted on the proposed rulemaking to ensure that CNWRA staff is familiar with them.

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

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

The CDS Development subtask continued with NRC staff from the four program elements participating along with CNWRA staff in a focused integration review of existing KTUs. Compilation of review comments has begun and potential KTU restructuring strategies have been discussed. The initial KTU integration reviews will be completed early in the next period. After review of the results, NRC and CNWRA staff will interact to define any required response.

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). The NRC staff from

the DFCSS, who have taken primary responsibility for writing CDMs 1.4 and 1.5, report that drafts of these documents are 75 percent complete. A meeting will be scheduled for the next period to initiate the review of this draft. Preparation of a draft for CDM 2.7 has begun and is expected to be completed on August 5, 1994. Some CDMs from other technical elements are expected to be completed in the next period. Activity continues on development of a Crosswalk of Regulatory/Institutional Uncertainties with Review Plan Topics (IM 5702-222-451) which will become an appendix to the LARP. The NRC is reviewing a draft of this document.

The CNWRA continued providing support to a special project to prepare input to the CDTS. CNWRA support is limited to those issues related to HLW. This activity has been extended beyond the initial estimate of 45 days. A CNWRA staff member detailed on a staff exchange to the DWM to facilitate support for this work has continued to provide support beyond the completion of the staff exchange.

Work on RPD Phase II (Version 1.1) was completed in this period with the delivery of the User's Guide for the Generalized Report Writer (IM 5702-252-403) on June 29, 1994. This version of the RPD enhances the earlier version by providing for the automated generation of specialized reports (e.g., the KTU Report and the LARP) by extracting information from the database in any combination of content, style, or format. The current versions of the CDSs and CDMs were loaded into the RPD at the CNWRA. Additionally, introductory material and regulatory requirements for the LARP were loaded in order to support future automated production of the LARP using the report writer capability. Work commenced on the incorporation of the OITS as an application of the RPD.

RPD and OITS operation and maintenance efforts continued with the installation of RPD Version 1.1 on some SUN and OS/2 workstations. The DOS/Windows port preparation is proceeding following the final delivery of vendor-supplied software. The MacIntosh port installation will commence following testing and installation of the DOS/Windows client application. The installation of RPD Version 1.1 at the NRC is being delayed until network security issues being addressed by the COPS Element can be resolved.

During the next period, the WSE&I Element will focus on the following areas: (i) producing CDMs; (ii) developing porting software to support the installation of the RPD on various computer platforms; (iii) continuing the migration/incorporation of OITS into RPD; (iv) coordinating LARP development activities throughout the CNWRA, including conducting training necessary to support CDM development; (v) preparing a Crosswalk of Regulatory/Institutional Uncertainties with Review Plan Topics; (vi) developing an Uncertainty Identification and Resolution Procedure; (vii) continuing KTU integration; (viii) supporting the CDTS; and (ix) preparing the CNWRA FY95 Operations Plans.

1.3 *External Quality Assurance (EQA)*

The more frequent DOE audits of the HLW program participants, as the end of FY94 approaches, have resulted in greater usage of CNWRA QA staff on the NRC audit

observation teams. Specifically, CNWRA QA representatives participated as NRC observers at the following DOE audits:

- The audit of the M&O during June 6–10, 1994, in Vienna, Virginia, and June 20–27, 1994, in Las Vegas, Nevada (IM 5702-331-411)
- The audit of USGS during June 20–24, 1994, in Denver, Colorado (IM 5702-331-412)
- The audit of DOE EM-323, Vitrification Projects, at Germantown, Maryland during June 27–July 1, 1994 (IM 5702-331-414)

The CNWRA audit observation report on the DOE audit of SAIC was sent to the NRC during this period (IM 5702-331-410), following the field work that occurred in the previous period. Work continued on the re-evaluation of appropriate QA requirements for CNWRA activities, especially those relevant to the use of computer software.

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

Observation audit reports for the M&O, USGS, and EM-323 audits will be completed during the next period. Observation audit activities are planned for DOE audits of the OCRWM and the M&O Design Control activities during the next period. Work will also be completed on the re-evaluation of CNWRA QA requirements.

1.4 *Geologic Setting (GS)*

Geology and Geophysics

Work began on the draft CDM dealing with Potentially Adverse Condition—Evidence of Extreme Erosion During the Quaternary Period, Review Plan 3.2.1.10 (AD 5702-422-403). A schedule for task completion has been set. The KTUs were reviewed by the GS element as part of the KTU Integration Task and provided to CNWRA WSE&I element. Review of the LARP draft was begun by M. Miklas.

Fault displacement probabilities calculated using SEISM 1.1 were compared with published results. Results are in reasonable agreement for fault offsets at or below the maximum expected probabilities for a particular fault. A draft of the SEISM 1.1 Test Analysis Report (IM 5702-425-441-406) was completed and is undergoing format review prior to technical and programmatic reviews. The text describes corrections necessary for predicting peak acceleration for underground facilities. Such corrections to predictions for surface facilities are a function of vibration frequency and shear wave velocity of the surrounding medium.

The Scientific Notebook for the SEISM 1.1 development was brought into compliance with CNWRA QA requirements. A brief description of the SEISM 1 code was initiated to bring the code under CNWRA configuration management. The description will

precede addenda derived from a series of Lawrence Livermore National Laboratory reports which contain discussions of SEISM 1 functionality.

The GIS library population now includes DEM from the USGS. Some careful data processing is necessary to ensure high data quality. Three arc second resolution DEM data sets are available in 1 × 1 degree longitude by latitude data sets. These data sets are being integrated into the GIS database to facilitate analysis of structural controls over a larger area of the western United States. Also, selected areas of interest are being included to facilitate analysis of analog sites for volcanism.

Searches of NOAA and Western Region USGS databases and CDROM based data sets have yielded 30 arc second resolution DEMs for the contiguous United States. These 30 arc second DEMs are in the process of being digitally shaded and integrated into the GIS database. Typically, these shaded relief DEMs are used to highlight and illustrate the spatial relationships of other data sets such as regional hydrography and groundwater flow in relation to physiography, magnetic, and gravitational surveys).

SAR/SLAR data sets have been received from the EROS data center in Sioux Falls, South Dakota. These data sets provide topographic and physiographic information while minimizing atmospheric effects. Once registered, these data sets will be coregistered with other GIS database components and evaluated for inclusion into the GIS database.

Continued work in the SRA area is anticipated during the next period. It is anticipated that the CNWRA review of the SEISM 1.1 Test Analysis Report will be completed during the next period for delivery to NRC. No reactive work is anticipated.

Geochemistry, Hydrology, and Climatology

Evaluation and integration of the KTUs continued as part of the on-going effort in LARP development.

CNWRA technical and programmatic reviews were completed for the CDMs for RRT 3.1.2, Hydrologic Systems Description (IM 5702-424-403); RRT 3.1.3, Geochemical Systems Description (IM 5702-424-404); and RRT 3.1.4, Climatologic and Meteorological System Description (IM 5702-424-405). These are currently awaiting NRC decisions on how the descriptive CDMs will be handled. The first draft of the CDM for Review Plan 3.2.2.5, Flooding (IM 5702-424-401) was developed.

Calculational effort continued in GWTT, but was delayed when the calculation code was transferred from one machine to another. CNWRA staff prepared a presentation on the status of GWTT calculations through Period 10 in preparation for meetings with NRC staff July 14–15, 1994 in Washington, D.C.

Work continued on constructing a 3D hydrostratigraphic model of the repository block. Porosity, saturated conductivities, and water contents were entered into the EarthVision software.

NRC and CNWRA staff outlined future efforts in the Task to Investigate Issues in Hydrology, Geochemistry, and Meteorology. CNWRA staff and consultants were assigned to identify data needs and data sources for CDM development.

Work in SRA will continue at increased levels during the next several periods to complete the FY94 CDMs. KTU integration will continue as part of CDS development. The staff was scheduled to present the results of GWTT calculations to NRC July 14–15, 1994 in Washington, D.C. The calculational effort will continue, but at a reduced rate until computer disk storage problems can be resolved. CNWRA staff will seek to identify data needs and sources for CDM development. Data will be obtained where possible for evaluation for input into the GIS database.

1.5 *Engineered Barrier Systems (EBS)*

Integration activities for the KTUs in the EBS area continued in conjunction with the WSE&I Program Element.

The SCCEX Code Manual (IM 5702-551-410-010) has undergone a detailed review, and all comments are being addressed. This code will be applied to analyze different scenarios in the near-field to estimate waste package failure times.

Work is ongoing to compare the new GEM code (IM 5702-523-410) with TWITCH. The copper oxidation problem was selected for comparison purposes because of the formation of secondary alteration products. Preliminary results did not yield the same alteration sequence as the TWITCH code. The reasons for this discrepancy are being explored.

As a result of improvements made in the experimental apparatus, the comparison of the model calculations using the GEM code and the experimental data showed good agreement. Previously, the experiment took much longer time to reach a steady state compared to the theoretical results. Now the times are approximately within a factor of two.

Improvements to the two-phase fluid transport code C-TOUGH continued. A new computational solver was installed which significantly reduced computation time. It also reduced the storage requirements. The solver significantly extended the size of problems that can be handled. Calculations are currently under way to investigate the near-field environment of a partially saturated repository.

Technical review and the resolution of comments for the report on the Role of Colloids in the Release of Radionuclides from Vitrified Waste Forms and Spent Fuel (IM 5702-523-415) continues.

Two CNWRA staff members visited AECL Whiteshell Laboratories in Pinawa, Canada, on June 28–29, 1994. Technical discussions on metal corrosion and spent-fuel modeling and experiments were held with the AECL key staff. A trip report on the visit was prepared and issued.

In the next period, integration of KTUs for EBS will continue in conjunction with the WSE&I Program Element.

An EBS Program Element review meeting is planned for August 8, 1994, at the NRC White Flint Offices. Several staff from the CNWRA are expected to participate.

During this period, the draft Colloids Report and the SCCEX Code Manual will be completed and issued.

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

The RDCO Element concentrated on the following activities: (i) developing of CDSs, (ii) developing CDM on Shafts and Ramps Design, (iii) evaluating computer codes for compliance determination and rock joint model development, (iv) conducting prelicensing interactions, and (v) performing ESF design reviews.

NRC/CNWRA teleconference meetings regarding KTU integration continued. The CNWRA RDCO staff conducted KTU integration review on the 58 KTUs and provided the review comments to the CNWRA KTU integration team.

The development of the CDM for RRT 4.3, Shafts and Ramps Design (IM 5702-622-401-001) continued. This CDM has been revised during this period to incorporate the comments received from the CNWRA WSE&I staff. The CNWRA technical review on this CDM will be conducted during the next period. The technically reviewed version of this CDM will be delivered to NRC as AD 5702-622-401-003: CDM for RRT 4.3, Shafts and Ramps Design, for NRC management review.

In this period, the evaluation of the finite element code, ABAQUS, continued. Based on exploratory analysis of the Problem Set 3, Heated Drift in Fractured Rock, a new problem definition has been developed for this problem set assuming symmetry condition around the original tunnel. This case becomes similar to the case of a drift surrounded by similar drifts. This keeps the geometric domain symmetric and of reasonable size without sacrificing the intended purpose of evaluating ABAQUS. Both heat flow and stress-deformation analyses were conducted using the model. The data are being analyzed. Since there is no analytical solution available for this problem set, results from UDEC analysis will be used for comparison. Work progresses to develop models for UDEC analysis. The preparation of the 1994 Progress Report, Evaluation of ABAQUS (IM 5702-623-402), was initiated during this period.

Development of a constitutive model to simulate the response of a rock joint under pseudostatic and dynamic loads progressed as observed in the experimental results of the Seismic Rock Mechanics research project. It was intended to use the set of ten 'standard' profiles (JRC 0 to 20), developed by N. Barton of Norwegian Geotechnical Institute and adopted by the International Society for Rock Mechanics as standard, as a baseline for the development of the rock joint constitutive model. However, the work carried out so far under this subtask, using the theory of fractal geometry, has proved that this set of profiles does not adequately represent the roughness of a natural joint surface. Aside from being 1D, the order of the profiles by degree of roughness is not consistent. Thus,

a new baseline will need to be established for the development of the rock joint constitutive model. Development of a new baseline is expected to have impact on the schedule of the model development work, that may affect FY95 schedule for delivery of Seismic Model Development Report (IM 5702-623-501). The concepts of fractal geometry are being used for characterization of rock surfaces. The results show that the fractal dimension alone is not sufficient to uniquely describe a profile, contrary to popular thinking. A new parameter has been proposed along with the fractal dimension for unique characterization of profiles. This work is now being extended to 2D surfaces. Characterization of wear of each joint surface following the method used in tribology is in progress. Some work will be done on correlating both bottom and top surfaces of a specimen for determining the wear characteristics.

Two letter reports are in preparation for submission to NRC to formally record the completion of 90 percent design reviews of ESF Packages 2B and 2C, which have been completed during Periods 4, 8, and 9 of FY94. These will be delivered as: (i) Major Design Report Reviews FY94–ESF 2B (IM 5702-642-401) and (ii) Major Design Report Reviews FY94-ESF 2C (IM 5702-642-402).

Technical discussions during June 24–30, 1994 between CNWRA and NRC focused on activities of RDCO and the Seismic Rock Mechanics (SRM) research project. This discussion included both ongoing and future activities. The overall objectives of TMH work being conducted under the RDCO and SRM research projects were discussed in detail. The scope of TMH work as outlined in the CNWRA FY94 RDCO Operations Plan and SRM Project Plan is considered to be reasonable. The FY95 revisions of these two plans will be made in coordination with the NRC staff based on the current scope. Other topics of discussion included KTU integration, CDM development, ESF Design Packages Reviews, Prelicensing activities, and Workshop on Rock Mechanics Issues in Repository Design and Performance Assessment. A trip report will be submitted during the next period.

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 organized and conducted activities in the following areas: (i) preparing a report on the use of expert judgment in PA, (ii) participating in the KTU integration activity, (iii) conducting auxiliary analyses for IPA, (iv) developing new scenario modules for TPA, (v) presenting training course in PA techniques, (vi) preparing a report on the INVENT preprocessor code for TPA, (vii) preparing a CNWRA report on the updated LHS module, and (viii) reviewing DOE TSPAs.

Preparation of the background report on the use of expert judgment in PA continued. The report follows the outline previously reviewed by the NRC staff and consists of eight major sections. The document is intended to support a future NUREG/CR on expert

judgment that will be developed and issued later in FY94. The background report, which is expected to be completed in August, will be submitted to the NRC to fulfill Background Report on Use of Expert Judgment in PA (IM 5702-712-405). This work is being conducted under the scope described in the PA&HT Element Subtask 1.2 of the OPS.

Participation in the KTU integration activity continued with the assistance of T. Bonano (consultant). Comments and recommendations are being developed regarding the consolidation, addition, and elimination of selected KTUs. Recommendations developed by the PA staff regarding KTU integration (i.e., consolidation, addition, and/or elimination of KTUs) will be discussed with the NRC PA staff prior to finalization. This work was conducted under the scope described in the PA&HT Element Subtask 2.1 of the OPS.

Work on the auxiliary analysis of infiltration at YM also progressed. Additional analysis was performed to determine the cloud cover and associated rainfall statistics. An exponential-decaying relationship was established between cloud cover and precipitation events, with only a few percent of rainfall events occurring at less than maximum cloud cover. Cloud cover has been found to be difficult to model since it is at zero about half of the time and maximum about a sixth of the time. Currently, cloud cover is treated as a random Gaussian process. This modeling study will be documented in a CNWRA report that will be submitted to NRC to fulfill Report on Infiltration Study (IM 5702-723-445). This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

Work on numerical models of near-field flow progressed. 1D rectangular and 2D cylindrical models of the repository have been constructed, and the evolution of the temperature and saturation fields has been simulated using the CTOUGH code (an improved version of the TOUGH code). Work continues on a 1D cylindrical model for temperature, and both liquid and vapor flow. The analyses are focusing on the evolution of the thermal-hydrologic environment of the waste packages. This modeling study will be documented in a CNWRA report that will be submitted to NRC to fulfill Report on Near-Field Flow Analysis (IM 5702-723-450). This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

Work on the development of a hydrostratigraphic model continued for the YM site. This work builds upon the geologic stratigraphic model developed by the GS element. The hydraulic conductivity, porosity, and moisture content has been collected, analyzed, and summarized for a number of boreholes in the vicinity of YM. The hydraulic conductivity data from five boreholes has been entered into a data file for the Earth Vision software. It appears, however, that the current model may need to be rezoned. This work is being conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

Work is on-going for 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. A draft paper entitled, The Infiltration of a Liquid Finger Down a Fracture into Superheated Rock was prepared and submitted for technical review. It is anticipated that J. Firth will participate in the near-field flow analyses as part of his staff exchange assignment at the

CNWRA. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

A draft description of the proposed technical description of a new FAULT model for IPA has been completed. On July 8, the draft was transmitted to the NRC for feedback. The draft describes a method for modeling the direct effects of potential fault displacement by direct disruption of the waste packages. The model proposed in the draft is similar to that used in the EPRI TSPA; however, it neglects indirect effects of faulting such as creating either conduits or barriers for groundwater flow. This work is being conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

A one-day course entitled Overview of High Level Waste Performance Assessment Techniques was presented on June 28, 1994, at CNWRA by two instructors from SAIC. Two organizers from INEL/EG&G monitored the course, while four NRC staff and 15 CNWRA staff members attended. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

Revision of the CNWRA report on the INVENT module continued. The report was revised to resolve comments raised by technical reviewers. The revised report has been submitted for programmatic review and is expected to be completed in the next reporting period. The CNWRA will issue the final report entitled Letter Report on Demonstration of a GUI and Centralized Database for TPA Code (5702-723-430). This work is being conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

Testing and documentation of the updated LHS module (of the TPA code) is on-going. The modified module, designated as LHS94, is being documented as required by the technical operating procedure TOP-018 dealing with configuration management of engineering and scientific codes. This document will be added as a new deliverable for this Subtask. This work was conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

The FEHMN code is being used to simulate the near-field thermal-hydrologic environment. The PATRAN code is being used to describe the geometry and boundary conditions for the problems. This work is being conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

The C-14 auxiliary analysis commenced. A computer model is being developed to more realistically assess the transport of C-14 gas at a mountain scale. The new model will be a 2D cylindrical formulation that accounts for the interactions between the gaseous, liquid, and solid phases of carbon. The model will also account for the effects of heat, buoyancy, and rock-dryout. This work is being conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

B. Sagar attended the last PAAG meeting in Paris. In addition, to participating in various discussions, he contributed to the final report of the PAAG. A trip report was prepared and transmitted to NRC. This work is being conducted under the scope described in the PA&HT Element Subtask 2.3 of the OPS.

There was discussion concerning the technical directive to review the two DOE TSPAs which were published recently by SNL and M&O/Intera. An overall review strategy was developed for review of the TSPAs. In addition, a list of discipline-specific reviewers was developed. This work is being conducted under the scope described in the PA&HT Element Subtask 4.1 of the OPS.

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) participating in the KTU integration activity, (iii) continuing work on the auxiliary analyses, (iv) reviewing DOE TSPAs, (v) continuing documentation of the LHS94 module, and (vi) conducting integration meetings with PIs working on research projects.

1.8 *Research*

Research Project 1—Overall Research

At the Natural Analogs and Performance Assessment Workshop June 14–15, 1994, in San Antonio, applications of analog data for performance assessment were discussed with particular attention to use of data from the Nopal I and Akrotiri sites. Results of pre-meeting exercises were presented by CNWRA and NRC participants, including: (i) estimation of K_d values abstracted from observations and measurements at the Nopal I analog site, (ii) preliminary flow and transport calculations based on data from the Akrotiri analog site, and (iii) calculations of fracture and matrix retardation and matrix diffusion. A draft summary of the results of the Natural Analogs and Performance Assessment Workshop was written and distributed to the participants for comment.

Preparations continued for the Workshop on Rock Mechanics Issues in Repository Design and Performance Assessment. During this period two additional abstracts were received. A total of nine abstracts have been accepted from organizations outside the NRC and the CNWRA; it is expected that about seven papers will be presented by the NRC and CNWRA participants.

Drafting of the Sub-regional Ground-Water Flow and Transport Studies Project plan continued during this period.

Receipt of an SOW for the new Near-Field 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 Rock Mechanics workshop is anticipated to continue. The draft summary of the results of the Natural Analogs and Performance Assessment Workshop will be revised in response to comments received from participants. Writing of the Sub-regional Ground-Water Flow and Transport Studies Project plan is anticipated to continue, with a scheduled completion of July 29, 1994.

Research Project 2—Geochemistry

As a result of technical reviews by all three external peer reviewers, revisions to the Topical Report on Geochemistry (MM 5704-014-094-002) have commenced in preparation for its resubmission to NRC.

Evaluation of new experimental data on ion-exchange between clinoptilolite and K^+/Sr^{2+} and K^+/Ca^{2+} has been completed. These new data, together with literature data on ion-exchange between aqueous solutions and clinoptilolite, will be used to derive parameters for the Margules zeolite solid solution model which was discussed in the topical report. A comprehensive compilation of model parameters will be generated and will be submitted for publication in a peer-reviewed journal. The new experimental data and modeling results will also be presented by R.T. Pabalan and F.P. Bertetti at the upcoming 49th Annual Calorimetry Conference on July 31–August 4 in Santa Fe, New Mexico.

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.

Research Project 3—Thermohydrology

In this reporting period, the Thermohydrology Research Project has been active in several areas, including: (i) preparing and conducting laboratory-scale experiments, (ii) determining hydraulic properties of the test media, and (iii) developing analytical and mathematical models of physical mechanisms associated with moisture redistribution in isothermal and nonisothermal regime.

The most recent experiment in the Test 6 series of coupled-effects experiments has concluded. This experiment was conducted using ceramic, a material with relatively high permeability, as the test medium. Initiation of the next experiment in this series, with cement slurry with relatively low permeability as the test medium, is progressing. Interpretation of data from the Test 6 series of experiments is ongoing.

Experiments focusing on the gas-gradient, coupled-processes phenomena continued. Results from the gas-gradient, coupled-processes experiments will be used to assess theories developed through dimensional analysis of heat and mass transfer in unsaturated fractured rock. The heating phase of this experiment has concluded. A differential gas pressure of about 0.15 to 0.25 bar was measured between the heater element and the side wall. The maximum pressure was observed during the first 12 to 24 hours of the experiment after which a monotonic decline in gas pressure was observed. These results agree favorably with simulations reported at the IHLWMC in May. An additional cement-slurry test cell with more refined material dimensions and medium properties is being prepared. A high degree of effort is being expended to fabricate these more refined test cells as a way to reduce uncertainty in the density measurements of the coupled-processes experiments. An abstract entitled Characterization of Fluid Flow Regimes in Heated, Partially-Saturated Porous Media has been accepted for presentation at the Chapman Conference on Aqueous Phase and Multiphase Transport in Fractured Rock on September 12–15, 1994.

Hydraulic characterization of media used in the laboratory-scale experiments continued. These media include the cement mixtures to be used in the gas-gradient tests, and alumina powders used in several completed experiments. The saturated hydraulic

conductivity, porosity, and retention curve for the ceramic have been prepared. These curves are being used in the analysis of the experimental results.

Work toward the completion of the dimensional analyses has continued. A 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.

Theoretical analysis of flow mechanisms and identification of simple mathematical models to represent flow in a thermosyphon have continued. Prediction of gas flow through media under the imposition of a heat load continued.

In the next period, work will continue in four areas: (i) continuing the gas-gradient coupled-processes tests using a cement slurry as the test medium, (ii) conducting hydraulic property measurement experiments of cement mixtures and alumina, (iii) continuing the Test 6 series with a cement mixture, and (iv) scoping measurements of the dimensional analysis and preferential flow investigations. The completion date for the Thermohydrology Research Project has been specified as February 28, 1995 in the revised research plan to provide for sufficient time to prepare the summary report. The completion date was revised in light of the time required for the preparation of final reports in the completion of other CNWRA research projects. Experimental work is still scheduled for completion by the end of FY94.

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, and (iii) report preparation for Tasks 5, 7, and 8.

The small-scale model (about 1/15 scale) tests of jointed rock mass using a shaking table were completed. This small-scale model consists of approximately 670 simulated rock mass components aligned within a test frame at 45 degrees to the horizontal. The size of the model was $1.22 \times 1.22 \times 0.61$ m and each individual component was $0.05 \times 0.05 \times 0.61$ m. In the center of the small-scale rock mass model is a 150 mm circular tunnel. Thin steel cables are used to provide boundary constraints. The total stress applied to the vertical and horizontal boundaries was about 1 MPa. The experiments were conducted on a shaking table by applying horizontal earthquake displacement signals. The first test was conducted using a 7.5-second earthquake with a maximum displacement of 0.15 in. To investigate the cumulative effect of repetitive seismic load on jointed rock mass, four tests were conducted with this earthquake motion.

The tests were repeated with maximum earthquake displacements of about 0.30 in, 0.45 in., 0.60 in., and 0.75 in., with four tests being conducted under each earthquake load. In consultation with the NRC, it was decided that, to provide adequate time and resources, the delivery of the Report for Scale Model Experiments (IM 5704-034-094-002) will be rescheduled from FY94 to FY95. This will also lead to the rescheduling of the Final Project Report (MM 5704-037-094-002) from FY94 to FY95.

The activities associated with the coupled MH experiments continued during this period at a reduced level because of higher demand on laboratory staff and some equipment for conducting shaking table tests of the jointed rock mass model. Modeling of the Big-Ben experiment using the finite element code ABAQUS continued for DECOVALEX Phase III study. A report on DECOVALEX Phase III modeling entitled Report on DECOVALEX Modeling Phase III (IM 5704-039-094-003) is in preparation for submission to NRC by September 30, 1994.

The preparation of the Report for Groundwater Hydrology Field Studies (MM 5704-035-094-002) continued during this period, and it will be submitted to NRC by July 18, 1994.

During the next period, activities within the Seismic Rock Mechanics Research Project will include: (i) initiation of data analysis of the small-scale model of jointed rock mass; (ii) submission of the Report for Groundwater Hydrology Field Studies (MM 5704-035-094-002); (iii) DECOVALEX modeling and experiments including preparation of the Report on DECOVALEX Modeling Phase III (IM 5704-039-094-003) and Report on DECOVALEX MH Experiments, Phase I (IM 5704-039-094-002); and (iv) organization of the Rock Mechanics workshop.

Research Project 5—Integrated Waste Package Experiments (IWPE)

Long-term localized corrosion testing is continuing for the tenth month. No localized corrosion has been observed on the specimen held 100 mV below the repassivation potential. Additional long-term corrosion tests were implemented. In a previous test, crevice corrosion was observed at the specimen-PTFE gasket interface at a potential 100 mV greater than the repassivation potential. Consequently, a test duplicating these conditions is currently underway. An additional test, with the specimen held at the repassivation potential, is also being conducted. Long-term localized corrosion tests of specimens with controlled crevices were also started. These tests are being conducted in an identical solution containing 1000 ppm Cl^-, 85 ppm HCO_3^-, 20 ppm SO_4^{2-}, 10 ppm NO_3^-, and 2 ppm F^-. Crevices on both polished and mill-finished chromium-depleted surfaces were formed by attaching PTFE crevice blocks to the specimens with an insulated alloy C-276 bolt. The recent results of crevice repassivation tests have suggested that crevices formed by this method are reproducible. Tests are being conducted with specimens of this geometry at 100 mV above as well as 100–200 mV below the repassivation potential.

Tests designed to compare the results of slow strain rate tests to U-bend tests were partially completed. No indication of stress corrosion cracking was found on 316L tensile specimens strained to 105 percent and then 130 percent of the yield strength in a

1000 ppm Cl^- solution containing 10^{-2} molar thiosulfate. Localized corrosion in the form of pitting was observed on the specimen held at an applied anodic potential.

No stress-corrosion cracking has been observed on alloy 825 U-bend specimens tested in high-chloride concentrations. Additional U-bend tests are being implemented to test alloy 825 in 40 percent $MgCl_2$. Stress-corrosion cracking has previously been observed in slow strain rate tests conducted in this environment. Single U-bend specimens in polished and mill-finished chromium-depleted surfaces will be tested under these conditions. In addition, polished, double U-bend specimens will be tested in this environment to determine if the presence of a crevice promotes stress corrosion cracking.

U-bend specimens of 316L were machined from the same heat of material used for slow strain rate tests. U-bend tests are presently planned for these specimens to allow further comparison of the material heats and test techniques.

The result of microstructural investigations of mill-annealed specimens thermally treated after receiving 20–61 percent cold work have confirmed that, without solution annealing, only very limited sensitization of the material is possible. Boiling nitric acid tests are currently being conducted on sensitized specimens following solution annealing and approximately 15 percent cold work. The results of these tests will be compared to those of solution-annealed specimens and specimens receiving no cold work between the solution annealing and sensitization heat treatments.

Long-term localized corrosion tests will continue. Additional U-bend tests of the two heats of 316L will be conducted to determine the differences in susceptibility to stress corrosion cracking of the two material heats. These tests will also allow a direct comparison of slow strain rate and U-bend test techniques. The results of boiling nitric acid tests of sensitized alloy 825 specimens in both the solution-annealed and solution-annealed and cold-worked conditions will be used as a guideline for the additional material processing required for long-term sensitization studies.

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) completion and submission of the technical report entitled Stochastic Analyses of Large-Scale Simulation of Flow and Transport in Heterogeneous Fractured Rock: Results and Analyses (MM 5702-053-094-001), (ii) preparation for a presentation of Stochastic Project results at the Xth International Conference on Computational Methods in Water Resources, and (iii) organization of a Society for Industrial and Applied Mathematics (SIAM) mini-symposium.

The report Large-Scale Flow and Transport (MM 20-5704-053-094-001) was forwarded to the peer-reviewers.

A presentation entitled Unsaturated Flow and Advection-Dispersion in Three-Dimensionally Heterogeneous Geologic Media was made by A. Bagtzoglou at the Xth International Conference on Computational Methods in Water Resources. A. Bagtzoglou

was invited by the conference program committee to chair the technical session on Subsurface Transport. An invited presentation the paper by D. Zhang and S.P. Neuman (University of Arizona) was also given at this session.

A SIAM mini-symposium entitled Advanced Mathematical Modeling in the Waste Management Program is being organized under the auspices of the PA and Stochastic research projects. This mini-symposium will be held in San Antonio during the third SIAM Conference on Mathematical and Computational Issues in the Geosciences.

During the next reporting period, activities will concentrate on incorporating peer-review comments for the technical reports on effective properties and large-scale flow and transport.

Research Project 7—Geochemical Analogs

Alpha spectrometry to measure U and Th activities of whole rock samples from Level +10 of the Nopal I analog site continued. Samples being analyzed by alpha spectrometry were collected along a traverse across the northern margin of the deposit. Gamma counting and XRD analysis of fracture material from a fracture on Level +10 of Nopal I continued. Material for these analyses was collected from a relatively continuous, sub-vertical fracture that trends to the north and appears to bound the deposit on the east. Optical microscopy indicates the presence of Fe-oxides, jarosite, kaolinite, and minor uranophane (in samples near the deposit).

Plans for field research at the Akrotiri site continued with submission of NRC Forms 445 and coordination of planned activities with Greek scientists.

A Workshop on Natural Analogs and Performance Assessment was hosted in San Antonio on June 14 and 15, 1994. Participants included NRC and CNWRA technical staff. Results of pre-meeting exercises were: (i) estimation of K_d values abstracted from observations and measurements at the Nopal I analog site, (ii) preliminary flow and transport calculations based on data from the Akrotiri site, and (iii) calculations of fracture and matrix retardation and matrix diffusion were presented by the CNWRA and NRC participants. Applications of analog data for performance assessment were discussed with particular attention to use of data from the Nopal I and Akrotiri sites.

Preparation of the FY95 text and budget for the Geochemical Natural Analog Project Plan continued during Period 10. A draft summary of the results of the Natural Analogs and Performance Assessment Workshop was written and distributed to the participants for comment. Element manager and editorial reviews were received and resolved, and the chapter was submitted for technical review. A paper titled, "*In situ* Distribution Coefficients Derived from Uranium and Thorium Decay Series Isotopes in Water-rock Systems: Promise and Practice," will be presented at the Natural Analogues Working Group meeting in September 1994 as an invited contribution. An abstract entitled, "The Role of Secondary Mineral Formation on Uranium Retardation and Transport at the Peña Blanca Natural Analog Site," was submitted for presentation at the Geological Society of America Annual Meeting.

During Period 11, activities within the Geochemical Analog Research Project are anticipated to include: (i) continued gamma and alpha 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) interpretation of leachate analyses of the tuff from the Akrotiri site; and (v) completion of a summary report from the Natural Analogs and Performance Assessment Workshop.

Research Project 8—Sorption Modeling

Experiments studying ^{233}U sorption on quartz sand and on montmorillonite are in progress. These experiments will determine the effects of pH, solid-mass to solution-volume ratio (M/V), and radionuclide concentration on U sorption on mineral surfaces. Aqueous samples were taken and measured using liquid scintillation counting to determine the uranium concentrations at the start of the forward experiments. The starting pHs of the solutions were also measured. New sorption experiments using clinoptilolite as the sorbent and with M/V=20 g/L were initiated. These latter experiments are designed to complement previous experiments at M/V=2 g/L and to test the predictive capability of surface-complexation models for U sorption on clinoptilolite.

Modifications to the laboratory facility (installation of glove bag and air blower with HEPA filter) are in progress. These modifications are necessary to allow work on other actinides such as neptunium and plutonium to be conducted. Modifications to the glove box which will be used for controlled atmosphere experiments have been completed. U sorption experiments at high pCO_2 (10^{-2} atm) will be initiated as soon as the gas mixture tanks (1%CO_2 in air) come in.

Sorption modeling results continued to be compiled to develop a database of sorption reactions for surface complexation models. As part of the Workshop on Natural Analogs and Performance Assessment hosted in San Antonio on June 14–15, 1994, surface complexation modeling was used as a means to predict fracture sorption from observations and measurements at the Nopal I analog site. Participants in the Workshop included NRC and CNWRA technical staff.

The author final draft of the Sorption Modeling for High-Level Waste Performance Assessment portion of the CNWRA Research Semi-Annual Report was written and submitted for CNWRA review.

Uranium sorption experiments on montmorillonite, quartz, and clinoptilolite will continue. Experiments on sorption of neptunium and plutonium will be initiated as soon as modifications to the laboratory facility have been completed. Sorption modeling of experimental results will continue. Compilation of modeling results will also continue.

Research Project 9—Performance Assessment (PA)

In this reporting period, the technical staff concentrated on: (i) performing unsaturated flow simulations for the Peña Blanca site, (ii) preparing a journal article on flow in fractures, (iii) documenting a new infiltration model for IPA, (iv) conducting a study of data filtering, and (v) preparing Chapter 6 of the Semi-Annual Research Report.

Unsaturated flow simulations for the Peña Blanca natural analog site continued. These 2D flow simulations will be used to assist in the design of infiltration experiments that will be performed under the Geochemical Analogs Project. Problems in performing the computer simulations using the CTOUGH code (CNWRA version of the VTOUGH code) were initially encountered because of the large memory requirements and relatively long run times. To overcome these problems, a new matrix solver routine was developed and implemented. The new solver routine is more than twice as fast as the original band solver and requires less than a third of the computer memory. Results of the unsaturated flow simulations are being documented in the 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 draft manuscript was written entitled, Penetration Length of Viscous Flows in Fractures in Unsaturated Porous Medium. This manuscript documents new work that extends the previously developed mathematical theory for modeling flow in a discrete fracture with imbibition into a porous matrix. The paper, which is authored by V. Kapoor, will be submitted to *Water Resources Research*. The computer code TFILM, which implements this mathematical theory, was improved and comments added to internally document the FORTRAN source code. This work is being conducted under the scope described in Task 2 of the PA Research Project Plan for FY94–95.

Preparation of a CNWRA report on the new infiltration model, referred to as BREATH, continued. This new model is currently being used in an IPA auxiliary analysis of infiltration processes at YM. Preparation of a CNWRA report on the BREATH code is nearing completion; the report covers model theory, computational techniques, and user instructions for use of the code. This report will be submitted to fulfill the Intermediate Milestone entitled Infiltration Model for IPA Auxiliary Analysis (IM 5704-192-094-005). A new activity was initiated dealing with the benchmarking of CNWRA and DOE codes. Various simulation problems were developed for use in testing and comparing the CNWRA codes PORFLOW and CTOUGH against the DOE code FEHMN. This work is being conducted under the scope described in Task 2 of the PA Research Project Plan for FY94–95.

A study of data filtering and its impact on model predictions continued. 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. A set of prerequisite statistical and computational codes are being developed to conduct this simulation study. This activity was conducted under the scope described in Task 3 of the PA Research Project Plan for FY94–95.

In the next reporting period, work will be performed in the following areas: (i) continuing documentation of the BREATH code, (ii) continuing work on a report on the near-field conceptual and mathematical models, (iii) continuing data filtering modeling study, and (iv) continuing work on hydrologic analysis and modeling of fracture flow at the Peña Blanca natural analog site.

Research Project 10—Volcanic Systems of the Basin and Range

During Period 10, five nominees were invited to participate on the volcanism peer-review panel. Four of the five nominees have accepted to date.

Review of the GIS volcanism database continued during this period, with particular attention initially given to accuracy and completeness of the data and associated uncertainties for Coso, California, volcanic field. Data compilation activities included acquisition of aeromagnetic and radar data for selected volcanic fields.

Efforts will continue to acquire acceptance from all five leading nominees for the volcanism peer-review panel, with additional invitation letters being sent out if necessary.

Review of the GIS volcanism database will continue, as will compilation of aeromagnetic and radar data for selected volcanic fields.

Research Project 11—Tectonic Processes

Research in Tectonics during the last period has focused on fault slip tendency analysis, 3D stress domains in California and Nevada, compilation of fault slip data and establishing a format for ARC/INFO coverages for fault slip data, and incorporation of SLAR coverage for the Greater Death Valley Region into the Tectonics Research database. Significant progress was made on preparation of samples for separation of minerals (especially apatite and zircon) to be used for fission track analysis. The ARC/INFO coverage on Conodont Color Alteration indices for parts of southern California and Nevada, including the Nevada Test Site, was completed during this period. Also during this period, the Tectonics Research group prepared and submitted two abstracts for the 1994 Annual Meeting of the Geological Society of America to be held in Seattle, Washington, in October. The two abstracts are on the Tectonics GIS database and 3D stress domains in southern California and Nevada interpreted from slip tendency analysis. Integrated work between Regional Tectonics Research and Regional Hydrology Research has continued with emphasis on comparing transmissivity anisotropy and *in situ* stress. Preparation of the Tectonics chapter of the semi-annual report has been a major focus of Tectonics Research during the last period.

During the next reporting period, research will continue on compiling fault slip data and critical review of compiled data for earthquakes, faults, and terrain. Preparation of samples for fission track analysis will continue during the next period. Integrated work between Regional Tectonics Research and Regional Hydrology Research will continue during the next period with emphasis on the effects of *in situ* stress on groundwater flow, and the geometry of the regional carbonate aquifer. Planning for field work will continue during the next reporting period, and field work may be conducted in the San Francisco Volcanic Field (Arizona) during Period 11.

Research Project 12—Field Volcanism

A geophysics topical report entitled Application of Seismic Tomographic and Magnetic Methods to Issues in Basaltic Volcanism (MM 5704-144-001) was delivered to NRC as

planned in Period 10. The report summarized CNWRA research conducted during 1993 and 1994 on applications and limitations of geophysical methods to the study of intrusive or buried extrusive basalts, with the objectives of reviewing application of geophysical methods being used in the YMR for site characterization, discussing applications in the context of volcanism studies, and exploring the utility and limitations of geophysical methods in volcanism studies through presentation of parametric models and the results of numerical experiments.

Field work was initiated at the Tolbachik cinder cones, Kamchatka Peninsula, Russia. The first phase of field work will be completed at the Tolbachik cinder cones during the next period.

Research Project 13—Regional Hydrogeologic Processes

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. Work continues to digitize the carbonate exposures in areas north and northwest of Cactus Flat and Gold Flat. Efforts are continuing on correlating 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. Geologic cross-sections constructed by International Technology Corporation and Geotrans, Inc., as part of the environmental restoration program at NTS, will be obtained and balanced to ensure their accuracy.

Future activities will focus on completing the semi-annual research report and continuing the development of alternative conceptual models of local and regional flow systems. Work will also continue on summarizing existing data and conceptual models of flow in the Death Valley Region for an upcoming letter report.

1.9 *Waste Solidification Systems (WSS)*

The preliminary comments on the draft of the Vitrification Plant Hot Operations and High-Level Waste Interim Storage Final Safety Analysis Report (SAR-003) were prepared by a team of reviewers. Consolidation of the comments is in process and will be transmitted to the NRC on July 18, 1994. Many of the supporting references for the SAR were received at the CNWRA as late as July 1, 1994. As a result, this round of review mainly focused on the text of the draft SAR. The preliminary review comments, which are currently due on July 20, 1994, are needed to support the NRC contribution to DOE Combined Review Group.

Revisions to the FY94 milestones in the WSS Program Element Operations Plan were recommended by the CNWRA to support the current needs of the program. NRC acceptance of the proposed revisions was also received.

In the next period, the review comments on the draft version of SAR-003 will be sent to the NRC. The CNWRA staff will participate in a Technical Review Session of the Combined Review Team for the SAR-003 on August 2–4, 1994, in Seattle, Washington.

1.10 *Monitored Retrievable Storage (MRS)*

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

The CNWRA will wait for further guidance on MRS from the NRC.

2. MANAGEMENT ISSUES

The DOE recently announced a PPA that introduced a measure of uncertainty into the NRC and, consequently, the CNWRA program. Potential changes include a significant alteration in the "mix" of reactive versus proactive work, acceleration of proactive work related to site characterization, and reintroduction of tasks related to interim storage. Should they occur, these changes could affect the demand for particular technical skills within the CNWRA. The most immediate impact of this increased uncertainty is that guidance cannot be developed for preparation of Operations Plans for DWM. As a result, these Operations Plans will not be delivered on time. Given the long-term nature of the RES component of the program, adequate guidance has been provided to allow for revision of the Research Project Plans. NRC and CNWRA management are currently analyzing potential short- and long-term impacts of the PPA; it is our understanding that NRC is preparing a complete analysis of the PPA for the Commissioners.

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 $392,456. 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 a consistent trend in both the DWM and RES DRA JCs. These JCs reflect decreased expenditures each period since Period 8. The aggregate underrun in these JCs is about 6.1 and 9.4 percent for DWM and RES, respectively.

The relatively slight reversal in the declining underrun status for the DWM JC may be attributed principally to increased spending in the EQA and GS Elements. Generally, DWM aggregate spending will adhere to its current level or it may change to accommodate a revised schedule for planned activities, including the use of student labor. Based on last quarter spending, the DWM elements will probably spend approximately 3 percent less than the total budget for the balance of this current fiscal year.

A similar reversal in the RES JC has been effected by reduced spending in the Thermohydrology, Seismic Rock Mechanics, IWPE, Stochastic, Sorption Modeling, Volcanic Systems of the Basin and Range, Field Volcanism, and Tectonic Processes Projects since last period. The Overall Research, Geochemistry, Thermohydrology, will probably show a continued pattern of below-estimate spending. With the exception of Seismic Rock Mechanics, Stochastic, Field Volcanism, and Tectonic Processes, all RES projects currently are underrun. Although peer reviews and augmented student labor will increase costs somewhat during the next two periods, the RES JC will likely be underspent by about 7 percent for the rest of this current year.

Again, core CNWRA staff work in an integrated and matrix structure, dividing their time equitably among the DWM elements and RES projects. A recent review of core CNWRA staff's labor hour distribution showed a relatively consistent pattern of labor resource allocation among the various JCs. Where both the DWM and RES DRA JC spending increases or decreases somewhat proportionately, usually vacation and sick leave cost will move inversely to the spending pattern for the DWM as well as RES DRA.

It is important to note in this regard that reallocation of core staff from task-to-task and project-to-project does not affect aggregate CNWRA spending nor the attendant accomplishment of assigned work and associated deliverables. Where possible, subcontractor, consultant, and SwRI resources have been and continue to be introduced to augment CNWRA labor, thus mitigating underspending and improving the on-time delivery of products. However, not all activities lend themselves to such augmentation. Efforts have been most effective in bringing additional resources to bear on (i) longer term activities where the investment in training and programmatic familiarization are cost-effective; (ii) certain software development efforts where programmatic awareness is not, in general, necessary; and (iii) reactive program work, particularly technical review of design and site characterization documents. Because many areas of work do not fit these criteria and we have not been tasked as extensively as anticipated in area "iii", we have been unable to significantly decrease the current underrun situation through the employment of non-core resources. This situation is anticipated to continue, and may be exacerbated by lack of further core-staff hiring in the face of current DOE programmatic uncertainties and lack of a firm base of work for others.

The actual cost through Period 10 for the DWM JC is 6.1 percent below the estimated cost. All of the elements, except GS, show cost underruns which are explained in the following paragraphs.

The aggregate underspending of 8.3 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 spending has not surpassed estimates in Subtasks 151 and 155 since Period 5 and Period 4, 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 11 through 13 will represent the CNWRA staff's participation in the development and presentation of FY95 Operations Plans. As anticipated, Subtask 154 costs have subsided in Period 10 due to completion of the CNWRA internal audit and the report preparation. Actual spending in Subtask 156, TDOCS Development, has remained under budget during the last four periods, and expenditures are expected to be consistent with estimates for the balance of FY94.

The WSE&I Element is 2.8 percent underspent at the end of this period. This represents an essentially constant level of variance for the last three periods. The expenditure level in the next period may decrease somewhat as a result of the completion of RPD Phase II implementation and a diversion of resources to resolve computer system security issues. However, this may be mitigated by an increase in activity related to OITS migration to the RPD.

Actual costs for the EQA Element are currently 26.8 percent below the estimated spending plan. This underrun is due, in part, to the postponement of DOE audits earlier in the fiscal year. The DOE audits planned through the remainder of the fiscal year are on a much more accelerated schedule and the rate of expenditure has risen substantially. By the end of FY94, EQA spending should closely approximate the estimated spending plan.

The total GS Element is 9.3 percent overspent at the end of Period 9. This reflects a 49.9 percent overrun in Geology and Geophysics and a 28.7 percent underrun in Hydrology, Geochemistry, and Climatology. The overrun in the Geology and Geophysics area decreased, but continues to reflect earlier overruns as well as additional work on two IMs. The underrun in the Hydrology, Geochemistry, and Climatology area continues to reflect the earlier low level of assignments and staff involvement in these disciplines. Increased effort, especially in Investigations of Issues Related to Hydrology, Geochemistry, Climatology, and in GWTT task areas has resulted in a decrease in the underrun.

The expenditures through Period 10 for the EBS Element are 6.7 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 8.4 percent below those planned. The decrease in spending this period is primarily due to no tasking on DBE rulemaking. 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 continues to decrease on a percentage basis. At the end of Period 10, the spending is 13.4 percent under the projected amount. A steady reduction of cost variance is expected as progress is made on the various auxiliary analyses and the expert judgment study. In addition, new tasking on the review of the DOE TSPAs was recently received; this work will require the contributions of several CNWRA staff members, SwRI personnel, and consultants.

The actual cost through Period 10 for the RES JC is 9.4 percent below the estimated cost. All of the projects, except Seismic Rock Mechanics, Stochastic, Field Volcanism, and Tectonic Processes, show cost underruns which are explained in the following paragraphs.

Costs incurred to date for the Overall Research Project are 10.7 percent below projected costs. This underrun is largely due to the delay in receipt of the Near-Field Research Project SOW.

The Geochemistry Research Project is presently 6.2 percent below budget. This deficit is expected to be eliminated in upcoming periods as consultant time for peer reviews is billed and as the final topical report is revised.

Costs to date for the Thermohydrology Research Project are currently 13.0 percent below estimated costs. 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 currently 5.1 percent more than the planned expenditure. This is because of the efforts needed for completing the shaking table test of jointed rock mass. Expenditures during the next three periods will decrease thereby bringing the cost close to planned levels by the end of FY94.

The IWPE Research Project costs to date are 6.2 percent less than planned. The IWPE Research Project activities will increase primarily in Task 3, and the costs will be close to the project plan in the future periods.

Total spending to date for the Stochastic Research Project is 28.2 percent over the projected costs. It is anticipated that the final overrun of the Project will be approximately 35 percent.

The Geochemical Natural Analog Research Project costs to date are 6.9 percent under total planned costs. Project costs for the remainder of the fiscal year should approximate planned values. Occasional, short-term, cost deviations corresponding largely to field research expenses are anticipated.

By Period 10, spending for the Sorption Modeling for High-Level Waste Performance Assessment to date is 1.8 percent less than expected. Spending levels should continue to follow predicted costs closely in the future periods.

By the end of Period 10, spending in the Volcanic Systems of the Basin and Range Research Project is 21.2 percent less than expected. Underspending is attributed to increased effort in the Field Volcanism project during Period 10. It is anticipated that spending will remain low in Period 11 also due to activities in the Field Volcanism project. Expenses are expected to increase sharply in the final periods as the peer review activities increase.

By the end of Period 10, the Regional Hydrology Research Project is 10.7 percent underspent. Activities related to stress-conductivity evaluations and database loading are anticipated to increase spending over the next period.

Total expenditures through Period 10 for the Field Volcanism Research Project are about 3.9 percent more than expected. This spending was due to (i) preparation of the MM on application of geophysical methods to volcanology, and (ii) preparation for field work at Tolbachik volcano. Spending will remain at about the same rate due to field work, then decrease sharply in the final periods due to peer review activities in the Volcanic Systems of the Basin and Range Research Project.

By the end of Period 10, the Tectonics Research Project was 15.7 percent overspent. This reflects a continuation of the overall decrease in the cost overrun for the project and a continuation of spending below the planned rate.

At the end of Period 10, the PA Research Project costs are 19.0 percent under the cumulative 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: (i) a focused effort on completion of remaining milestones, (ii) completion of three new deliverables which were recently added to the project, and (iii) consultant costs associated with external peer reviews of three technical reports.

Expenditures to date in the WSS Project are 1.1 percent below the planned level. The current activities in reviewing the Vitrification SAR from the DOE have increased the expenditures in the project.

In the MRS Project, no work was assigned to the CNWRA by the NRC. Costs incurred to date for the MRS project are 77.1 percent below those planned. CNWRA may not receive additional work assignments until an MRS site is identified.

TABLE 1. CNWRA CORE STAFF—HIRING PROFILE AND STATUS (07/08/94)

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	1
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	1
GEOHYDROLOGY/HYDROGEOLOGY (b)	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 (a)	4	5	5	6	6	6	6	6	2
QUALITY ASSURANCE	2	2	2	2	2	2	2	2	0
RADIOISOTOPE GEOCHEMISTRY	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	1
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 (b)	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	6

Staffing Summary

	Professional	Support	Total
Current	52	16	68
Limited Term	1	0	1
Offers Made	0	0	0
Planned This Date	53	16	70
Planned End of FY94*	60	17	77

*Include staff planned for work for others

(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 (07/08/94)

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, A.B.GUREGHIAN, S.STOTHOFF, G.WITTMEYER
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, R.MANTEUFEL, S.MOHANTY
QUALITY ASSURANCE	B.MABRITO, R.BRIENT
RADIOISOTOPE GEOCHEMISTRY	D.PICKETT
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
5702-151-440	IM	TDI Report	08/25/94	N/A	Deleted - Contents to be part of TDOCS Implementation IM 5702-155-402 as agreed to by NRC
5702-425-402	IM	Analysis of Coupled Fault/Dike Interaction	05/09/94	08/15/94	Redoing graphics obtained from subcontractor
5702-723-430	IM	Letter Report on Demonstration of a GUI and Centralized Database for TPA Code	06/30/94	08/01/94	Additional time required to address technical review comments
5704-034-094-002	IM	Report for Scale Model Experiments	09/30/94	TBD FY95	Additional time required for analysis of experimental results
5704-037-094-002	MM	Final Project Report (Seismic Rock Mechanics)	09/29/94	TBD FY95	This report can only be completed either concurrently or after completion of IM 5704-034-094-002 which has been rescheduled from FY94 to FY95
5704-191-094-004	IM	Analysis of Hydraulic Characteristics of Hydrothermally-Altered Tuff	07/29/94	09/16/94	Additional time needed for analysis of laboratory data and application of computer codes
5704-002-094-030*	IM	Support Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-038-094*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-046-080*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report

* Milestone represents a chapter in the Semi-Annual Report 1994-1.

TABLE 3. SUMMARY OF SCHEDULE CHANGES (Cont'd)

Milestone Number	Type	Description	Original Date	Revised Date	Rationale for Change
5704-065-094*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-074-181*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-125-030*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-136-402*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-145-001*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-167-003*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report
5704-194-094*	IM	Semi-Annual Report 1994-1	08/12/94	09/12/94	Delayed due to the learning of new software (Framemaker) being used to prepare this report

* Milestone represents a chapter in the Semi-Annual Report 1994-1.

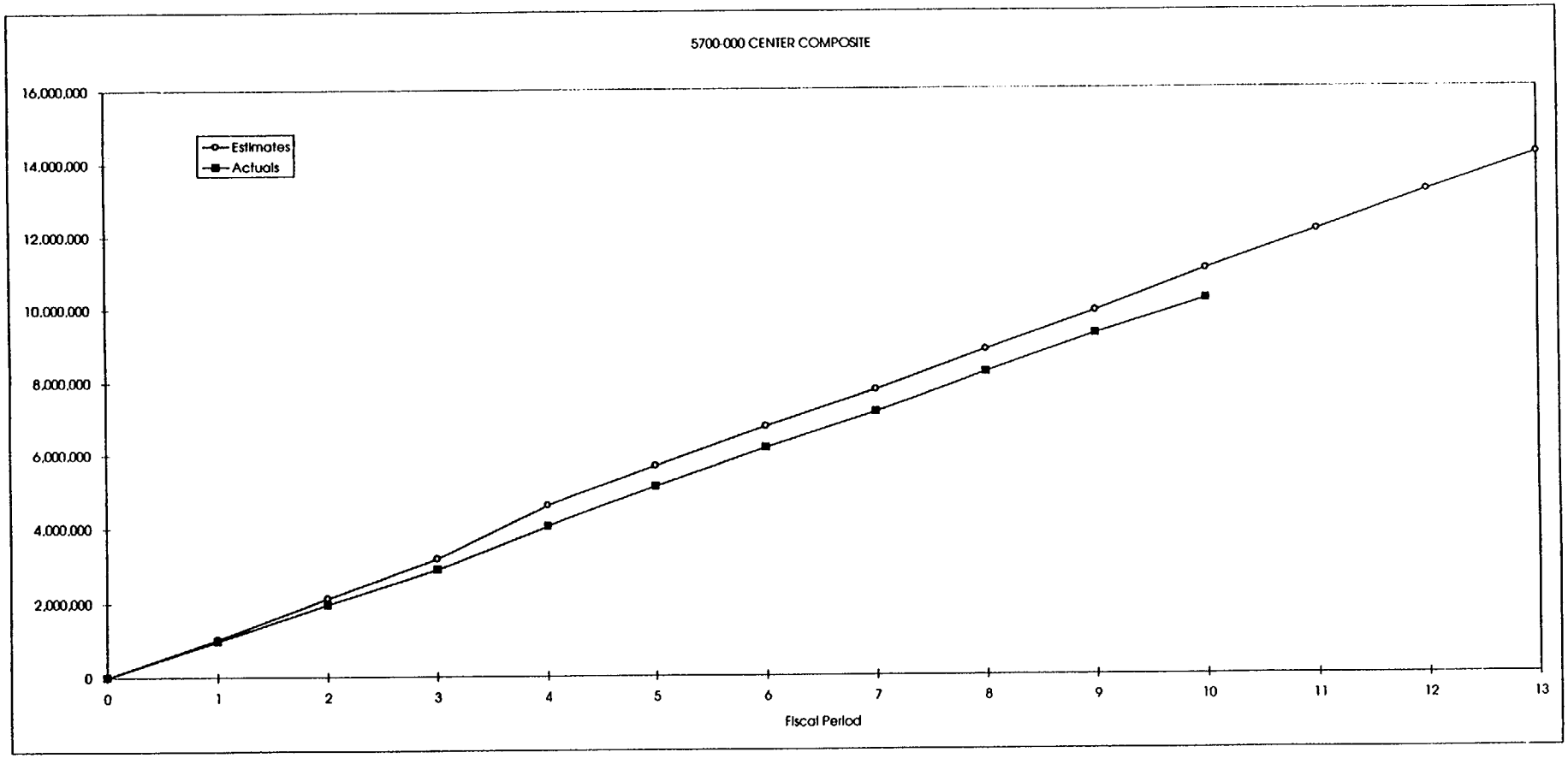
TABLE 4. FINANCIAL STATUS

	Funds Authorized*	Funds Costed to Date**	Funds Uncosted	Commitments
GS	3,567,399	2,237,974.37	1,329,424.63	11,693.18
EBS	2,376,992	1,422,246.66	954,745.34	31,570.38
RDCO	1,206,199	1,731,080.23	(524,881.23)	27,547.20
WSEI	2,582,731	2,448,810.28	133,920.72	6,417.95
EQA	1,284,454	194,472.79	1,089,981.21	6,458.00
PA	2,480,853	2,479,537.98	1,315.02	162,416.76
COPS	4,329,800	3,774,267.51	555,532.49	29,322.50
HLW	17,828,428	14,288,389.82	3,540,038.18	275,425.97
OVERALL	466,856	340,364.67	126,491.33	2,726.28
GEOCHEM	388,410	371,212.42	17,197.58	0.00
THERMO	924,236	666,516.11	257,719.89	2,641.00
SEISMIC	1,208,067	881,474.23	326,592.77	44,822.21
IWPE	1,377,499	964,017.48	413,481.52	1,874.99
STOCH	510,727	467,318.45	43,408.55	100.00
ANALOGS	1,069,663	713,602.62	356,060.38	2,810.00
SORPTION	996,066	737,515.52	258,550.48	1,308.62
RES PA	795,113	847,205.06	(52,092.06)	17,444.34
VOLCAN (R)	427,348	479,375.43	(52,027.43)	2,725.20
VOLCAN (FLD)	774,382	434,262.23	340,119.77	36,279.50
REG HYDRO	774,545	218,033.22	556,511.78	0.00
TECTONIC	1,236,738	569,007.52	667,730.48	4,298.21
RES	10,949,650	7,689,904.96	3,259,745.04	117,030.35
WSS	235,392	184,776.76	50,615.11	0.00
MRS	56,231	17,221.92	39,009.08	0.00
TOTAL	29,069,701	22,180,293.46	6,889,407.41	392,456.32

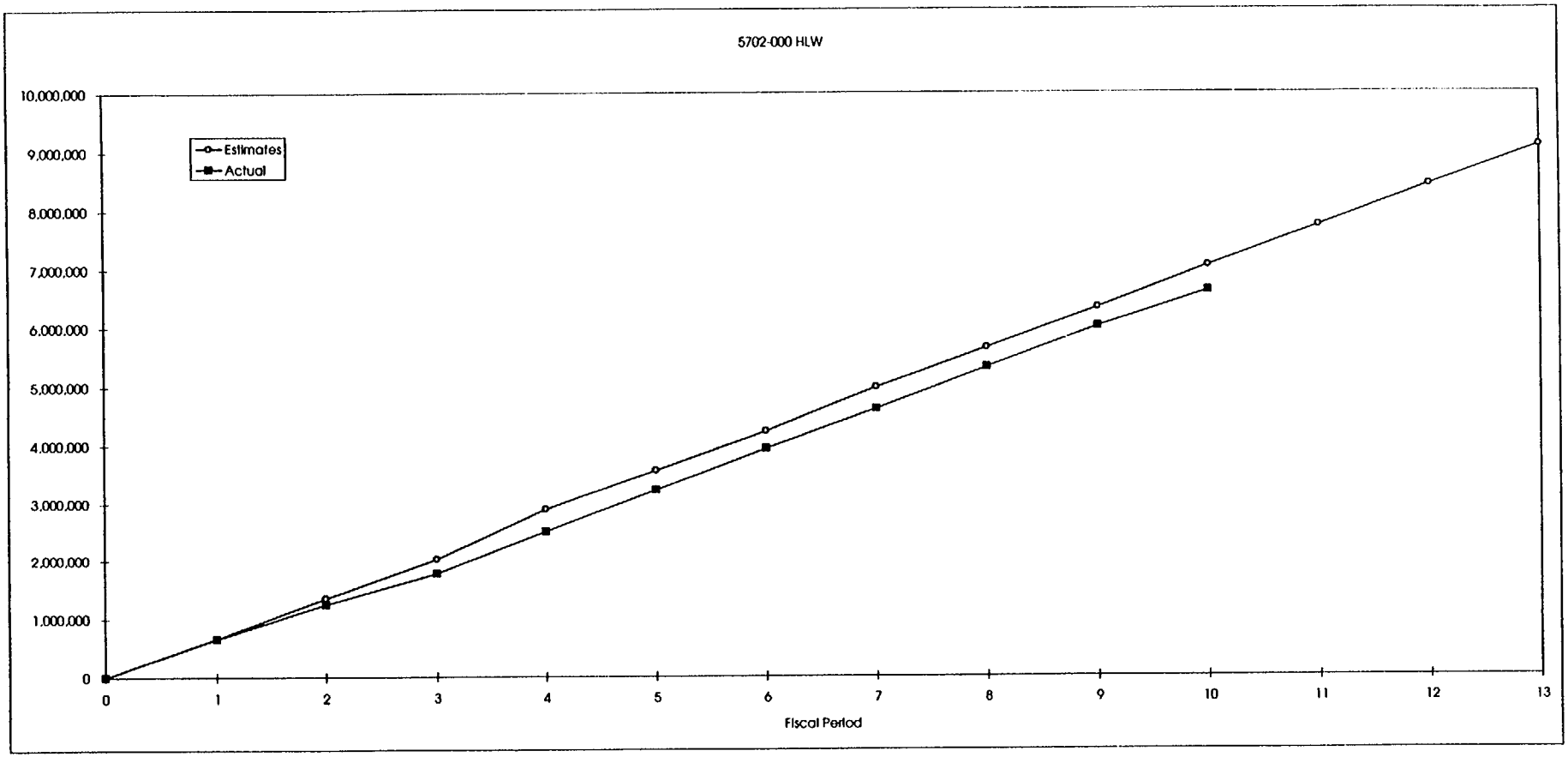
* Additional Authorized Funds of $2,576,788 for HLW and $314,325 for RES have not been allocated.
** Costed to Date includes Base Fee. Additional fee awarded is not included. Amount authorized includes carryover.

APPENDIX A

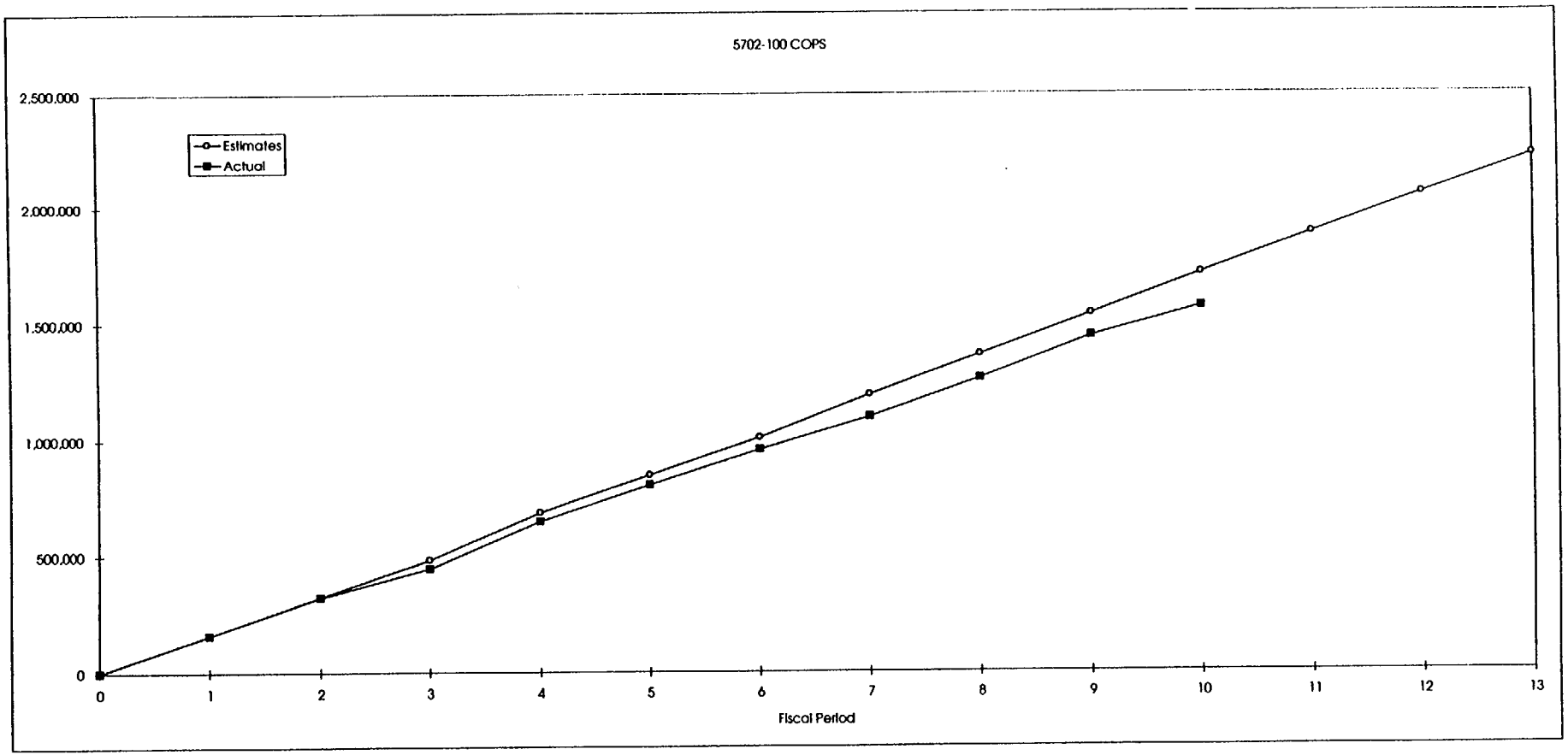
PLANNED AND ACTUAL COSTS, AND COST VARIANCES



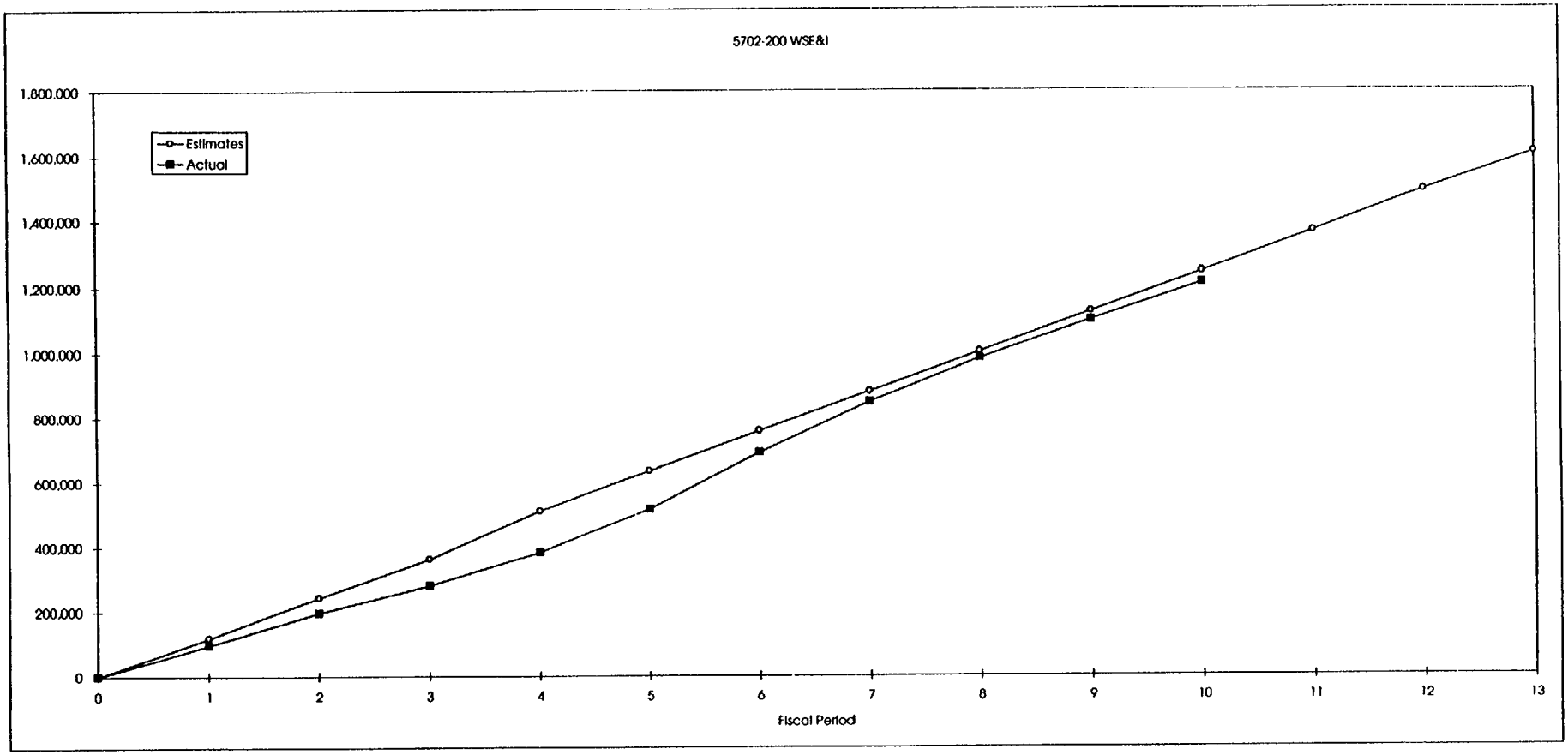
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	1,036,251	1,078,946	1,059,336	1,414,291	1,078,045	1,071,882	1,014,150	1,072,881	1,074,638	1,129,355	1,058,997	1,070,915	1,024,255	11,029,775
ACT. PERIOD COST	988,990	968,936	933,235	1,128,970	1,078,151	1,053,022	982,940	1,080,961	1,054,851	951,161	0	0	0	10,221,216
VARIANCE, $	47,261	110,010	126,101	285,321	(106)	18,860	31,210	(8,080)	19,787	178,194	0	0	0	808,559
VARIANCE, %	4.6%	10.2%	11.9%	20.2%	0.0%	1.8%	3.1%	-0.8%	1.8%	15.8%	0.0%	0.0%	0.0%	7.3%
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	5,098,281	6,151,304	7,134,244	8,215,204	9,270,055	10,221,216	0	0	0	
PERCENT COMPLETE	7.0%	13.8%	20.4%	28.3%	35.9%	43.4%	50.3%	57.9%	65.4%	72.1%	0.0%	0.0%	0.0%	
VARIANCE, $	47,261	157,272	283,373	568,694	568,588	587,447	618,657	610,578	630,365	808,559	0	0	0	
VARIANCE, %	4.6%	7.4%	8.9%	12.4%	10.0%	8.7%	8.0%	6.9%	6.4%	7.3%	0.0%	0.0%	0.0%	



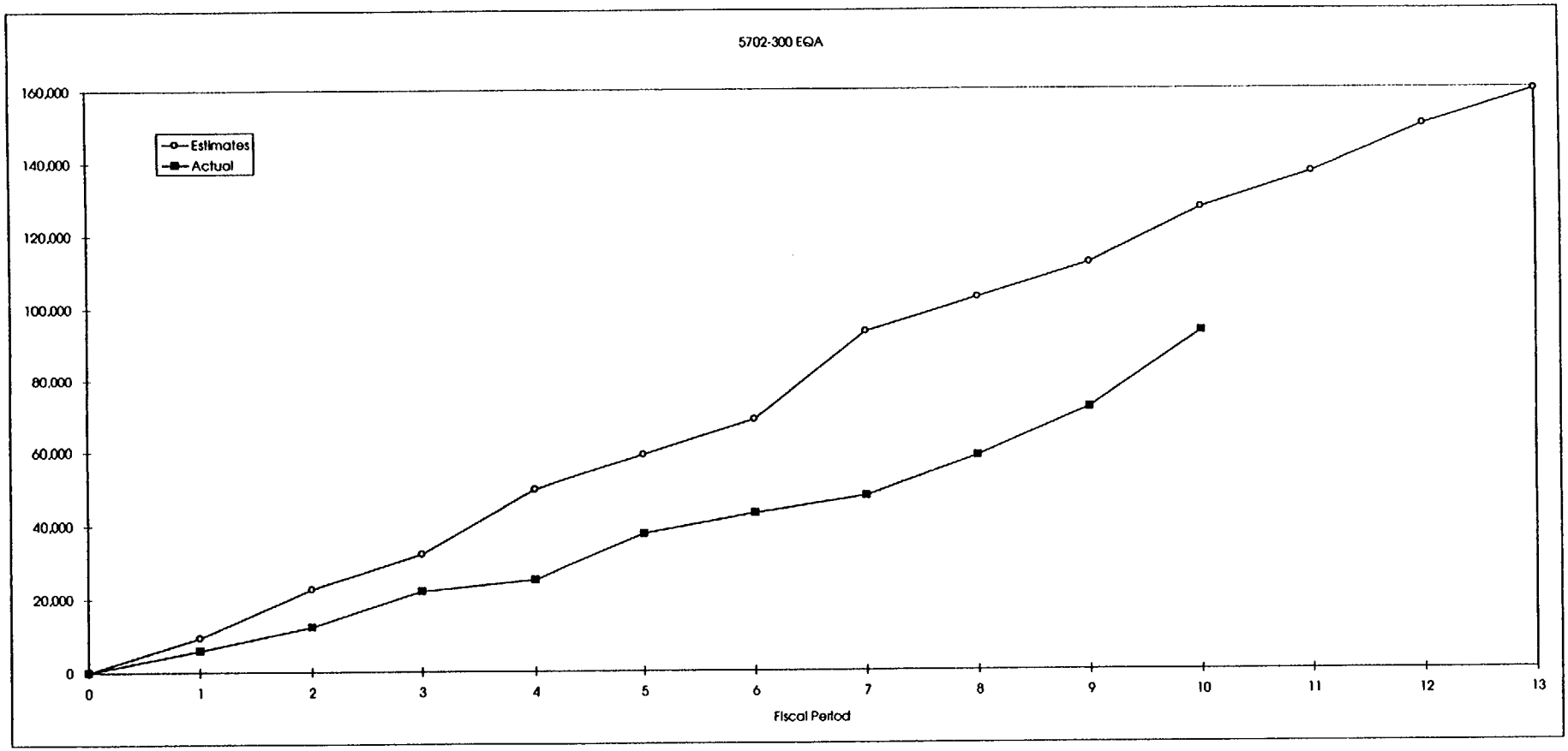
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	657,900	683,467	673,276	876,775	670,044	664,041	747,693	677,579	681,092	713,118	681,421	685,782	664,624	7,044,985
ACT. PERIOD COST	644,178	600,899	531,606	721,653	723,345	715,068	673,816	711,145	691,351	604,644	0	0	0	6,617,704
VARIANCE, $	13,722	82,568	141,670	155,122	(53,301)	(51,027)	73,877	(33,566)	(10,259)	108,474	0	0	0	427,281
VARIANCE, %	2.1%	12.1%	21.0%	17.7%	-8.0%	-7.7%	9.9%	-5.0%	-1.5%	15.2%	0.0%	0.0%	0.0%	6.1%
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	6,013,061	6,617,704	0	0	0	
PERCENT COMPLETE	7.1%	13.7%	19.6%	27.5%	35.5%	43.4%	50.8%	58.6%	66.2%	72.9%	0.0%	0.0%	0.0%	
VARIANCE, $	13,722	96,290	237,960	393,082	339,781	288,754	362,631	329,065	318,806	427,281	0	0	0	
VARIANCE, %	2.1%	7.2%	11.8%	13.6%	9.5%	6.8%	7.3%	5.8%	5.0%	6.1%	0.0%	0.0%	0.0%	



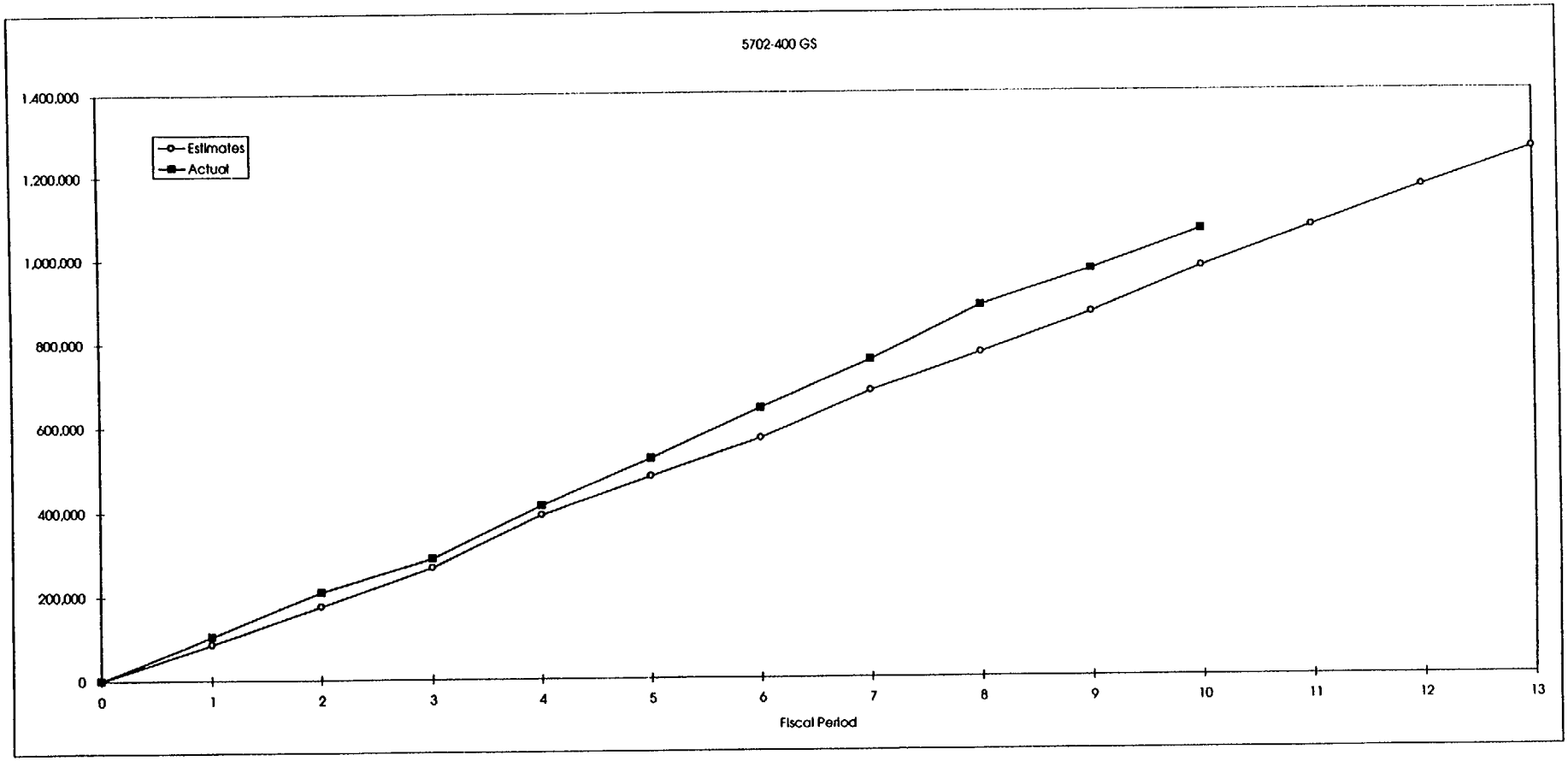
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	158,237	166,818	158,580	204,037	160,928	161,388	181,456	172,949	174,616	171,415	170,141	172,223	168,862	1,710,424
ACT. PERIOD COST	160,035	161,950	125,227	202,472	155,313	150,826	141,954	163,030	183,818	123,846	0	0	0	1,568,470
VARIANCE, $	(1,798)	4,868	33,353	1,565	5,615	10,562	39,502	9,919	(9,202)	47,569	0	0	0	141,954
VARIANCE, %	-1.1%	2.9%	21.0%	0.8%	3.5%	6.5%	21.8%	5.7%	-5.3%	27.8%	0.0%	0.0%	0.0%	8.3%
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	1,444,624	1,568,470	0	0	0	
PERCENT COMPLETE	7.2%	14.5%	20.1%	29.2%	36.2%	43.0%	49.4%	56.8%	65.0%	70.6%	0.0%	0.0%	0.0%	
VARIANCE, $	(1,798)	3,070	36,424	37,989	43,604	54,166	93,668	103,587	94,385	141,954	0	0	0	
VARIANCE, %	-1.1%	0.9%	7.5%	5.5%	5.1%	5.4%	7.9%	7.6%	6.1%	8.3%	0.0%	0.0%	0.0%	



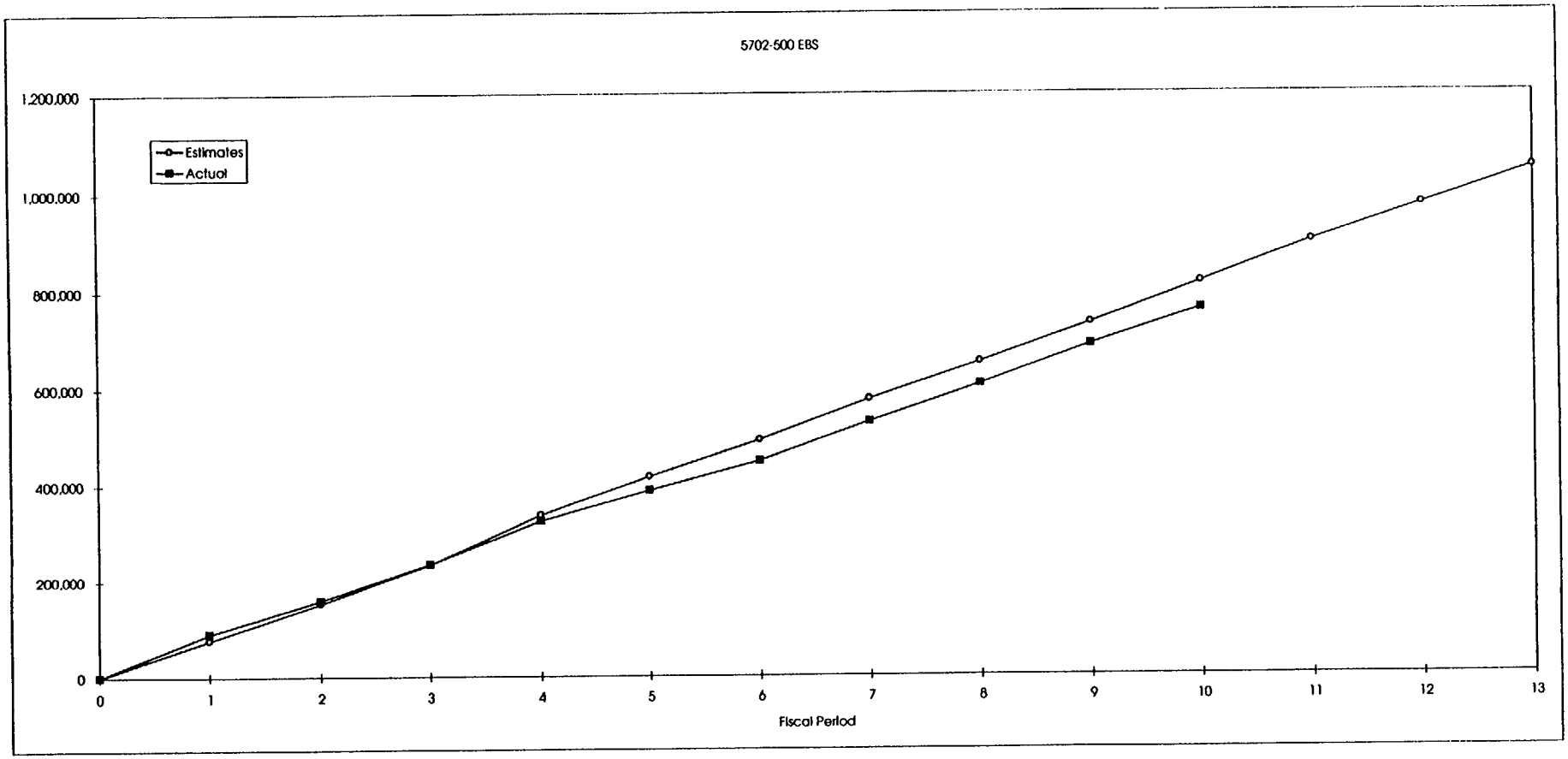
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	119,827	123,641	118,376	151,465	121,502	121,740	122,552	122,722	120,476	122,817	118,103	123,956	117,767	1,245,118
ACT. PERIOD COST	98,078	98,795	83,026	102,918	135,074	173,506	154,749	135,897	115,546	112,718	0	0	0	1,210,307
VARIANCE, $	21,749	24,846	35,350	48,547	(13,572)	(51,766)	(32,197)	(13,175)	4,930	10,099	0	0	0	34,811
VARIANCE, %	18.1%	20.1%	29.9%	32.1%	-11.2%	-42.5%	-26.3%	-10.7%	4.1%	8.2%	0.0%	0.0%	0.0%	2.8%
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	1,097,590	1,210,307	0	0	0	
PERCENT COMPLETE	6.1%	12.3%	17.4%	23.9%	32.3%	43.1%	52.7%	61.2%	68.4%	75.4%	0.0%	0.0%	0.0%	
VARIANCE, $	21,749	46,594	81,944	130,491	116,920	65,154	32,957	19,782	24,711	34,811	0	0	0	
VARIANCE, %	18.1%	19.1%	22.6%	25.4%	18.4%	8.6%	3.7%	2.0%	2.2%	2.8%	0.0%	0.0%	0.0%	



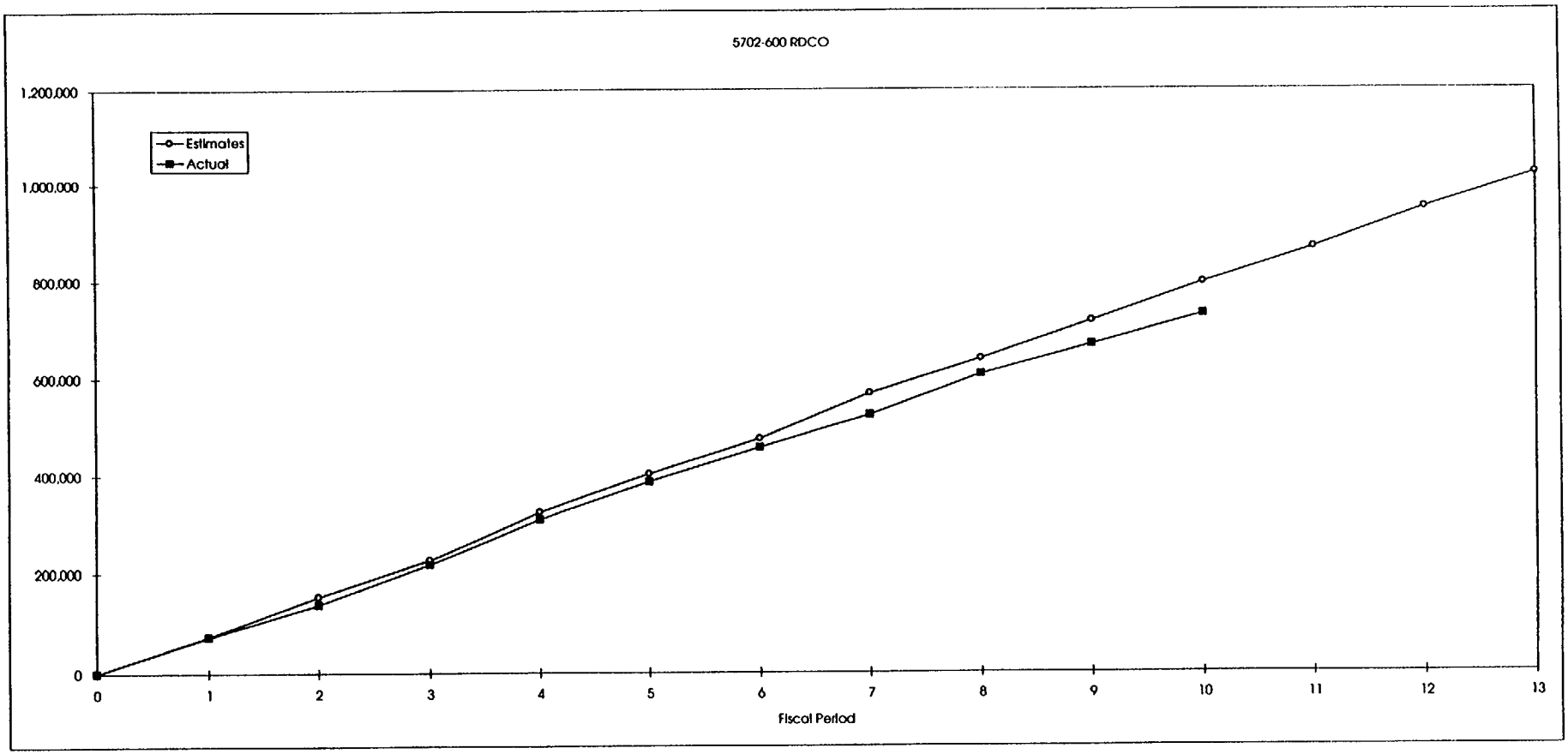
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	9,472	13,130	9,619	17,387	9,419	9,745	24,398	9,543	9,395	15,020	9,619	13,130	9,543	127,128
ACT. PERIOD COST	5,931	6,296	9,795	3,003	12,542	5,524	4,459	11,051	13,286	21,232	0	0	0	93,119
VARIANCE, $	3,541	6,834	(176)	14,384	(3,123)	4,221	19,939	(1,508)	(3,891)	(6,212)	0	0	0	34,009
VARIANCE, %	37.4%	52.0%	-1.8%	82.7%	-33.2%	43.3%	81.7%	-15.8%	-41.4%	-41.4%	0.0%	0.0%	0.0%	26.8%
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	71,887	93,119	0	0	0	
PERCENT COMPLETE	3.7%	7.7%	13.8%	15.7%	23.6%	27.0%	29.8%	36.8%	45.1%	58.4%	0.0%	0.0%	0.0%	
VARIANCE, $	3,541	10,375	10,199	24,583	21,460	25,681	45,620	44,112	40,221	34,009	0	0	0	
VARIANCE, %	37.4%	45.9%	31.7%	49.6%	36.4%	37.3%	49.0%	42.9%	35.9%	26.8%	0.0%	0.0%	0.0%	



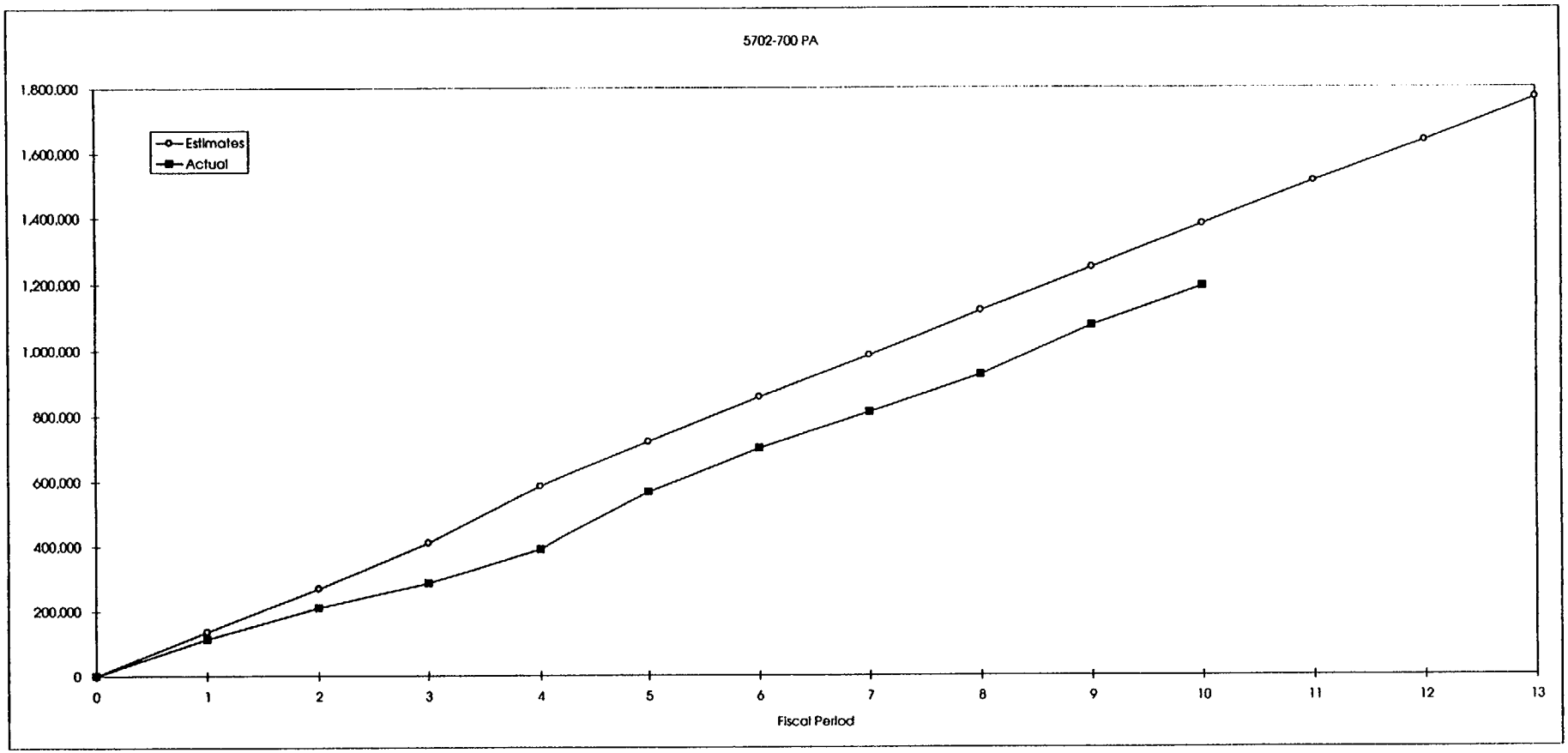
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	85,199	89,534	91,769	124,743	88,111	88,443	112,570	90,681	94,493	108,147	96,917	94,226	91,166	973,690
ACT. PERIOD COST	103,969	104,642	78,620	126,025	107,488	120,307	113,676	127,911	85,441	96,169	0	0	0	1,064,248
VARIANCE, $	(18,770)	(15,108)	13,149	(1,282)	(19,377)	(31,864)	(1,106)	(37,230)	9,052	11,978	0	0	0	(90,558)
VARIANCE, %	-22.0%	-16.9%	14.3%	-1.0%	-22.0%	-36.0%	-1.0%	-41.1%	9.6%	11.1%	0.0%	0.0%	0.0%	-9.3%
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	968,079	1,064,248	0	0	0	
PERCENT COMPLETE	8.3%	16.6%	22.9%	32.9%	41.5%	51.0%	60.1%	70.3%	77.1%	84.7%	0.0%	0.0%	0.0%	
VARIANCE, $	(18,770)	(33,878)	(20,730)	(22,012)	(41,389)	(73,253)	(74,359)	(111,589)	(102,536)	(90,558)	0	0	0	
VARIANCE, %	-22.0%	-19.4%	-7.8%	-5.6%	-8.6%	-12.9%	-10.9%	-14.5%	-11.8%	-9.3%	0.0%	0.0%	0.0%	



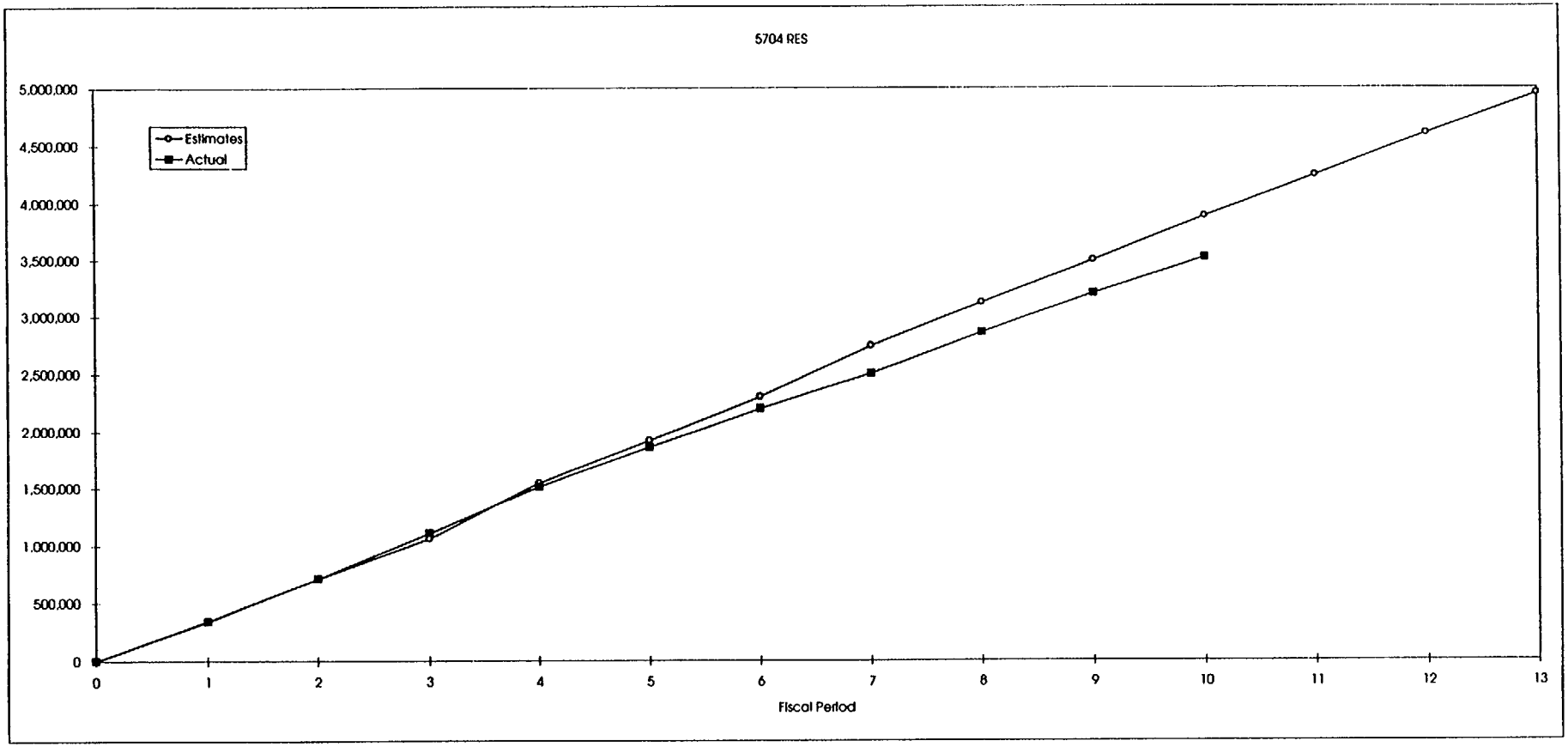
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	76,356	76,589	81,729	103,642	77,971	75,208	84,524	74,539	79,238	84,381	81,687	75,658	75,384	814,177
ACT. PERIOD COST	89,924	68,848	76,194	90,429	62,146	61,174	80,174	76,556	80,357	73,679	0	0	0	759,482
VARIANCE, $	(13,568)	7,741	5,535	13,213	15,825	14,034	4,350	(2,017)	(1,119)	10,702	0	0	0	54,695
VARIANCE, %	-17.8%	10.1%	6.8%	12.7%	20.3%	18.7%	5.1%	-2.7%	-1.4%	12.7%	0.0%	0.0%	0.0%	6.7%
EST. FY CUMUL	76,356	152,945	234,674	338,316	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	685,803	759,482	0	0	0	
PERCENT COMPLETE	8.6%	15.2%	22.4%	31.1%	37.0%	42.9%	50.5%	57.8%	65.5%	72.5%	0.0%	0.0%	0.0%	
VARIANCE, $	(13,568)	(5,828)	(293)	12,920	28,745	42,779	47,130	45,112	43,993	54,695	0	0	0	
VARIANCE, %	-17.8%	-3.8%	-0.1%	3.8%	6.9%	8.7%	8.2%	6.9%	6.0%	6.7%	0.0%	0.0%	0.0%	



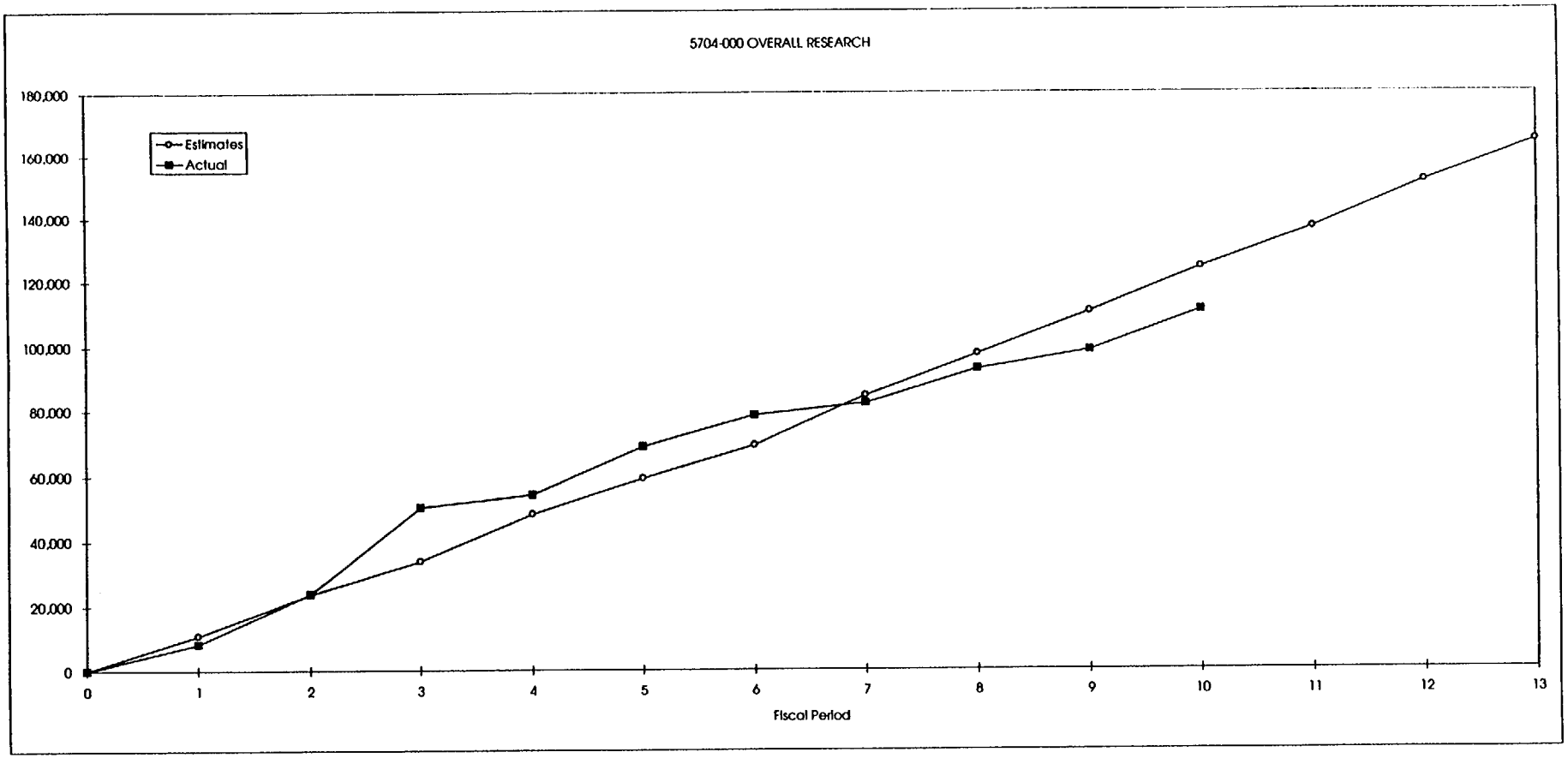
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	72,685	80,430	73,220	99,845	76,147	72,059	93,419	70,965	75,924	80,708	72,414	79,689	72,757	795,402
ACT. PERIOD COST	72,067	64,548	81,312	92,428	76,019	69,791	67,524	82,685	60,986	60,888	0	0	0	728,249
VARIANCE, $	618	15,882	(8,092)	7,417	128	2,268	25,895	(11,720)	14,938	19,820	0	0	0	67,153
VARIANCE, %	0.8%	19.7%	-11.1%	7.4%	0.2%	3.1%	27.7%	-16.5%	19.7%	24.6%	0.0%	0.0%	0.0%	8.4%
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	667,361	728,249	0	0	0	
PERCENT COMPLETE	7.1%	13.4%	21.4%	30.4%	37.9%	44.7%	51.3%	59.4%	65.4%	71.4%	0.0%	0.0%	0.0%	
VARIANCE, $	618	16,500	8,408	15,825	15,953	18,221	44,116	32,395	47,333	67,153	0	0	0	
VARIANCE, %	0.8%	10.8%	3.7%	4.9%	4.0%	3.8%	7.8%	5.1%	6.6%	8.4%	0.0%	0.0%	0.0%	



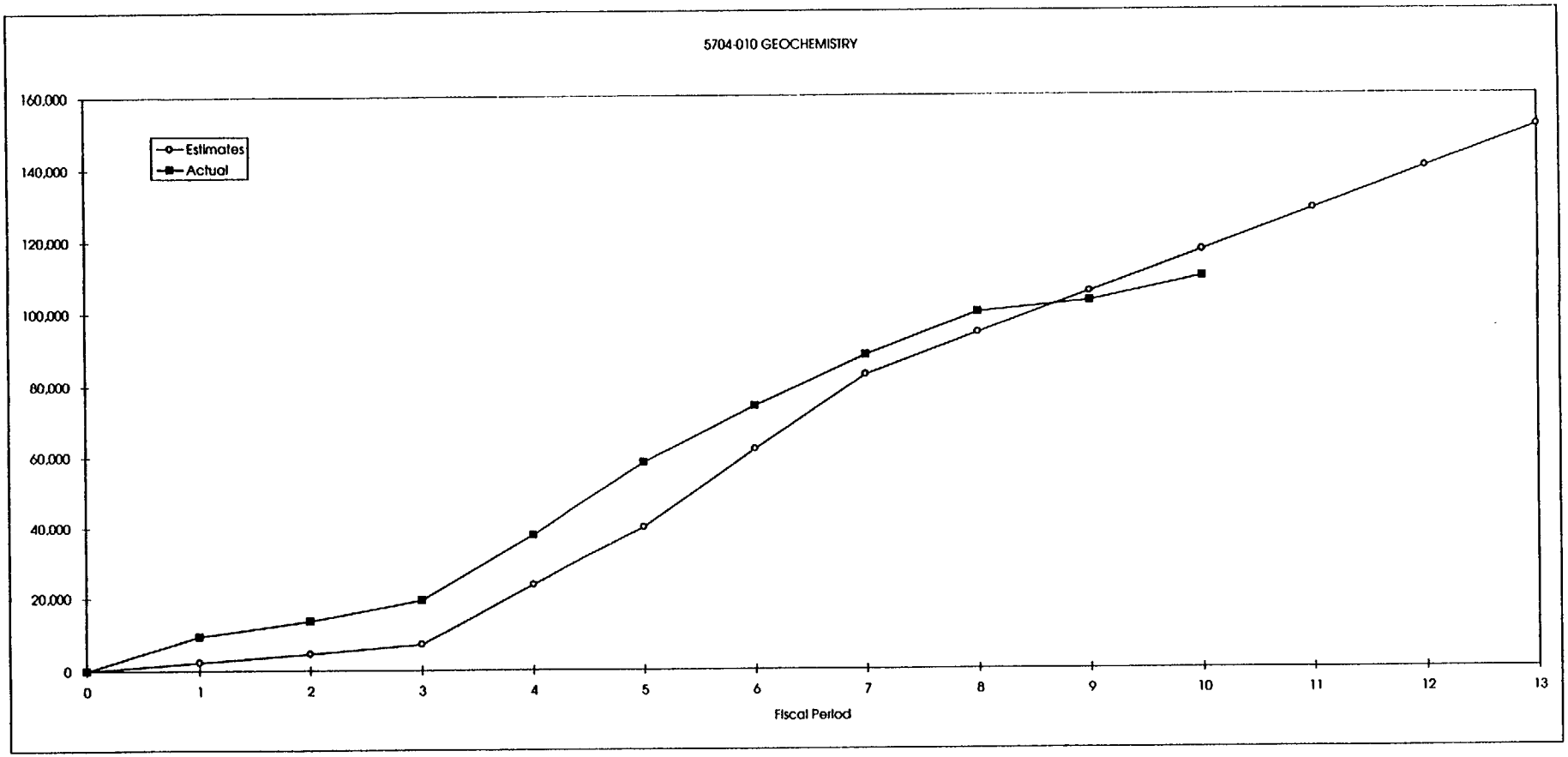
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	136,124	133,325	139,983	175,656	135,966	135,458	128,774	136,180	126,950	130,630	132,540	126,900	129,145	1,379,046
ACT. PERIOD COST	114,173	95,819	77,432	104,378	174,763	133,941	111,280	114,014	151,918	116,111	0	0	0	1,193,828
VARIANCE, $	21,951	37,506	62,551	71,278	(38,797)	1,517	17,494	22,166	(24,968)	14,519	0	0	0	185,218
VARIANCE, %	16.1%	28.1%	44.7%	40.6%	-28.5%	1.1%	13.6%	16.3%	-19.7%	11.1%	0.0%	0.0%	0.0%	13.4%
EST. FY CUMUL	136,124	269,449	409,432	585,088	721,054	856,512	985,286	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	1,077,717	1,193,828	0	0	0	
PERCENT COMPLETE	6.5%	11.9%	16.3%	22.2%	32.1%	39.6%	45.9%	52.4%	61.0%	67.5%	0.0%	0.0%	0.0%	
VARIANCE, $	21,951	59,457	122,008	193,286	154,489	156,007	173,501	195,667	170,699	185,218	0	0	0	
VARIANCE, %	16.1%	22.1%	29.8%	33.0%	21.4%	18.2%	17.6%	17.4%	13.7%	13.4%	0.0%	0.0%	0.0%	



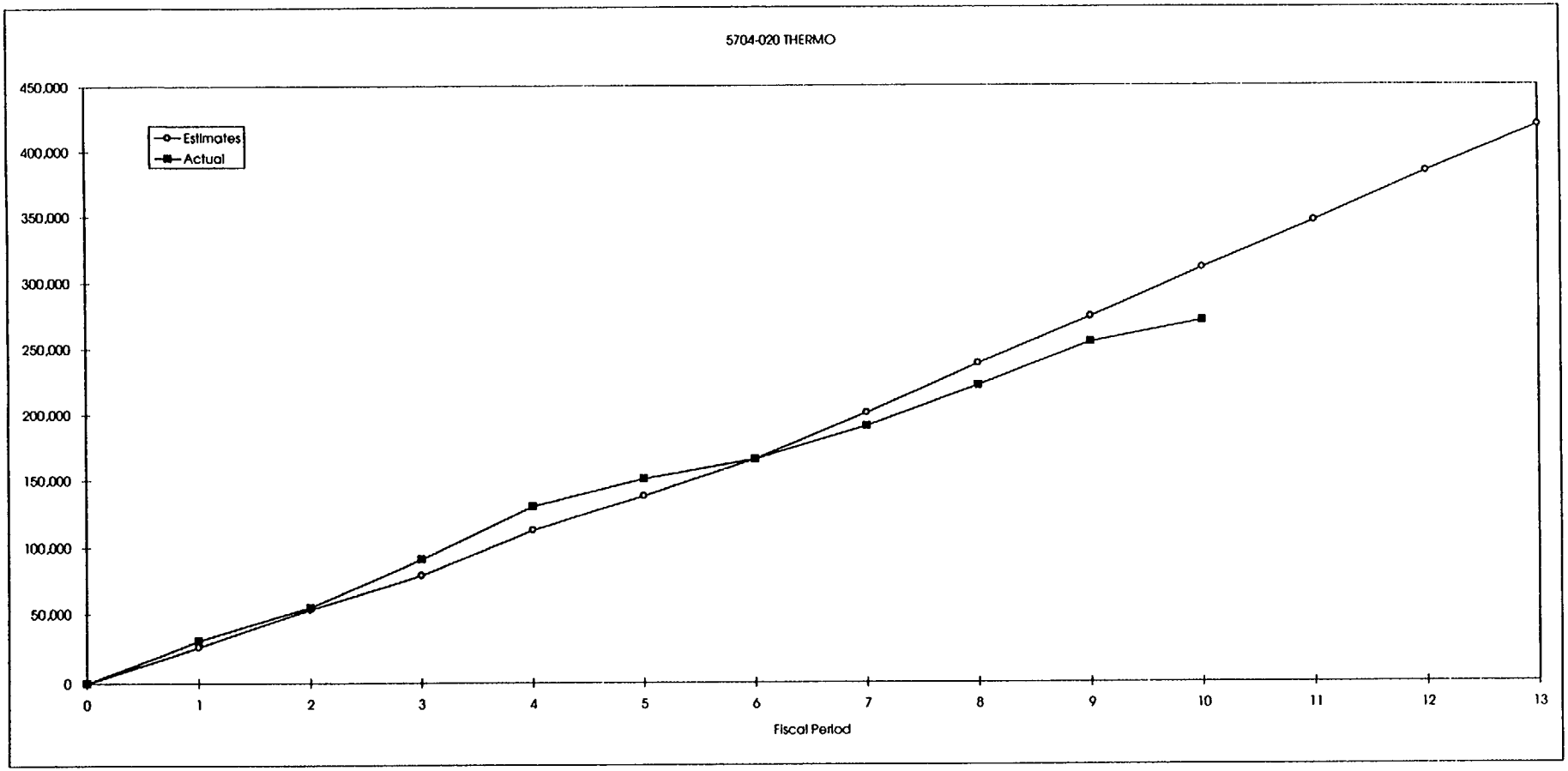
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	345,037	360,641	350,759	489,674	373,097	375,287	443,430	378,904	371,967	391,344	357,089	365,466	343,321	3,880,140
ACT. PERIOD COST	342,323	364,760	399,889	404,182	350,424	330,940	305,497	356,554	346,781	313,808	0	0	0	3,515,157
VARIANCE, $	2,714	(4,119)	(49,130)	85,492	22,673	44,347	137,933	22,350	25,186	77,536	0	0	0	364,983
VARIANCE, %	0.8%	-1.1%	-14.0%	17.5%	6.1%	11.8%	31.1%	5.9%	6.8%	19.8%	0.0%	0.0%	0.0%	9.4%
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	3,201,349	3,515,157	0	0	0	
PERCENT COMPLETE	6.9%	14.3%	22.4%	30.6%	37.6%	44.3%	50.5%	57.7%	64.7%	71.1%	0.0%	0.0%	0.0%	
VARIANCE, $	2,714	(1,405)	(50,535)	34,957	57,630	101,977	239,910	262,260	287,447	364,983	0	0	0	
VARIANCE, %	0.8%	-0.2%	-4.8%	2.3%	3.0%	4.4%	8.8%	8.4%	8.2%	9.4%	0.0%	0.0%	0.0%	



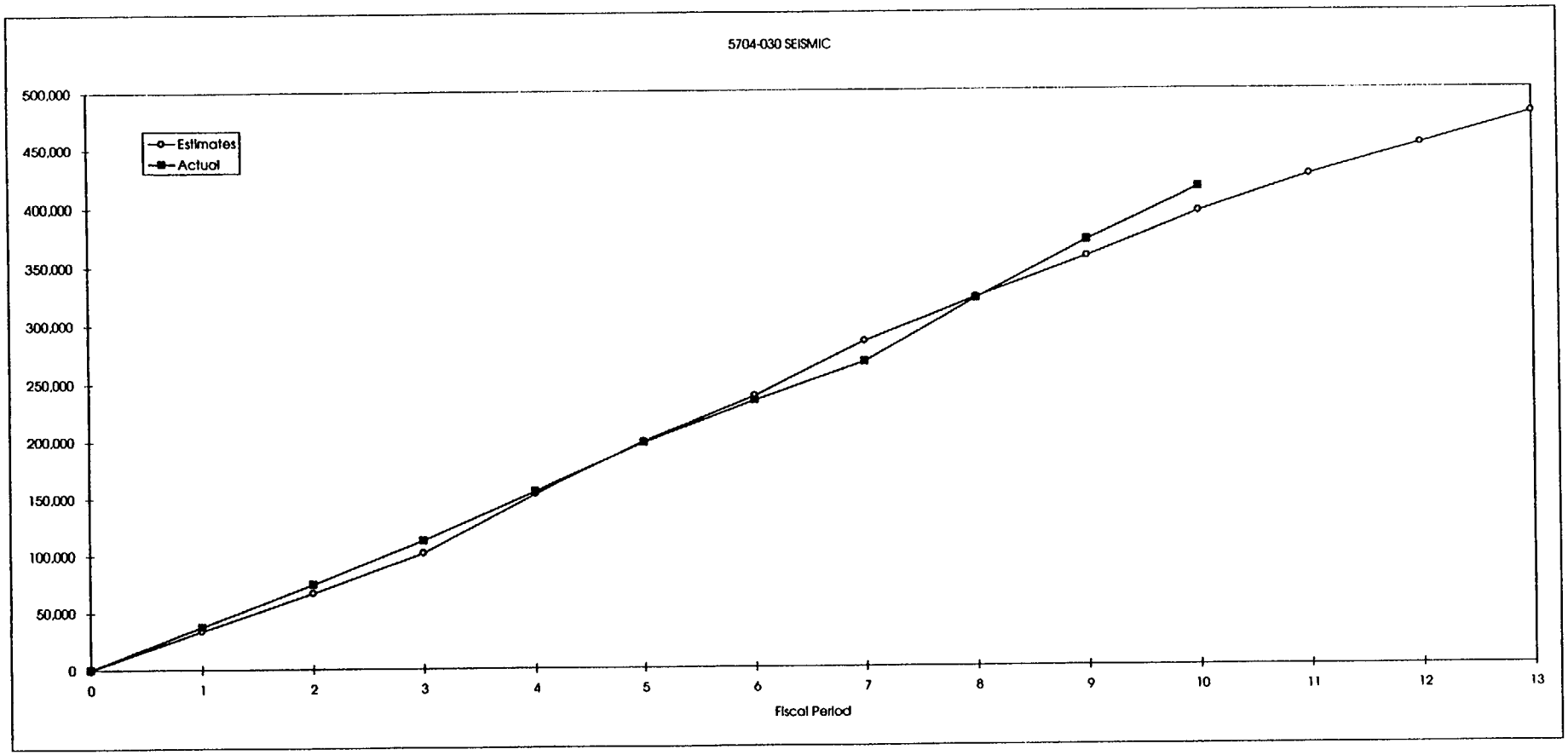
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	10,705	12,830	10,214	14,593	10,754	9,785	15,443	13,077	12,921	13,823	12,357	14,972	12,920	124,145
ACT. PERIOD COST	8,084	15,638	26,636	3,894	14,289	9,817	3,571	10,693	5,790	12,474	0	0	0	110,886
VARIANCE, $	2,621	(2,808)	(16,422)	10,699	(3,535)	(32)	11,872	2,384	7,131	1,349	0	0	0	13,259
VARIANCE, %	24.5%	-21.9%	-160.8%	73.3%	-32.9%	-0.3%	76.9%	18.2%	55.2%	9.8%	0.0%	0.0%	0.0%	10.7%
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	98,412	110,886	0	0	0	
PERCENT COMPLETE	4.9%	14.4%	30.6%	33.0%	41.7%	47.7%	49.8%	56.3%	59.9%	67.5%	0.0%	0.0%	0.0%	
VARIANCE, $	2,621	(186)	(16,608)	(5,910)	(9,445)	(9,477)	2,395	4,779	11,910	13,259	0	0	0	
VARIANCE, %	24.5%	-0.8%	-49.2%	-12.2%	-16.0%	-13.8%	2.8%	4.9%	10.8%	10.7%	0.0%	0.0%	0.0%	



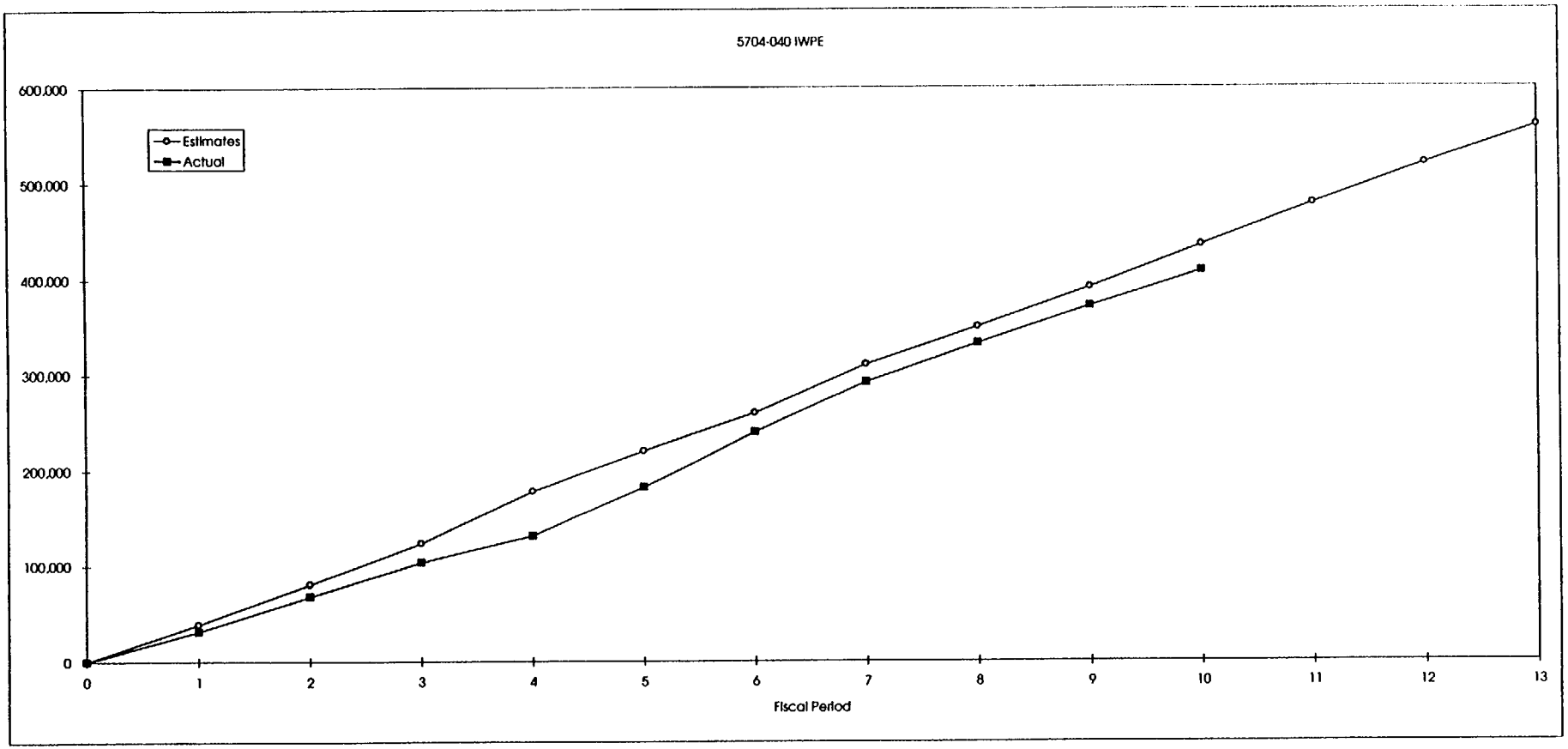
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	2,381	2,292	2,502	16,354	16,354	21,997	20,844	11,366	11,366	11,366	11,461	11,461	11,463	116,822
ACT. PERIOD COST	9,570	4,153	5,451	18,497	20,566	15,808	13,968	11,840	2,964	6,773	0	0	0	109,590
VARIANCE, $	(7,189)	(1,861)	(2,949)	(2,143)	(4,212)	6,189	6,877	(474)	8,402	4,593	0	0	0	7,232
VARIANCE, %	-301.9%	-81.2%	-117.9%	-13.1%	-25.8%	28.1%	33.0%	-4.2%	73.9%	40.4%	0.0%	0.0%	0.0%	6.2%
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	102,817	109,590	0	0	0	
PERCENT COMPLETE	6.3%	9.1%	12.7%	24.9%	38.5%	49.0%	58.2%	66.0%	68.0%	72.5%	0.0%	0.0%	0.0%	
VARIANCE, $	(7,189)	(9,050)	(11,999)	(14,142)	(18,355)	(12,165)	(5,289)	(5,763)	2,639	7,232	0	0	0	
VARIANCE, %	-301.9%	-193.7%	-167.2%	-60.1%	-46.0%	-19.7%	-6.4%	-6.1%	2.5%	6.2%	0.0%	0.0%	0.0%	



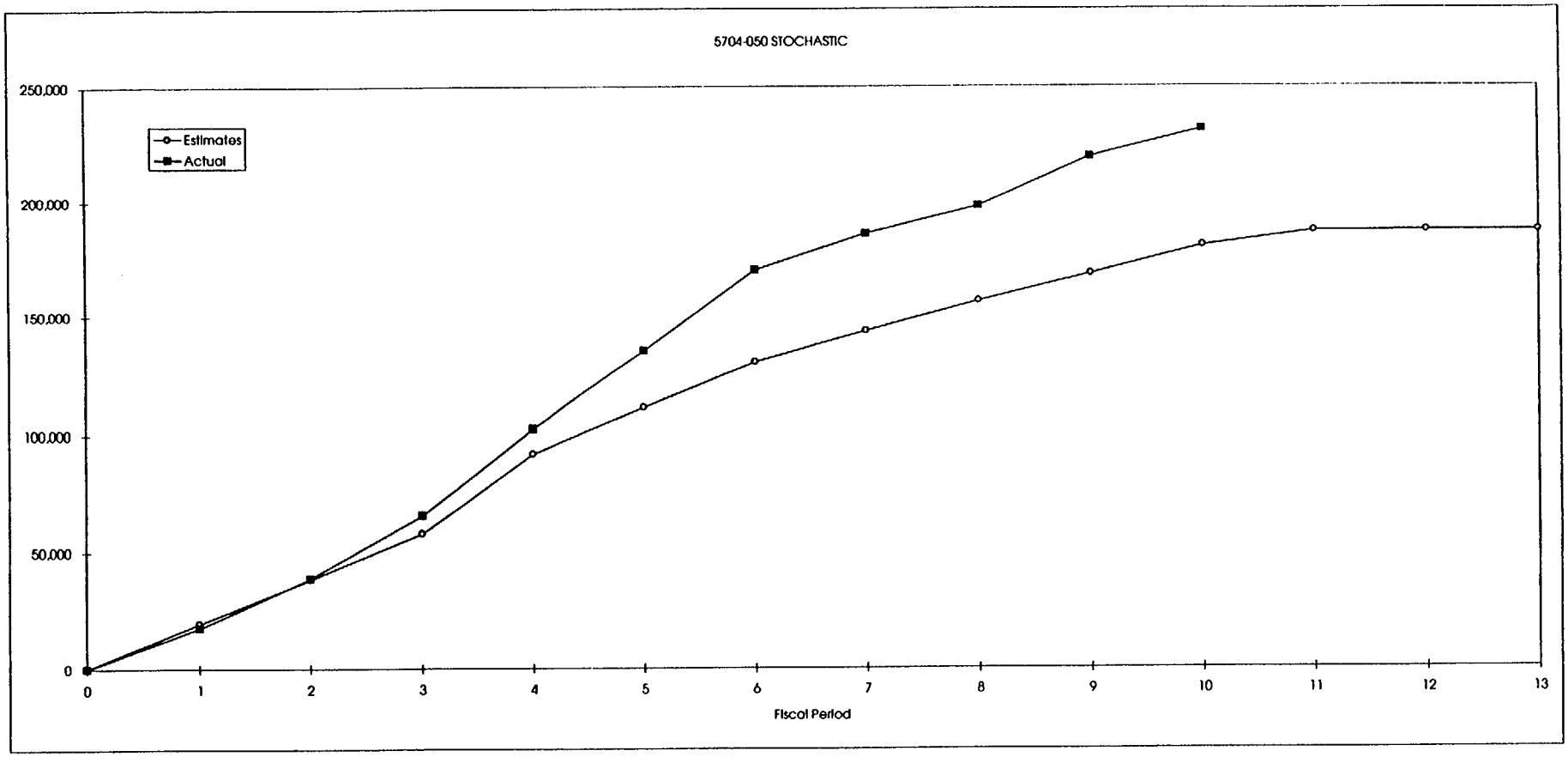
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	25,828	27,200	25,454	33,994	24,997	27,909	34,995	37,396	35,396	37,360	35,467	37,084	35,700	310,529
ACT. PERIOD COST	30,464	24,159	35,990	39,219	20,617	15,183	24,777	30,868	32,740	16,132	0	0	0	270,147
VARIANCE, $	(4,636)	3,041	(10,536)	(5,225)	4,380	12,726	10,218	6,528	2,657	21,228	0	0	0	40,382
VARIANCE, %	-18.0%	11.2%	-41.4%	-15.4%	17.5%	45.6%	29.2%	17.5%	7.5%	56.8%	0.0%	0.0%	0.0%	13.0%
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	383,080	418,780	
ACTUAL FY CUMUL	30,464	54,623	90,613	129,832	150,449	165,632	190,408	221,276	254,015	270,147	0	0	0	
PERCENT COMPLETE	7.3%	13.0%	21.6%	31.0%	35.9%	39.6%	45.5%	52.8%	60.7%	64.5%	0.0%	0.0%	0.0%	
VARIANCE, $	(4,636)	(1,595)	(12,131)	(17,356)	(12,976)	(250)	9,969	16,497	19,154	40,382	0	0	0	
VARIANCE, %	-18.0%	-3.0%	-15.5%	-15.4%	-9.4%	-0.2%	5.0%	6.9%	7.0%	13.0%	0.0%	0.0%	0.0%	



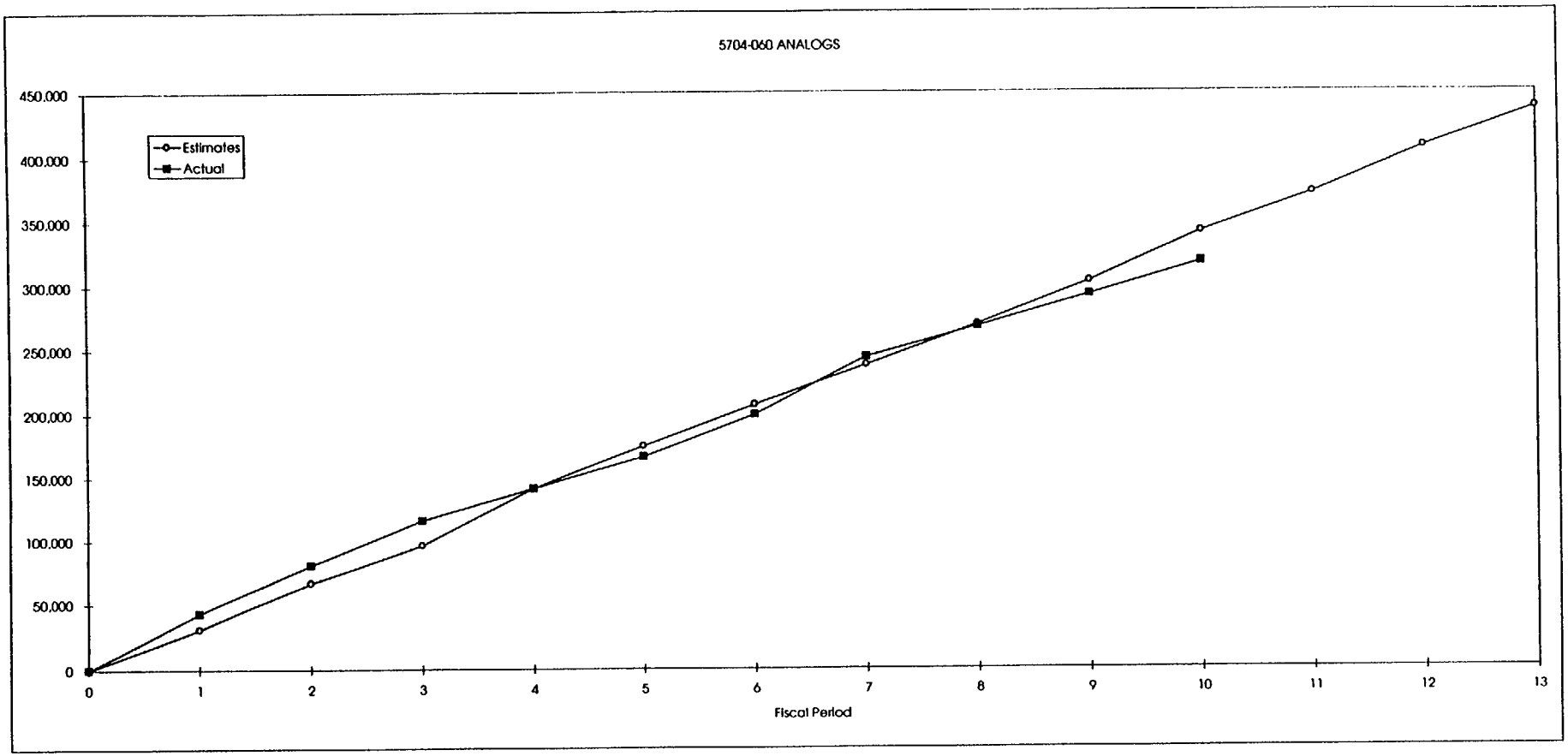
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	33,622	33,080	34,675	51,591	45,249	39,412	46,631	37,487	34,798	37,497	30,447	26,518	26,679	394,042
ACT. PERIOD COST	37,662	36,655	38,201	42,511	42,271	36,476	32,597	54,679	49,077	44,087	0	0	0	414,216
VARIANCE, $	(4,040)	(3,575)	(3,526)	9,080	2,978	2,936	14,034	(17,192)	(14,279)	(6,590)	0	0	0	(20,174)
VARIANCE, %	-12.0%	-10.8%	-10.2%	17.6%	6.6%	7.4%	30.1%	-45.9%	-41.0%	-17.6%	0.0%	0.0%	0.0%	-5.1%
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	266,373	321,052	370,129	414,216	0	0	0	
PERCENT COMPLETE	7.9%	15.6%	23.6%	32.5%	41.3%	48.9%	55.8%	67.2%	77.5%	86.7%	0.0%	0.0%	0.0%	
VARIANCE, $	(4,040)	(7,615)	(11,141)	(2,060)	918	3,853	17,887	695	(13,584)	(20,174)	0	0	0	
VARIANCE, %	-12.0%	-11.4%	-11.0%	-1.3%	0.5%	1.6%	6.3%	0.2%	-3.8%	-5.1%	0.0%	0.0%	0.0%	



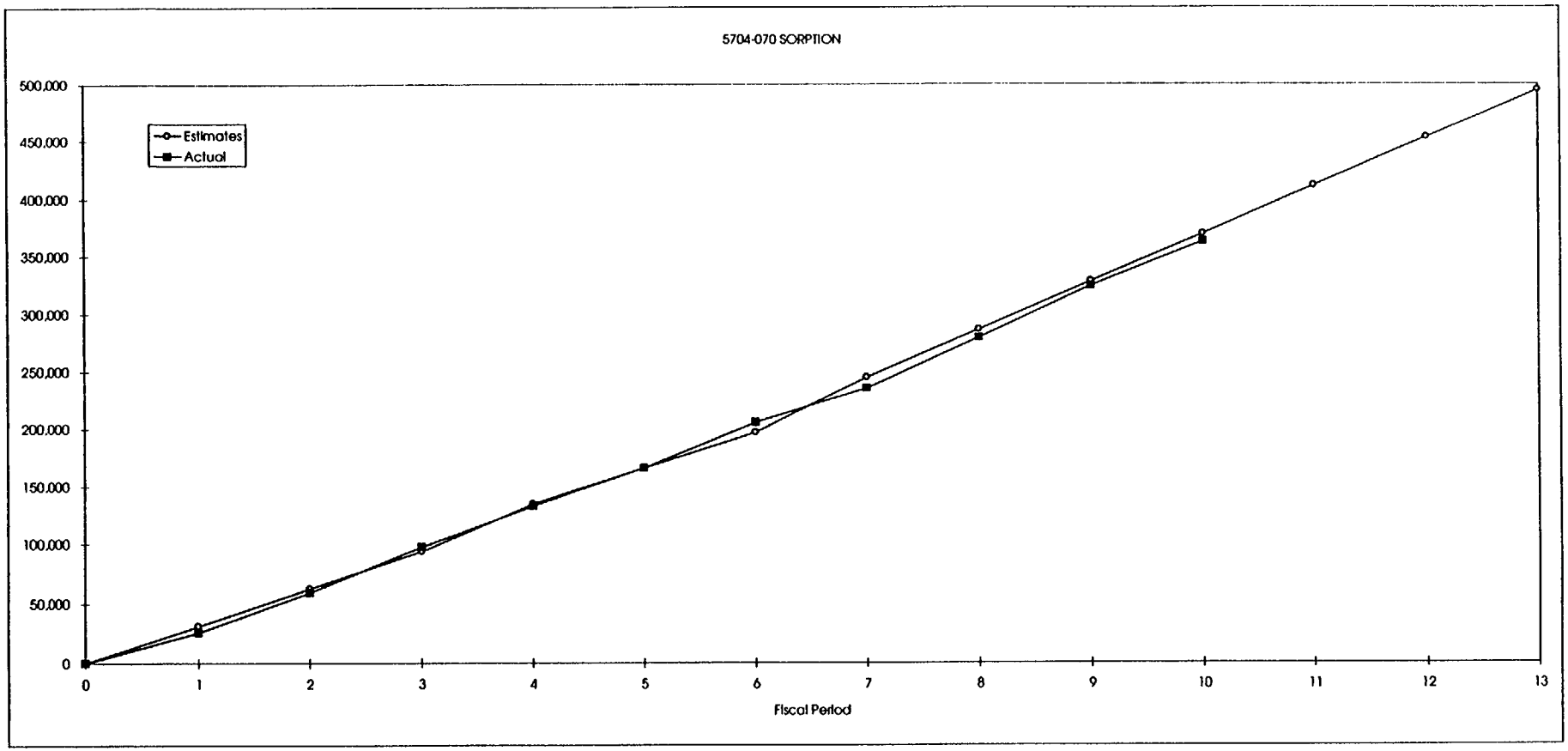
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	39,126	41,310	43,232	54,736	41,652	38,840	50,775	38,681	42,344	44,233	43,218	41,167	39,654	434,929
ACT. PERIOD COST	31,353	36,368	35,843	28,347	50,692	56,819	51,580	40,435	39,281	37,383	0	0	0	408,100
VARIANCE, $	7,773	4,942	7,389	26,389	(9,040)	(17,979)	(805)	(1,754)	3,063	6,850	0	0	0	26,829
VARIANCE, %	19.9%	12.0%	17.1%	48.2%	-21.7%	-46.3%	-1.6%	-4.5%	7.2%	15.5%	0.0%	0.0%	0.0%	6.2%
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	370,717	408,100	0	0	0	
PERCENT COMPLETE	5.6%	12.1%	18.5%	23.6%	32.7%	42.8%	52.1%	59.3%	66.3%	73.0%	0.0%	0.0%	0.0%	
VARIANCE, $	7,773	12,715	20,104	46,493	37,453	19,474	18,670	16,916	19,979	26,829	0	0	0	
VARIANCE, %	19.9%	15.8%	16.3%	26.1%	17.0%	7.5%	6.0%	4.9%	5.1%	6.2%	0.0%	0.0%	0.0%	



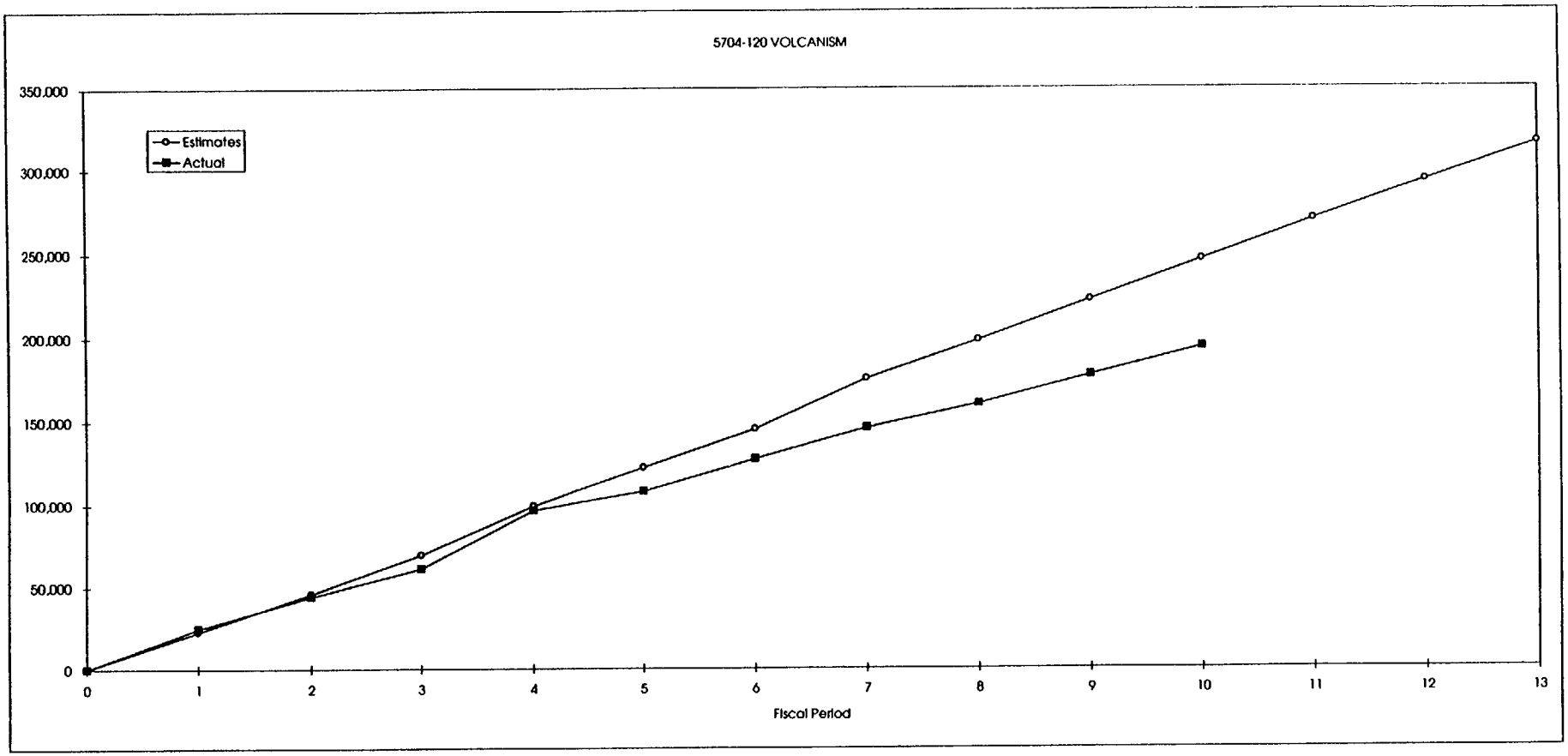
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	19,575	18,792	19,609	33,801	19,404	19,049	13,384	12,796	11,900	11,900	6,297	0	0	180,210
ACT. PERIOD COST	17,707	21,171	26,806	36,731	32,646	34,990	15,381	12,314	21,424	11,790	0	0	0	230,960
VARIANCE, $	1,868	(2,379)	(7,197)	(2,930)	(13,242)	(15,941)	(1,997)	482	(9,524)	110	0	0	0	(50,750)
VARIANCE, %	9.5%	-12.7%	-36.7%	-8.7%	-68.2%	-83.7%	-14.9%	3.8%	-80.0%	0.9%	0.0%	0.0%	0.0%	-28.2%
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	219,170	230,960	0	0	0	
PERCENT COMPLETE	9.5%	20.8%	35.2%	54.9%	72.4%	91.2%	99.4%	106.0%	117.5%	123.8%	0.0%	0.0%	0.0%	
VARIANCE, $	1,868	(511)	(7,708)	(10,638)	(23,881)	(39,822)	(41,819)	(41,337)	(50,860)	(50,750)	0	0	0	
VARIANCE, %	9.5%	-1.3%	-13.3%	-11.6%	-21.5%	-30.6%	-29.1%	-26.4%	-30.2%	-28.2%	0.0%	0.0%	0.0%	



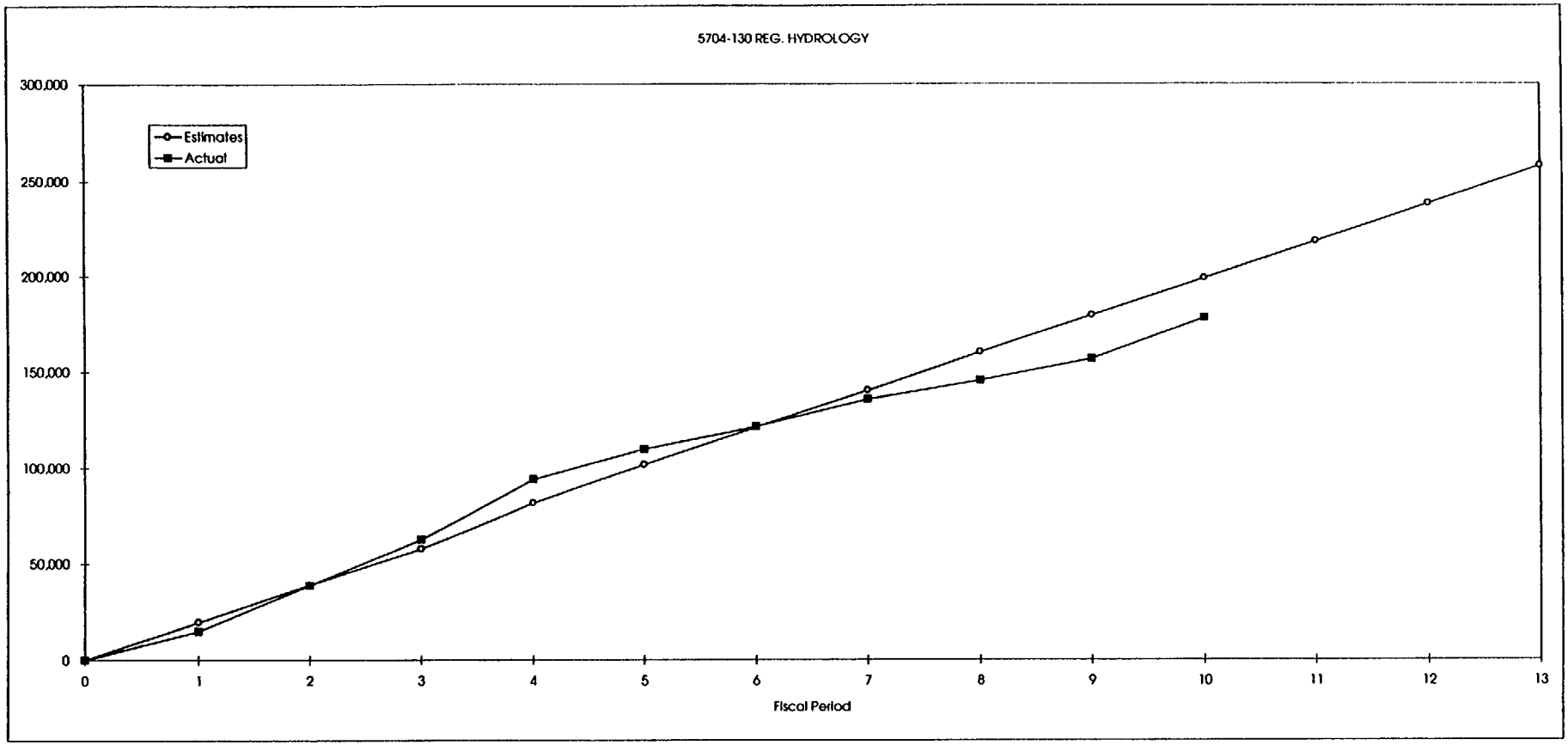
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	30,461	35,818	29,786	45,606	33,067	32,420	30,166	32,428	33,275	38,121	29,862	35,818	29,841	341,148
ACT. PERIOD COST	42,564	37,938	35,406	25,782	24,303	33,431	44,233	24,442	24,492	24,962	0	0	0	317,552
VARIANCE, $	(12,103)	(2,120)	(5,620)	19,824	8,764	(1,011)	(14,067)	7,987	8,783	13,159	0	0	0	23,596
VARIANCE, %	-39.7%	-5.9%	-18.9%	43.5%	26.5%	-3.1%	-46.6%	24.6%	26.4%	34.5%	0.0%	0.0%	0.0%	6.9%
EST. FY CUMUL	30,461	66,279	96,065	141,671	174,738	207,158	237,324	269,752	303,027	341,148	371,010	406,828	436,669	
ACTUAL FY CUMUL	42,564	80,502	115,908	141,690	165,992	199,424	243,656	268,098	292,590	317,552	0	0	0	
PERCENT COMPLETE	9.7%	18.4%	26.5%	32.4%	38.0%	45.7%	55.8%	61.4%	67.0%	72.7%	0.0%	0.0%	0.0%	
VARIANCE, $	(12,103)	(14,223)	(19,843)	(19)	8,746	7,734	(6,332)	1,654	10,437	23,596	0	0	0	
VARIANCE, %	-39.7%	-21.5%	-20.7%	0.0%	5.0%	3.7%	-2.7%	0.6%	3.4%	6.9%	0.0%	0.0%	0.0%	



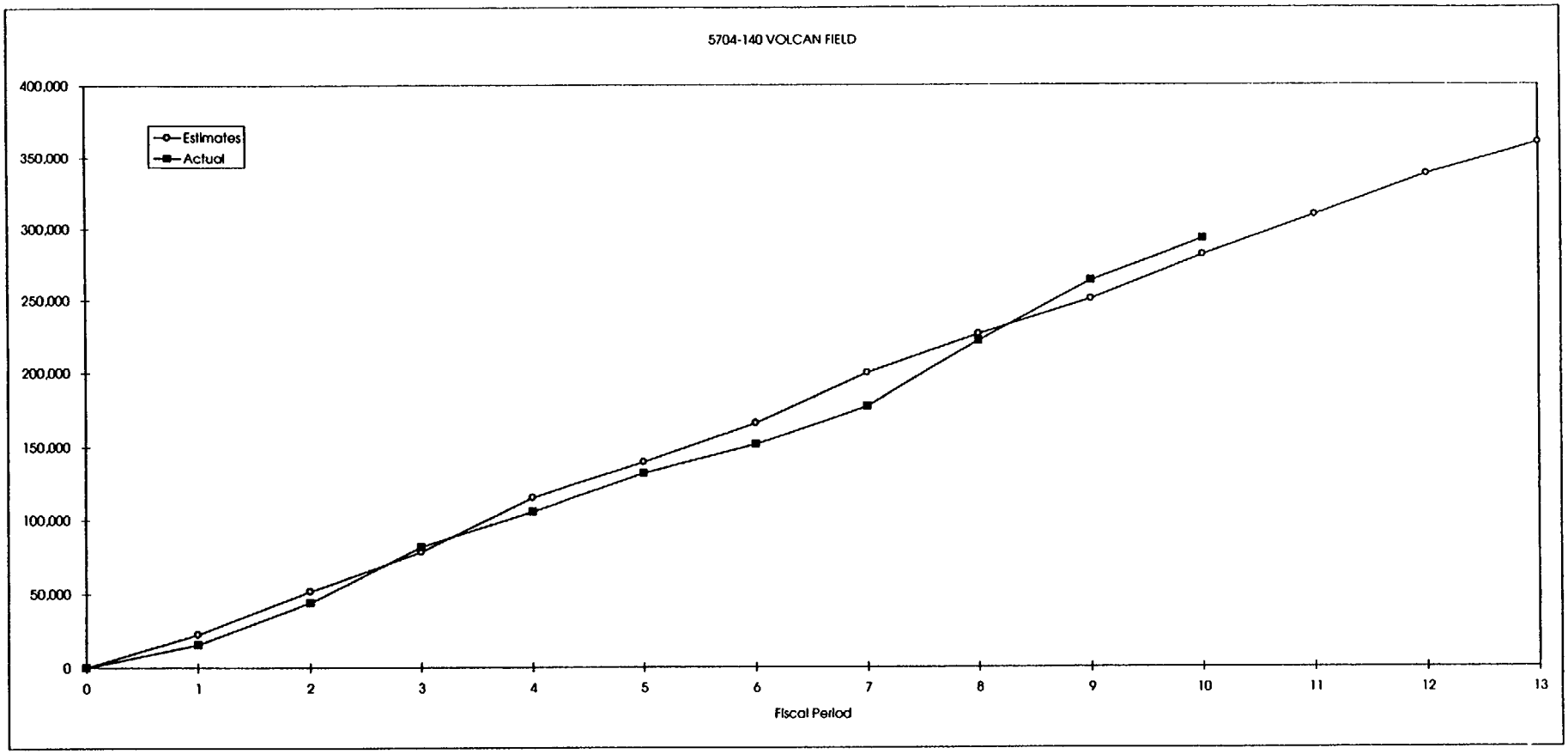
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	31,291	31,043	31,271	41,047	30,992	31,141	47,926	41,408	41,699	41,383	41,647	41,500	41,778	369,201
ACT. PERIOD COST	25,722	33,108	38,493	35,263	33,063	39,302	30,134	43,846	44,927	38,690	0	0	0	362,549
VARIANCE, $	5,569	(2,065)	(7,222)	5,784	(2,071)	(8,161)	17,792	(2,438)	(3,228)	2,693	0	0	0	6,652
VARIANCE, %	17.8%	-6.7%	-23.1%	14.1%	-6.7%	-26.2%	37.1%	-5.9%	-7.7%	6.5%	0.0%	0.0%	0.0%	1.8%
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	323,858	362,549	0	0	0	
PERCENT COMPLETE	5.2%	11.9%	19.7%	26.8%	33.5%	41.5%	47.6%	56.4%	65.5%	73.4%	0.0%	0.0%	0.0%	
VARIANCE, $	5,569	3,504	(3,718)	2,066	(5)	(8,166)	9,626	7,188	3,960	6,652	0	0	0	
VARIANCE, %	17.8%	5.6%	-4.0%	1.5%	0.0%	-4.1%	3.9%	2.5%	1.2%	1.8%	0.0%	0.0%	0.0%	



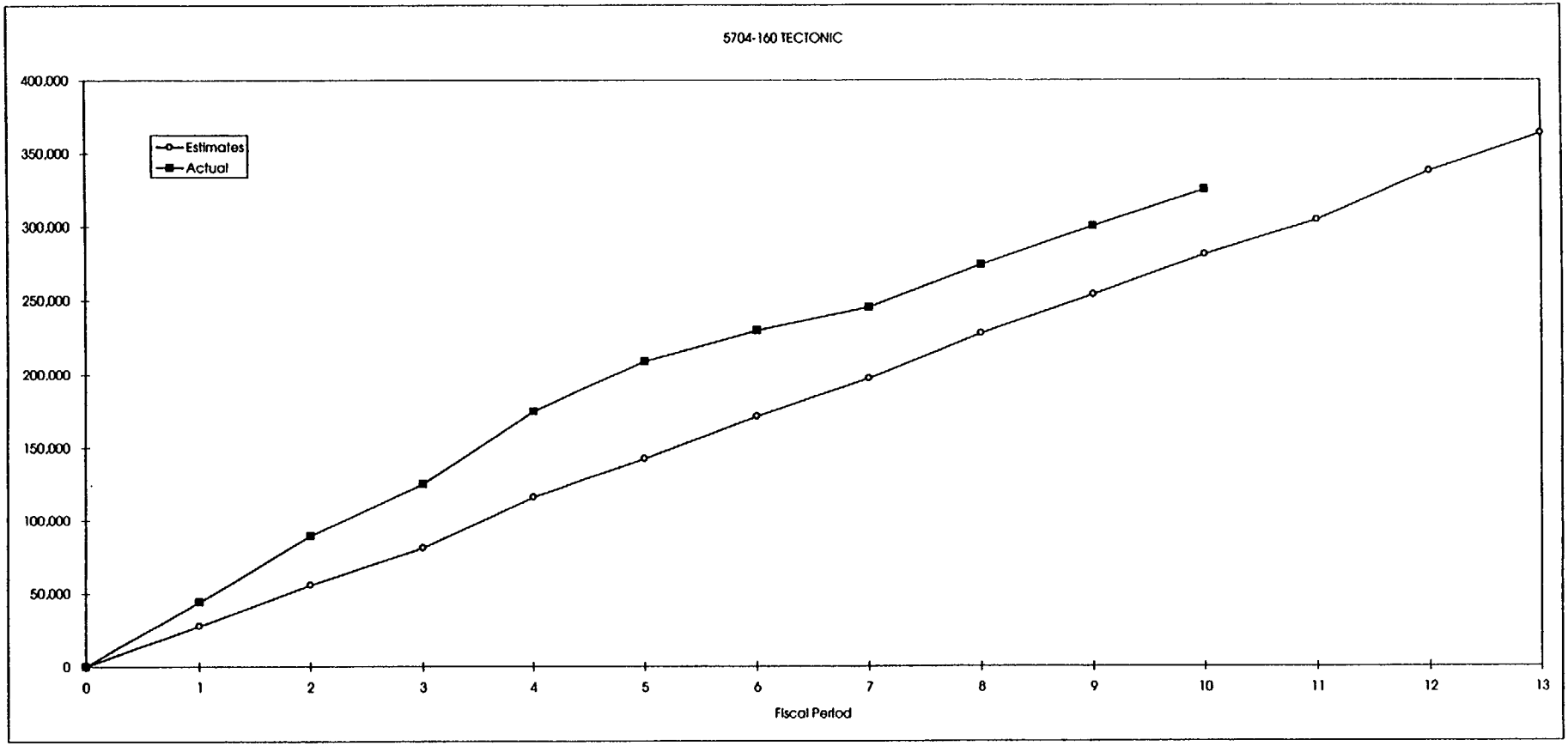
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	23,268	22,780	23,376	29,743	23,388	22,798	30,359	22,761	23,696	24,298	23,188	23,091	23,054	246,467
ACT. PERIOD COST	25,206	19,156	16,566	35,830	11,197	19,485	18,454	14,519	17,534	16,383	0	0	0	194,329
VARIANCE, $	(1,938)	3,624	6,810	(6,087)	12,191	3,313	11,905	8,242	6,162	7,915	0	0	0	52,138
VARIANCE, %	-8.3%	15.9%	29.1%	-20.5%	52.1%	14.5%	39.2%	36.2%	26.0%	32.6%	0.0%	0.0%	0.0%	21.2%
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	25,206	44,363	60,928	96,758	107,955	127,440	145,894	160,412	177,946	194,329	0	0	0	
PERCENT COMPLETE	8.0%	14.0%	19.3%	30.6%	34.2%	40.4%	46.2%	50.8%	56.3%	61.5%	0.0%	0.0%	0.0%	
VARIANCE, $	(1,938)	1,685	8,496	2,409	14,600	17,913	29,818	38,061	44,223	52,138	0	0	0	
VARIANCE, %	-8.3%	3.7%	12.2%	2.4%	11.9%	12.3%	17.0%	19.2%	19.9%	21.2%	0.0%	0.0%	0.0%	



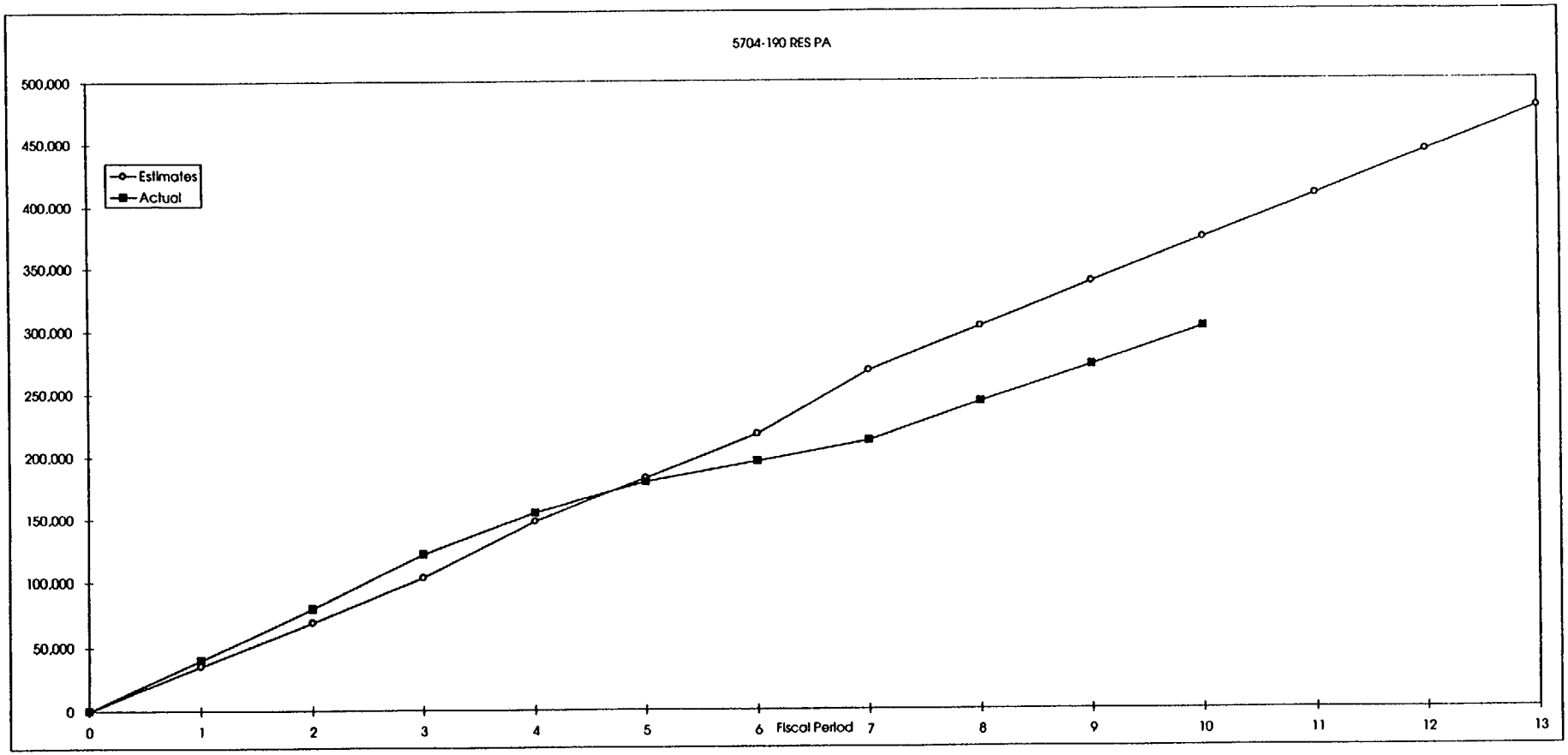
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	19,414	19,303	19,200	23,909	19,954	19,506	18,991	19,560	19,402	19,653	19,199	19,756	19,958	198,892
ACT. PERIOD COST	14,792	23,858	24,066	31,288	15,783	11,944	13,985	9,746	10,874	21,357	0	0	0	177,693
VARIANCE, $	4,622	(4,555)	(4,866)	(7,379)	4,171	7,562	5,006	9,814	8,528	(1,704)	0	0	0	21,199
VARIANCE, %	23.8%	-23.6%	-25.3%	-30.9%	20.9%	38.8%	26.4%	50.2%	44.0%	-8.7%	0.0%	0.0%	0.0%	10.7%
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	156,336	177,693	0	0	0	
PERCENT COMPLETE	5.7%	15.0%	24.3%	36.5%	42.6%	47.2%	52.6%	56.4%	60.6%	68.9%	0.0%	0.0%	0.0%	
VARIANCE, $	4,622	67	(4,799)	(12,178)	(8,007)	(445)	4,561	14,375	22,903	21,199	0	0	0	
VARIANCE, %	23.8%	0.2%	-8.3%	-14.9%	-7.9%	-0.4%	3.3%	9.0%	12.8%	10.7%	0.0%	0.0%	0.0%	



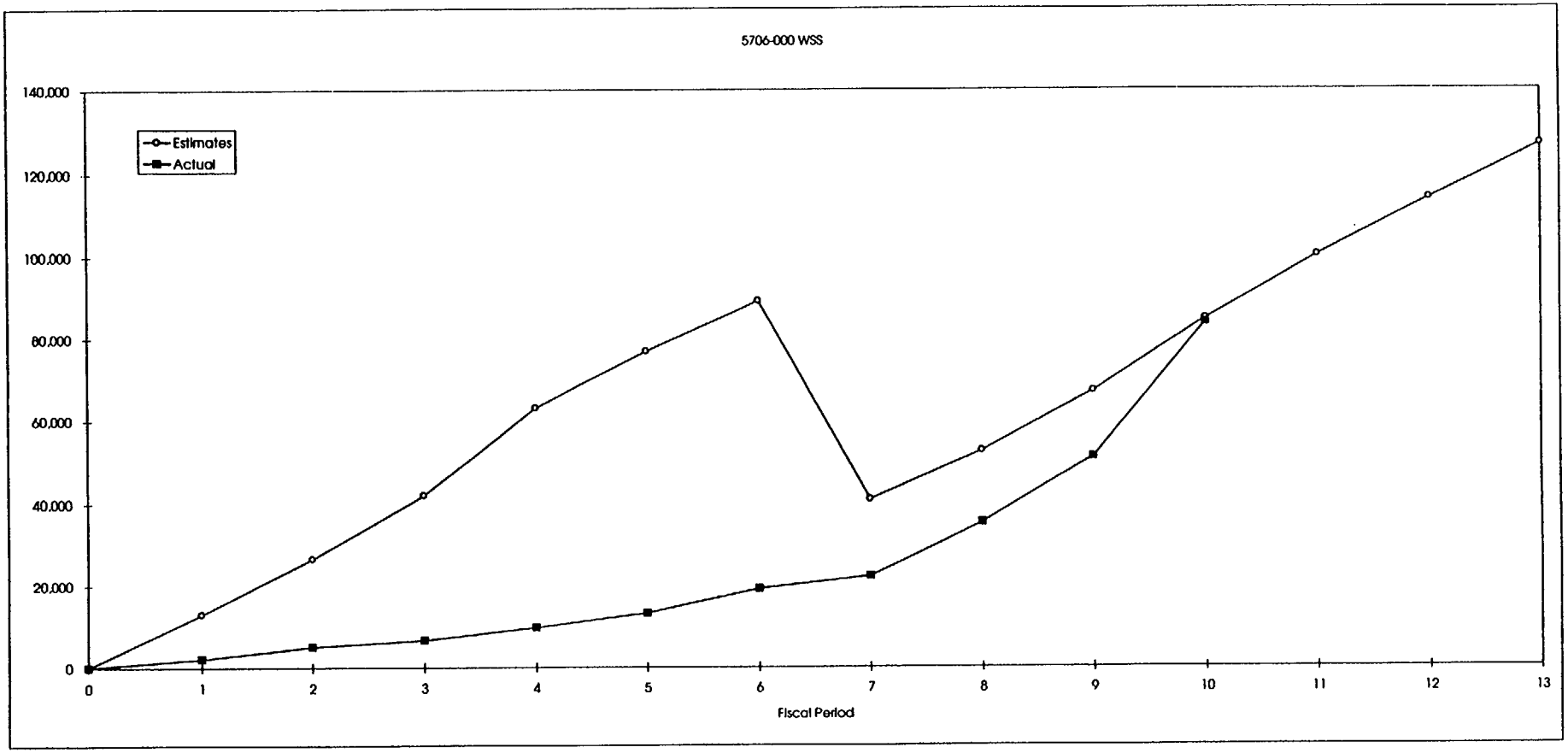
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	22,326	28,953	27,013	36,633	24,212	27,076	33,095	26,535	24,703	31,069	27,013	28,953	22,337	281,615
ACT. PERIOD COST	15,217	28,385	37,962	24,061	25,858	20,159	25,554	44,161	42,218	29,090	0	0	0	292,665
VARIANCE, $	7,109	568	(10,949)	12,573	(1,646)	6,917	7,541	(17,626)	(17,515)	1,980	0	0	0	(11,050)
VARIANCE, %	31.8%	2.0%	-40.5%	34.3%	-6.8%	25.5%	22.8%	-66.4%	-70.9%	6.4%	0.0%	0.0%	0.0%	-3.9%
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	263,575	292,665	0	0	0	
PERCENT COMPLETE	4.2%	12.1%	22.7%	29.3%	36.5%	42.1%	49.2%	61.5%	73.2%	81.3%	0.0%	0.0%	0.0%	
VARIANCE, $	7,109	7,677	(3,272)	9,300	7,654	14,570	22,112	4,486	(13,029)	(11,050)	0	0	0	
VARIANCE, %	31.8%	15.0%	-4.2%	8.1%	5.5%	8.8%	11.1%	2.0%	-5.2%	-3.9%	0.0%	0.0%	0.0%	



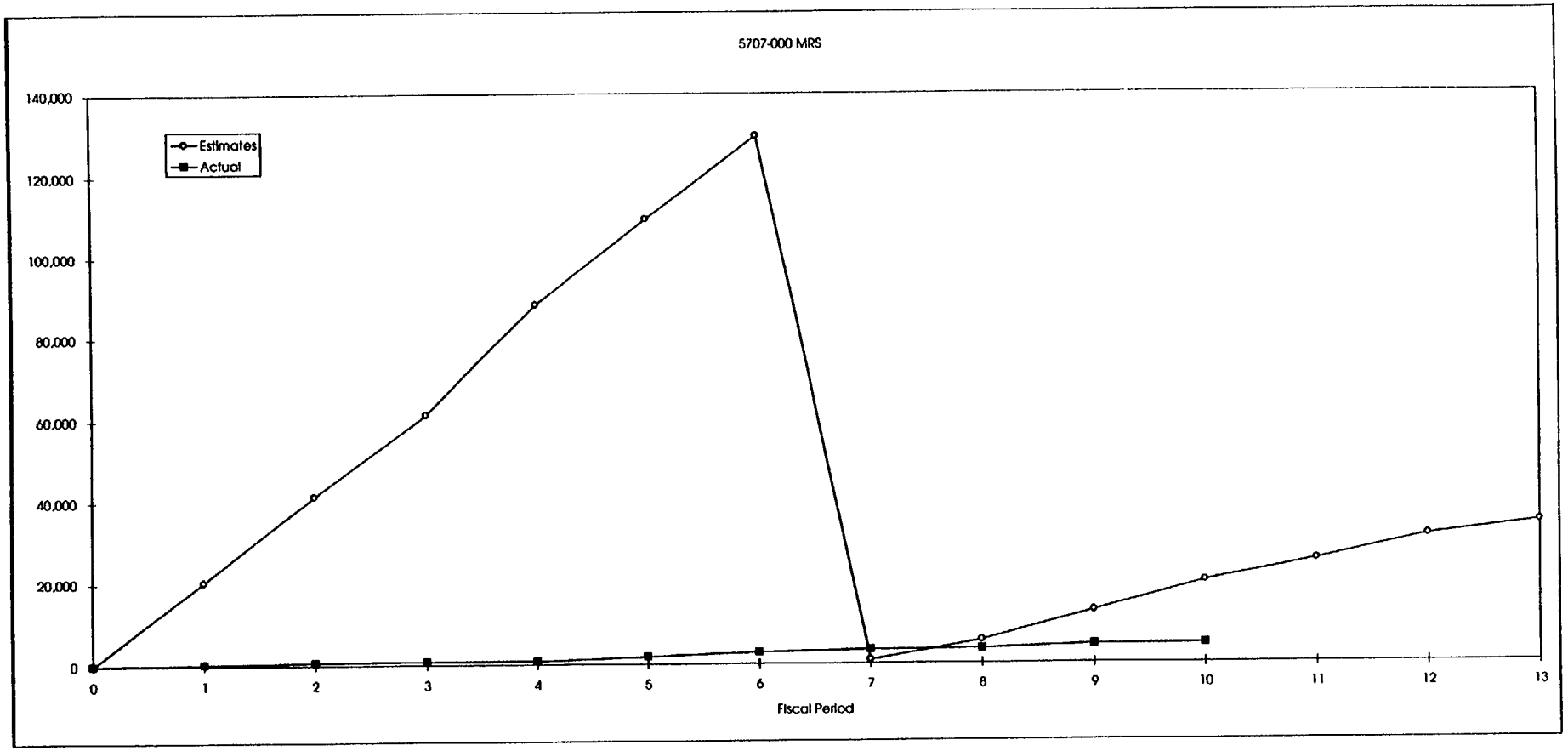
ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
EST PERIOD COST	27,357	28,497	24,920	35,059	26,639	28,942	25,930	30,833	25,862	26,797	23,611	32,879	26,162	280,836
ACT. PERIOD COST	44,248	44,712	36,034	49,680	34,211	21,432	15,253	28,308	26,354	24,738	0	0	0	324,968
VARIANCE, $	(16,891)	(16,215)	(11,114)	(14,621)	(7,572)	7,510	10,677	2,525	(492)	2,059	0	0	0	(44,132)
VARIANCE, %	-61.7%	-56.9%	-44.6%	-41.7%	-28.4%	25.9%	41.2%	8.2%	-1.9%	7.7%	0.0%	0.0%	0.0%	-15.7%
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	300,230	324,968	0	0	0	
PERCENT COMPLETE	12.2%	24.5%	34.4%	48.1%	57.5%	63.4%	67.6%	75.3%	82.6%	89.4%	0.0%	0.0%	0.0%	
VARIANCE, $	(16,891)	(33,106)	(44,220)	(58,840)	(66,412)	(58,902)	(48,225)	(45,699)	(46,191)	(44,132)	0	0	0	
VARIANCE, %	-61.7%	-59.3%	-54.7%	-50.8%	-46.6%	-34.4%	-24.4%	-20.0%	-18.2%	-15.7%	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	372,436
ACT. PERIOD COST	39,733	39,459	42,436	33,080	24,928	16,094	16,012	30,705	29,107	29,949	0	0	0	301,502
VARIANCE, $	(4,946)	(5,557)	(7,812)	11,192	9,839	18,503	34,862	4,020	6,241	4,591	0	0	0	70,934
VARIANCE, %	-14.2%	-16.4%	-22.6%	25.3%	28.3%	53.5%	68.5%	11.6%	17.7%	13.3%	0.0%	0.0%	0.0%	19.0%
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	211,741	242,446	271,554	301,502	0	0	0	
PERCENT COMPLETE	8.3%	16.6%	25.5%	32.4%	37.6%	41.0%	44.4%	50.8%	56.9%	63.2%	0.0%	0.0%	0.0%	
VARIANCE, $	(4,946)	(10,503)	(18,314)	(7,123)	2,717	21,220	56,082	60,102	66,342	70,934	0	0	0	
VARIANCE, %	-14.2%	-15.3%	-17.7%	-4.8%	1.5%	9.8%	20.9%	19.9%	19.6%	19.0%	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	84,722
ACT. PERIOD COST	2,192	2,956	1,534	3,099	3,547	5,854	3,070	13,199	15,780	32,565	0	0	0	83,795
VARIANCE, $	10,848	10,776	13,809	17,971	10,173	6,429	(51,322)	(1,469)	(1,282)	(15,006)	0	0	0	927
VARIANCE, %	83.2%	78.5%	90.0%	85.3%	74.1%	52.3%	106.4%	-12.5%	-8.8%	-85.5%	0.0%	0.0%	0.0%	1.1%
EST. FY CUMUL	13,040	26,772	42,115	63,185	76,905	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	51,230	83,795	0	0	0	
PERCENT COMPLETE	1.7%	4.1%	5.3%	7.7%	10.5%	15.1%	17.5%	27.9%	40.4%	66.0%	0.0%	0.0%	0.0%	
VARIANCE, $	10,848	21,624	35,433	53,405	63,578	70,006	18,685	17,215	15,933	927	0	0	0	
VARIANCE, %	83.2%	80.8%	84.1%	84.5%	82.7%	78.5%	45.6%	32.7%	23.7%	1.1%	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	19,928
ACT. PERIOD COST	297	321	206	37	835	1,160	558	63	939	144	0	0	0	4,559
VARIANCE, $	19,977	20,785	19,752	26,736	20,349	19,112	(129,279)	4,605	6,142	7,190	0	0	0	15,369
VARIANCE, %	98.5%	98.5%	99.0%	99.9%	96.1%	94.3%	100.4%	98.7%	86.7%	98.0%	0.0%	0.0%	0.0%	77.1%
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	4,415	4,559	0	0	0	
PERCENT COMPLETE	0.9%	1.8%	2.4%	2.5%	5.0%	8.3%	10.0%	10.2%	12.9%	13.3%	0.0%	0.0%	0.0%	
VARIANCE, $	19,977	40,762	60,514	87,250	107,598	126,710	(2,569)	2,037	8,179	15,369	0	0	0	
VARIANCE, %	98.5%	98.5%	98.7%	99.0%	98.4%	97.8%	-304.0%	36.9%	64.9%	77.1%	0.0%	0.0%	0.0%	