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

For The Fiscal Reporting Period

May 9, 1992 - June 5, 1992

PMPR No. 92-09

June 19, 1992

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TITLE: Center for Nuclear Waste Regulatory Analyses
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CONTRACT NO: NRC-02-88-005

FIN: D1035-8

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ESTIMATED BUDGET: $42,550,000

PERIOD OF PERFORMANCE: 10/26/87 - 10/26/92
PERIOD OF THIS REPORT: 05/09/92 - 06/05/92

1. TECHNICAL

1.1 *CNWRA Operations*

NRC and Center management continued effective coordination meetings and telephonic conferences addressing a range of day-to-day and long-term management topics. Center management, accompanied by a member of the SwRI executive management staff, made a presentation to the Center Review Group and Center management participated in a scheduled NRC/Center Management Meeting. Moreover, a revised final version of the DHLWM Advanced Computer Review System was submitted and a briefing on its content scheduled for the beginning of Period 10. Center management collaborated with NRC staff in securing and presenting information concerning the Center's opportunity to provide technical assistance to NRC's Low Level Waste Management Division. The Center assisted cognizant NRC staff in assimilating data for the contract renewal document, and provided additional information relative to the development of the FY94 Division of High-Level Waste Management budget, coupled with that for the Office of Nuclear Regulatory Research, associated with Center operations.

The current status of Center staffing is indicated in Tables 1 and 2. Although no additional professional staff was secured during this period, recruitment efforts continued for the positions in material science and earth sciences, including the position of Manager of Geologic Setting.

The annual Internal Center Quality Assurance audit took place during this reporting period, utilizing the NRC performance-based auditing method to measure compliance to procedures and implementation of the QA system. Three QA auditors and five technical specialists, all from SwRI and fully independent from the Center's work, conducted the audit June 2-5, 1992. An NRC audit observation team composed of three NRC staff members monitored the audit and agreed with the conclusions drawn by the audit team. Three Corrective Action Requests were issued by the audit team and they found the Center's QA system effective, except for the identified conditions adverse to quality.

1.2 *Waste Systems Engineering and Integration*

Compliance Determination Strategy (CDS) development continued in support of the preparation of the License Application Review Plan (LARP). The CDS final procedure was approved by NRC for use.

LARP development continued with CDS preparation and refinement of concepts for a Compliance Determination Method (CDM) procedure.

Regulatory Requirement review and revision proceeded with the production of approximately seventy draft Regulatory Requirement Reports. This effort is ensuring compatibility among the Regulatory Requirements, the Format and Content Regulatory Guide, and the LARP.

The prototype Open Item Tracking System was completed and demonstrated to the NRC. A draft User's Guide was delivered.

The Center submitted comments on the NRC's Overall Review Strategy for the High Level Waste Repository Licensing Program June 4, 1992.

1.3 *External Quality Assurance*

Activities this period involved participation on the NRC observation audit team at the Science Applications International Corporation DOE audit May 18-22, 1992. The Center submitted its input to the final observation audit team report within five work days of completion of the audit work. During this period, there was coordination between the External QA Program Element manager and the Center QA staff to plan for future FY92 work, including the Raytheon Services Nevada and Lawrence Livermore National Laboratory NRC audit observation team activities, and Task 3 (review and update of NRC QA documents) activities. Center QA staff is prepared to provide comments on the final version of the NRC Division of High-Level Waste Management Manual which is undergoing consolidation and revision.

1.4 *Geologic Setting*

CNWRA review of DOE's annotated outline for the topical report on extreme erosion was initiated during Period 9. M. Miklas attended the DOE/NRC Technical exchange on the annotated outline at Rockville, Maryland, on May 27, 1992. The CNWRA final report entitled "Comments on the DOE Erosion Topical Report Outline" was finalized

for delivery to the NRC by June 12, 1992.

The Natural Resources Assessment Methodology study continued with primary efforts related to development of the Compliance Determination Strategies (CDS) for the four pertinent Regulatory Requirements (RR). Systematic Regulatory Analysis (SRA) accomplishments on the four RRs associated with Natural Resources included reevaluation of the CDS for Naturally Occurring Materials (RR2018) in light of the postulated uncertainty reduction language (PURL) for 10 CFR 60.122. In addition, draft CDSs were developed for the three other RRs by the Natural Resources SRA Working Group. NRC management was informed of the CDS type selection for RR2003 Human Activity Affecting Groundwater. Technical background studies continued on the potentially adverse conditions on flooding, natural resources, volcanic hazards, tectonics, and probabilistic fault displacement and seismic hazard analysis. Identification and review of documents pertinent to the regulatory background and intent for these technical topics also occurred during the reporting period.

Work continued on development of methods for review of tectonic models, detailed evaluation of DOE cross sections of Yucca Mt., and integration of data into tectonic models. Preparation of the report on using computer-assisted balancing methods to evaluate existing structural cross sections across Yucca Mountain was a major activity.

The revised version of the Groundwater Travel Time (GWTT) options originally presented as Chapter 4 in the "Options Paper on Groundwater Travel Time as the Performance Measure of the Geologic Setting of a High-Level Radioactive Waste Geologic Repository--Draft" was prepared and internal review of the report at the Center was initiated. The revised options and the basis upon which the options have been formulated reflect discussions by the GWTT task group and the consensus of a teleconference discussion between the NRC and the Center completed May 3, 1992.

Activities on five computational analyses to evaluate the technical basis for the GWTT subsystem performance requirement of 10 CFR Part 60 occurred during the reporting period. These activities include the preparation of computational routines to assist in the creation of randomly distributed fractures and mesh and grid generators. These routines are designed to assist in the execution of the computational analyses.

Center staff prepared letter reports for CNWRA internal review based on Task 3 work on selecting alternative seismic acceleration attenuation functions for the Basin and Range, and assessing level of effort to convert SEISM 1 for use in Modeling Yucca Mountain Data with computer systems available at, or accessible from the Center. Center staff also prepared a draft report for CNWRA internal review concerning the regulatory history and intent for probabilistic fault displacement and seismic hazard analysis. The Center staff prepared draft Compliance Determination Strategies for RRs 2013, 2014 and 2015 and forwarded them to the NRC staff. Center staff participated in a meeting with NRC staff regarding completion of the analysis of fault and seismic data Staff Technical Position (STP). It was agreed that R. Hofmann and A.-B. Ibrahim would independently prepare Section 4 of the new STP for the group's review, keeping in mind that CDS preparation and other SRA activities may take precedence.

During Period 9, Center and NRC staff members on a SRA working group prepared materials for the briefing on type selection for RR 2012 (Structural Deformation) and RR 2016 (Igneous Activity). The initial briefing to J. Russell of the Center and R. Ballard of the NRC was conducted on June 3, and a follow-up briefing to higher NRC management was planned. Preliminary draft versions of the CDS reports for these two RRs were prepared by NRC and CNWRA members of a SRA working group. On May 13, G. Stirewalt attended the weekly reactive NRC Yucca Mountain Group meeting at One White Flint North.

As first author, G. Stirewalt prepared and submitted for internal CNWRA review and NRC programmatic review a paper entitled "Use of balanced cross-sections in development of scenarios for performance assessment analyses at Yucca Mountain, Nevada". Contributing co-authors were S. Young of the CNWRA and A. Morris of the University of Texas at San Antonio. Upon completion of reviews by the CNWRA and the NRC, the paper will be submitted for publication in the special issue of the Radioactive Waste Management and Nuclear Fuel Cycle Journal on Yucca Mountain.

1.5 *Engineered Barrier Systems*

The EBS staff participated in the Structural Task Force and closed on the EBS related RR/REOP structures. CDS development for the RR on the Release from the EBS was initiated.

The review of models to support the SCC example problem continued. Also, the review of data and information on the degradation of engineered structures continued.

The equilibrium solver developed in EBSPAC was tested. An error in the reaction modelling was detected and corrected. Additional testing indicated that the solver adequately accounted for the precipitation of solids. The corrosion related module was further developed and checked for discretization and time step sensitivities. The activity coefficients calculated by the code at different ionic strengths compared favorably with experimental values. A successful acetic acid experiment test case was modelled with active as opposed to passive corrosion. This is an important step in evaluating transient phenomenon in the corrosion of metals. Further testing is underway. User manuals for these modules are being prepared.

The chemical analyses of the leachate of two sets of PCT tests were received. Preliminary evaluation of the data indicates consistent results. Progress is being made on the glass review report.

An internal QA audit of activities in Tasks 2 and 3 of the EBS element was conducted by the SwRI QA Department on June 3, 1992. Initial feedback from the audit appears favorable.

P. Nair attended the Regulatory Process course conducted by an NRC consultant in Bethesda on May 20-21, 1992.

1.6 *Repository Design, Construction, and Operations*

Work on the camera-ready version of the ROC report "Repository Operational Criteria Analysis (NUREG/CR-5804)" has been initiated during this period and will be delivered to NRC during the next period. This version will incorporate NRC's comments on the previous version including making it consistent with the final Repository Functional Analysts (RFA) report.

J. Hageman assisted the NRC staff in preparation for a briefing to ACNW on the Proposed Rulemaking on Design Basis Events for the Geologic Repository Operations Area.

The RR and CDS reports on Shafts and Ramps were prepared by the CNWRA members of the team and were submitted to NRC for review and comments.

The staff technical position on Geologic Repository Operations Area Underground Facility Design--Thermal Loads was revised and submitted to NRC for review and comments. This revision incorporated the changes reflecting NRC's response to the comments on this STP made by DOE and the State of Nevada.

A literature review on the examination of the state-of-the-art in fully and partially coupled modeling of thermal-mechanical-hydrological-chemical processes relevant to repositories and the review of ESF Title I Design continued.

A. Chowdhury chaired the session "Experimental Methods in Rock Mechanics" and attended the meeting of ASCE Experimental Methods Division (EMD) Committee on "Experimental Analysis and Instrumentation" at the Ninth Engineering Mechanics Conference held at the Texas A&M University, College Station, Texas, May 25-27, 1992. A. Chowdhury also attended the Regulatory Process course organized by NRC on May 20-21, 1992.

1.7 *Performance Assessment*

A technical meeting on the Iterative Performance Assessment (IPA), Phase II, activity was held at the Center. The five day meeting was attended by NRC Staff representing Research and HLWM branches. The purpose of the meeting was two-fold: (1) to status progress of individual efforts on sub-model development and (2) to incorporate the simulation modules in the total system assessment (TPA) code and conduct initial trial runs. Significant progress was made on improving module interfacing and development of scenario modules. The TPA code was interfaced with the SOTEC, DITTY, LHS, FLOWMOD and NEFTRAN. An initial test run of the total system code was performed. Work is continuing on interfacing the TEMPER and C14 modules.

The technical report entitled "Regional Groundwater Modeling of the Saturated Zone in the Vicinity of Yucca Mountain, Nevada" was completed. The report authored by Mikko Ahola and Budhi Sagar will be submitted for issuance as a NUREG report.

Work continued on the technical report for the SOTEC code.

1.8 *Research*

Research Project 1 - Overall Research

Laboratory experimentation continued in Building 57 and in other SwRI facilities on six Center research projects.

Task 2 activities continued as follows:

- Coordination continued regarding preparation and review of papers for the proceedings of the 1991 Workshop on the Role of Natural Analogs in the Geologic Disposal of Nuclear Waste;

- Received 133 abstracts so far to the solicitation of papers for the Symposium on the Scientific Basis for Nuclear Waste Management XVI. The information on the submitted abstracts was entered into a computerized database. About half the abstracts are from foreign participants.

Research Project 2 - Geochemistry

Experiments at 25°C to study the equilibrium solubility of analcime, its rate of precipitation from supersaturated solutions, and phase equilibrium between analcime+clinoptilolite+aqueous-solution continued. Aqueous samples were taken from the set of reverse experiments for analysis of pH and Na, Al, and Si concentrations. Experiments to study the equilibrium solubility of Na-clinoptilolite were initiated.

A presentation was made by R. Pabalan to NRC staff on activities and results of Task 3 (Geochemistry Experiments) on May 13 in Rockville, Maryland.

Modeling of nonisothermal gas-water-rock interactions with gas volatilization for Yucca Mountain near-field conditions continued with the EQ6 code. The Geochemical Modeling task was reviewed during an internal quality assurance audit which focused heavily on software control of the EQ3/6 package.

Development of a program for numerical integration of the analcime dissolution rate equation was initiated to permit regression of experimental data. Thermodynamic analysis of analcime-clinophilolite equilibrium data were performed using EQ3.

Research Project 3 - Thermohydrology

Execution of Test 8 has continued. Test 8 is similar in configuration to Test 7 with the inclusion of a fracture.

A data pre-processor for VTOUGH has been written to expedite the entry of input files for the simulations. The pre-processor permits fabrication of regularly- or irregularly-spaced rectilinear grid blocks and presents the geometric dimensions in a form compatible

with the VTOUGH code. The pre-processor will facilitate the generation of model grids in subsequent simulations.

The Thermohydrology Research Project was reviewed by the peer-review team on May 13-14, 1992, at the CNWRA. The team members were joined by M. Silberberg, J. Randall, T. Margulies and R. Westcott of the NRC. The team members provided summaries of their reviews of the report at the outset of the meeting. The team members spent 1-1/2 days reviewing the project and laboratory facilities during the two-day meeting. A final report summarizing the assessments by each of the five team members was sent to CNWRA in early June.

A series of focused experiments has been initiated to measure various hydraulic properties of the test media. This exercise is undertaken to expand the capabilities of the project to conduct fundamental media hydraulic characterizations.

Research Project 4 - Seismic Rock Mechanics

Dynamic shear testing of single joint rock specimens under low normal load continued. The technical preparation for dynamic shear testing under high normal load is in progress. Data are being analyzed in the context of Coulomb, Barton-Bandis, and Continuously Yielding rock joint models.

The field data collection from the Lucky Friday Mine, Mullan, Idaho, continued. The mechanical, hydraulic, and seismic data are being analyzed. A poster paper on the results will be presented at the Induced Seismicity Workshop, 33rd U.S. Symposium on Rock Mechanics, Santa Fe, New Mexico, June 8-10, 1992. S. Hsiung will attend this workshop.

The results of DECOVALEX Phase 1 analysis were presented at the first DECOVALEX Workshop held in Stockholm, Sweden, on May 18-20, 1992. M. Ahola of CNWRA and J. Philip of NRC participated in this workshop. They also visited the Swedish Nuclear Waste Facilities at Forsmark and the Laboratory of Rock Engineering of the Helsinki University of Technology, Finland, on May 22, 1992. A trip report is in preparation.

A. Chowdhury chaired the session "Experimental Methods in Rock Mechanics" and attended the meeting of ASCE EMD Committee on "Experimental Analysis and Instrumentation" at the Ninth Engineering Mechanics Conference held at the Texas A&M University, College Station, Texas, May 25-27, 1992.

Research Project 5 - Integrated Waste Package Experiments

Pitting repassivation experiments continued with the inclusion of Hastelloy alloy C-22 for comparison. Thus far, pitting has not been induced in this alloy in 10,000 ppm chloride solutions even at +700 mV SCE.

To provide input to the crevice corrosion model, measurement of polarization curves of types 304L and 316L stainless steel, Incoloy alloy 825, and Hastelloy alloy C-22 in 4M chloride solutions (simulating a crevice solution) at 30°C and 95°C and various pH levels

are being carried out. These experiments will yield criteria for use in computing crevice corrosion initiation. A cell for crevice chemistry measurement has been fabricated.

Trial experiments with an electrochemical noise technique were successful. With the recent acquisition of the spectral analysis software, we can proceed with the development of this technique for use in wet-dry tests.

X-ray diffraction measurements were performed on copper specimens exposed for long times to HCO_3 + Cl and HCO_3 + SO_4 solutions to characterize the corrosion products.

Problems with the computer for data acquisition from the slow strain rate machine slowed the progress in the stress corrosion cracking studies task. These are being resolved. The stress corrosion cracking review report is being prepared.

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

R. Ababou gave a comprehensive presentation on "Effective Unsaturated Conductivity: A Continuum Approach" during the two-day Hydrology Workshop held in San Antonio with NRC staff, the University of Arizona Research Group, and the Center (May 27-28, 1992). This topic will be the subject of a refereed paper in preparation, in collaboration with Professor T.-C. Jim Yeh from the University of Arizona.

Data regarding the Apache Leap fractured tuff site were obtained, and are being considered for input into submodeling activities of the Project. An interactive graphics code to visualize and manipulate three-dimensional fracture networks has been developed and is being fine-tuned. The task on documentation of the BIGFLOW code is ongoing, including development and implementation of analytical benchmarks for variably saturated media.

Research Project 7 - Geochemical Analogs

Field research at the Peña Blanca analog site was conducted May 20-24, 1992. A permanent 1 x 1 meter sample grid encompassing the entire exposure of the Nopal I uranium ore body was established over about 600 m^2 of the cleared portion of Level +10. A contact gamma scintillometer survey was made along intersections of the sample grid. Preliminary interpretation of the gamma data was made in the field and was used to plan rock sample traverses. Samples were taken along two traverses, one north-south and one east-west, from the center of the exposure of the ore body out beyond the breccia pipe into the unmineralized host rocks. Assessment of work by I. Reyes showed that clearing of the specified portion of the +10 meter level of the Nopal I deposit was satisfactorily accomplished, but that the geologic map of a 4 km^2 area around the deposit and the geologic map of the cleared portion of the +10 meter surface, although excellent in many respects, were not acceptable; Reyes will correct those problems on new versions of the maps before acceptance for project use. Other activities included completion of observations necessary to qualify Peña Blanca mineral separate samples previously received from P. Ildefonse (University of Paris). Preparation of digital maps for the Peña Blanca analog site was initiated with compilation of the Level +10 location

grid, sample locations, and gamma intensities within the boundaries of the cleared area and the edge of the level.

Gamma spectroscopic analyses were begun of bulk rock samples collected during the May trip to Peña Blanca from the two traverses on the +10 m level. In total, 55 rock samples were collected at about 0.5 m intervals on two traverses across and away from the U-mineralized ore body. These indicate a distinct pattern of U distribution. Enrichment of U, up to 600 ppm U, outside of the ore body is concentrated in discrete oxidized (hematite/limonite-bearing) fracture zones. However, enrichment of relatively unaltered (iron oxide absent) bulk rock (10-100 ppm U) also occurs to distances of several meters. An abstract entitled "Oxidative alteration of uraninite at Peña Blanca, Chihuahua, Mexico: Possible contaminant transport and source term constraints for the proposed repository at Yucca Mountain, Nevada" was prepared for submittal to the Materials Research Society meeting in November.

Mineralogic work continued on Peña Blanca samples, which were prepared for transmission electron microscopy (TEM) using standard thin section techniques followed by thinning on a liquid nitrogen-cooled ion mill using TEM and scanning electron microscopy (SEM). Uraninite and soddyite were tentatively identified and the fine structures of the uraninite-kaolinite intergrowth were observed. Double-polished sections for fluid inclusion microthermometry were prepared and studied by optical microscopy. Secondary inclusions are most abundant; clearly primary inclusions are rare and will require preparation of additional sections.

A presentation describing the Peña Blanca analog site and research results to date was made for the Hydrology Research Meeting held at the Center on May 27-28, 1992. The Geochemical Analog Research Project underwent an internal Quality Assurance audit on June 3-4, 1992.

Preparations continued for field research at the proposed Akrotiri, Greece, analog site. Additional justification and assurance of awareness and acquiescence by the Greek government was provided to the NRC in response to further requests.

Research Project 9 - Sorption Modeling

Experiments to study sorption of uranium on the zeolite mineral clinoptilolite continued. Aqueous samples from the sorption kinetic experiments were taken for measurement of pH and uranium concentration. Uranium analysis of samples from the reverse experiments using polarographic methods also continued.

A spreadsheet program was constructed by T. Griffin to calculate enthalpies of reaction for Am, Pu, Tc, Np, U, Th, Cs, Sn, Zr, Ra, Ru, Co and Eu solids, aqueous species, and redox couples. This allows the MINTEQA2 code to calculate geochemical equilibrium at temperatures other than 25° C. The latest release of the EQ3/6 database (Data0.Com.R12) was checked for changes to the radionuclide data, and changes are in the process of being entered.

Additional sorption data for U, Th, Np, Pu, and Am were digitized from experiments

reported in the literature. The expanded MINTEQA2 radionuclide database was used to model speciation as a function of pH for several of these elements. FITEQL, Version 2.0 is being used to reinterpret U-sorption experiments performed in equilibrium with atmospheric CO_2 (Tripathi, 1984).

A presentation was made by R. Pabalan to NRC staff on May 13, 1992, in Rockville, Maryland, regarding results of Task 3 (Sorption Experiments) activities. An internal quality assurance audit of the Sorption Modeling Project was successfully conducted during the reporting period.

Research Project 10 - Performance Assessment

During Period 9, progress has been made on several fronts in the performance assessment research project. Under Task 5 on the incorporation of existing models into performance assessment methodology, Drs. R. Bagtzoglou and R. Ababou have been continuing work on the development of an efficient method for generating correlated, conditional random fields by implementing a nearest neighbor procedure on the CM-2 at Los Alamos Lab's ACL facility. Initial results are very promising and show that the method is much faster than traditional LU-decomposition, Fast Fourier Transform (FFT) or turning bands methods, although considerable effort is still being made to rigorously demonstrate the correctness of the procedure.

Also within Task 5 R. Islam, under the guidance of Dr. G. Wittmeyer, has begun work on developing an automatic mesh generation routine for finite element models based on the Delaunay triangulation procedure. We intend to make this routine the basis of an adaptive mesh procedure used in a 2D finite element model for variably saturated flow.

Under Task 7 on methodology for validation of models, Dr. Wittmeyer has continued his efforts on modelling flow and transport at the Las Cruces trench site as part of the international INTRAVAL project. Recently developed programs for estimating sample semi-variograms, kriging and estimating the parameters of the van Genuchten model describing water retention curves are being used to facilitate the construction of input data sets for the PORFLOW-3 code. These programs will be used to develop a suite of input data sets which describe different conceptual models of the trench and then to address key questions regarding the worth of data in validating models.

Dr. Bagtzoglou gave a presentation at the 13th meeting of the Radioactive Waste Management Committee, Probabilistic System Assessment Group (PSAG) in Paris, France from May 30-June 4 entitled "A Step Towards Validating Probabilistic Performance Assessment Models".

A hydrology research meeting was held at the Center, May 27-28, 1992, with participants from NRC, University of Arizona and CNWRA. The purpose of the meeting was to discuss research programs, results and future opportunities for joint projects. Technical presentations were given by the various participants.

Research Project 11 - Volcanic Systems

Center staff continued surveying, compiling, and reading literature pertinent to conduct of the Volcanism Research Project. An annotated outline for the literature review report was completed and preparation of the literature review manuscript was initiated. A detailed annotated outline of the section on the review of the relevance of nonlinear dynamics to investigations of volcanism and magmatism was also prepared.

1.9 *Licensing Support System*

The Center submitted the meeting report for the April 28 and 29, 1992, meeting with the LSSA to resolve issues on LSSA reports. It is expected that the Center will receive redirection on the work for Task 1 and need to reschedule the work on Task 2 also. The work on Task 1 will continue with further development of specific areas of the last report submitted on "Classification and Attributes of Non-Text-Searchable Documentary Material." The survey being conducted at the Center on Task 2 continues and the LSSA asked that it be completed as soon as possible, so a similar survey can be conducted at the NRC.

1.10 *Waste Solidification Systems*

A meeting was held at NRC White Flint Offices on May 22, 1992, to review the list of documents on the seismic evaluation of the vitrification facility at West Valley. The meeting was attended by the NRC and Center Program Element Managers. The review indicates that there are remaining five issues relating to integrity of building stack, design criteria for failure penetrations, damping factors, thermal analysis, and details of design calculations that need to be resolved. NRC has requested additional status information related to these topics from the DOE.

As per NRC technical direction, activities in Tasks 3 and 4 for the remainder of FY92 will focus on the review of DOE documents on hand and development of the additional information needs to be transmitted to the DOE. Work is underway in these tasks.

1.11 *Monitored Retrievable Storage*

The NRC initiated the new program element "Monitored Retrievable Storage" (MRS) at the Center on May 22, 1992. This program element will provide support to the NRC in planning and implementing its licensing program under the Nuclear Waste Policy Act (NWPA), as amended. Activities will be conducted in four tasks: Task 1-Environmental and Site Investigation; Task 2-Systems Integration and Regulatory Analysis; Task 3-Licensing Review; and Task 4-Monitoring and Inspections.

Only Task 3 is active during FY92, all other tasks will be initiated from the beginning of FY93. During this reporting period, the preparation of MRS Operations Plan for FY92-94 was initiated. As a part of the preparation of the Operations Plan, a brief review of DOE's MRS Annotated Outline dated March 31, 1992, was also initiated during this period. Frederick (Fritz) C. Sturz, NRC Program Element Manager for

MRS, will visit the Center on June 16, 1992, to discuss the MRS project activities with the Center staff.

2. MAJOR PROBLEMS

None.

3. FORECAST FOR NEXT PERIOD

Work will continue in accordance with the revised FY92-93 Operations Plans and Project Plans. Contract renewal activities will also be a focus of management staff efforts. Staffing will continue to be a high priority activity, within the constraints of funding. Resolution of the three Corrective Action Requests resulting from the Center's Internal audit will take place and implementation of the current Center QA Manual and Operating Procedures will occur.

The Center will continue to pursue work on the planned DHLWM Advanced Computer Review System to update the HLW functional needs relative to the existing computer system capabilities.

A briefing on the first phase of study will be given in Period 10 and system design will commence.

A sustained effort, highlighted by select meetings with cognizant NRC/Center management staff, will pursue completion of negotiations on renewal of the existing contract for the next five years. This will include discussions on the timing for development and presentation of the FY93-94 Operations/Project Plans and revision of the Center Cost Proposal for FY93-97.

Execution of the SRA Restart Plan will continue with focus on review and approval of Regulatory Requirements, development of Compliance Determination Strategies and Methods, and production of a License Application Review Plan.

Demonstration and training on Version 2.0 of PASS will continue for Center and NRC staff, as necessary. Work will continue on the Open Item Tracking System (OITS) to support implementation of the prototype system.

The Center QA Director will continue to plan and coordinate upcoming NRC audit observation team work. Work will continue in the External QA Task 1 (RSN audit) and Task 3 activities, as earlier forecast.

The Geologic Setting Element activities will continue to focus on technical assistance in the potential regulatory guidance on Natural Resources Assessment Methodology, GWTT, and seismic hazard analysis, tectonics, and volcanology, including assistance in the review and evaluation of key draft reports submitted in these areas. Staff will support joint NRC and CNWRA work on the SRA and will participate in technical exchange meetings, as requested.

The EBS Element will continue work on the STF and LARP activities in support of the SRA restart program. A presentation on the SCC example problem under Task 2 will be made to the NRC management staff on June 16, 1992. Review of pitting corrosion models and application

of a preliminary version of an electrochemical equation-solving technique to crevice corrosion model will continue. The evaluation of the PCT data from the leaching tests on the borosilicate glass will be completed.

Activities within the RDCO Element will include development of a CDS and CDM for the RR on Shafts and Ramps, and development of RR/REOP structures for all the RRs relevant to RDCO. In addition, work under ROC Activity 2 and the DBA rulemaking will continue in parallel, and support to revision of the TP on thermal loads and other prelicensing activities such as ESF Title I design, and resolution of SCA Objections, Comments, or Questions will be provided, as requested by NRC.

A workshop on the IPA is scheduled for June 8-10, 1992, at the Center. A large number of NRC and Center staff participants in the IPA are expected to take part. Final calculations for the IPA Phase II are expected to be done towards the middle of July. Work will move forward on the RR-REOP report on the three newly created RR's from the total system performance requirement of 10 CFR 60.112.

Work will continue on all research projects, in accordance with the approved FY92-93 Project Plans. Discussions will be held regarding revision of the Project Plans for FY93-94.

Within the LSSA Element, the Center will continue Task 1 work related to document categories and access protocols with discussions with the LSSA staff. Additional work will be done on substantiating the conclusion of the Task 2 report "Feasibility of Priority Loading Schedule for LSS Documents."

As part of the WSS Element activities, the review of the seismic analysis of the vitrification facility will continue. Revised schedules for the outstanding WSS tasks will be proposed.

The MRS Operation Plan and review of the DOE MRS Annotated Outline will be completed.

4. SUMMARY FINANCIAL STATUS

Table 3 indicates the financial status of the Center in the context of "authorized" funds established by the NRC. 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. Total commitments of the Center are $230,065. Pertinent information is provided for the Center program as a whole, the Division of High-Level Waste Management (HLW) FIN, and the Office of Nuclear Regulatory Research Division of Regulatory Applications FIN, as well as for each Program Element and Project. This information is provided in both graphical and tabular form.

Total costs of the Center and for the HLW, RES, and WSS FINs are significantly under plan. Detailed analyses of the cost variances of the individual Elements and Projects are evident in Appendix A. To summarize, the variances are due primarily to four factors: (i) assignments/approvals of work have not yet been received (particularly in Task 1 of HLW Elements), (ii) commensurate under-utilization of subcontractor and consultant staff in these activities, (iii) previously unresolved issues related to Systematic Regulatory Analysis have

delayed certain activities in WSE&I and Task 2 of the technical Elements (these have been resolved, see Section 2), and (iv) incomplete staffing in certain areas (note that although associated table shows the Center as fully staffed with respect to Plan, two staff members have not yet reported for full time work).

TABLE 1. CENTER CORE STAFF - HIRING PROFILE AND STATUS (06/05/92)

EXPERTISE/EXPERIENCE	FISCAL YEAR									TOTAL REQ'D	OPEN THIS QTR
	FY92				FY93	FY94	FY95	FY96	FY97		
	1Q	2Q	3Q	4Q							
ADMINISTRATION	5	5	5	5	5	5	5	5	5	5	0
CODE ANALYST (g)	1	1	1	1	1	2	2	2	2	2	-1
DATA BASE MANAGEMENT AND DATA PROCESS.	2	2	2	2	2	2	2	2	2	2	0
ELECTROCHEMISTRY	1	1	1	1	1	1	1	1	1	1	0
ENGINEERING GEOLOGY/GEOLOGICAL ENGNG (b)						1	1	1	1	1	0
ENVIRONMENTAL SCIENCES	1	1	1	1	1	1	1	1	1	1	0
GEOCHEMISTRY	5	5	5	5	5	5	5	5	5	5	0
GEOHYDROLOGY/HYDROGEOLOGY (g)	4	4	4	4	4	5	5	5	5	5	-1
GEOLOGY	2	2	2	2	2	2	2	2	2	2	0
HEALTH PHYSICS	1	1	1	1	1	1	1	1	1	1	0
INFORMATION MANAGEMENT SYSTEMS	2	2	2	2	2	2	2	2	2	2	0
MATERIAL SCIENCES (b) (a)	3	4	4	4	4	4	4	4	4	4	1
MECHANICAL, INCLUDING DESIGN & FABRICATION	1	1	1	1	1	1	1	1	1	1	0
MINING ENGINEERING	1	1	1	1	1	1	1	1	1	1	0
NUCLEAR ENGINEERING	1	1	1	1	1	1	1	1	1	1	0
NUMERICAL MODELING/ANALYSIS		1	1	1	1	1	1	1	1	1	0
PERFORMANCE ASSESSMENT	3	3	4	4	4	4	4	4	4	4	0
QUALITY ASSURANCE	2	2	2	2	2	2	2	2	2	2	0
RADIOISOTOPE GEOCHEMISTRY	1	1	1	1	1	1	1	1	1	1	0
REGULATORY ANALYSIS	1	1	1	1	1	1	1	1	1	1	0
ROCK MECHANICS (g)	2	2	2	2	3	3	3	3	3	3	-1
SEISMOLOGY	1	1	1	1	1	1	1	1	1	1	0
SPENT FUEL DEGRAD./SOURCE-TERM					1	1	1	1	1	1	0
STRUCTURAL GEOLOGY/SEISMO-TECTONICS (b) (a)	2	2	2	2	3	3	3	3	3	3	0
SYSTEMS ENGINEERING	2	2	2	2	2	2	2	2	2	2	0
VOLCANOLOGY/IGNEOUS PROCESSES (b) (a)					1	1	1	1	1	1	0
TOTAL REQUIRED	44	46	47	47	51	54	54	54	54	54	-2

(a) Interview scheduled next period.
(b) Resumes being solicited.
(c) Offer made.
(d) Offer pending.
(e) Offer accepted.
(f) Position re-opened.
(g) Negative number indicates early hire.

Staffing Summary

	Professional	Support	Total
Current	49	15	64
Offers Made	0	0	0
Planned This Date	47	15	62
Planned End of FY92	47	16	63

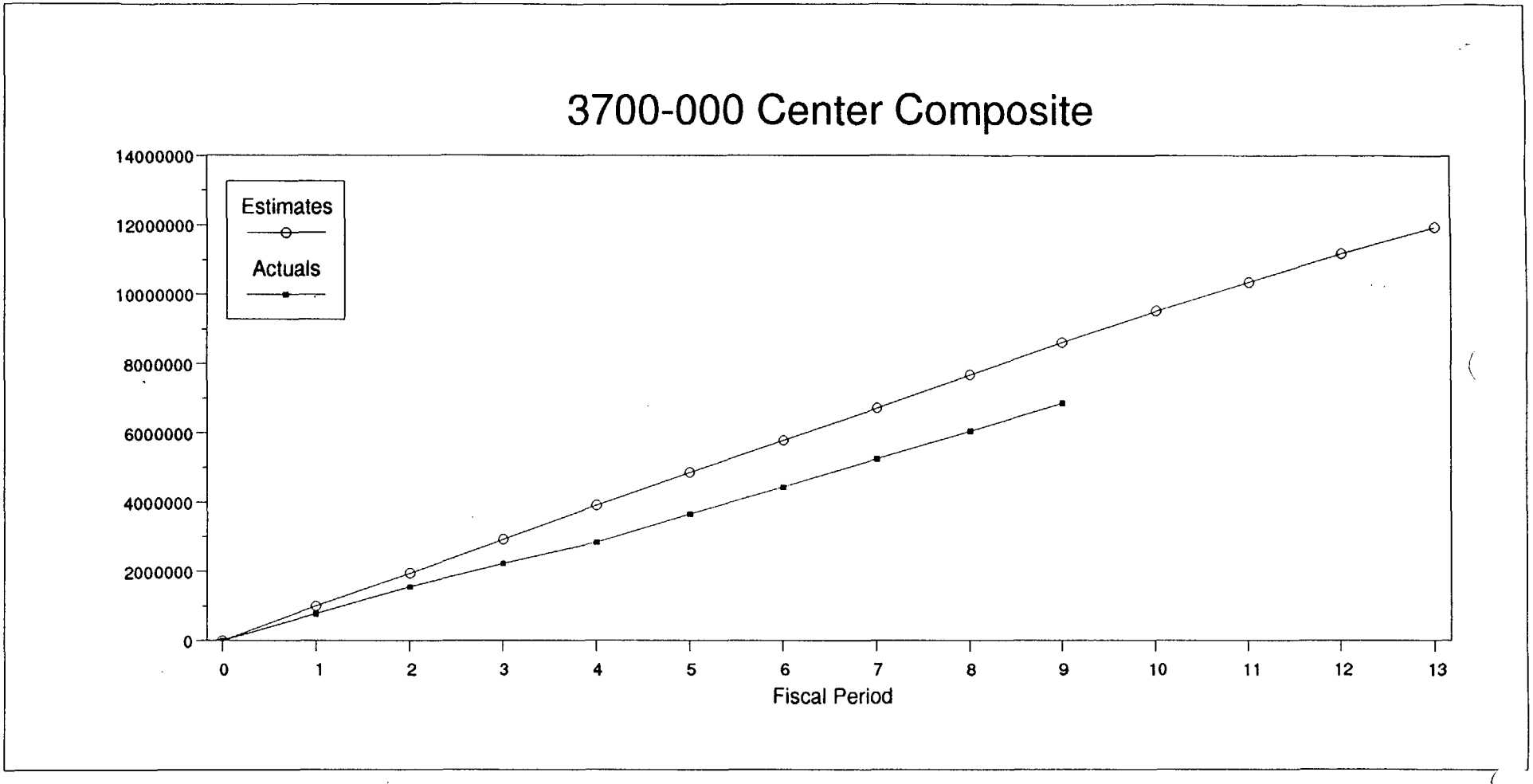
TABLE 2. CENTER CORE STAFF - CURRENT PROFILE (06/05/92)

EXPERTISE/EXPERIENCE	
ADMINISTRATION	J. Latz, R. Adler, H. Garcia, P. Mackin, W. Patrick
CODE ANALYST	R. Janetzke, R. Martin
DATA BASE MANAGEMENT AND DATA PROCESS.	A. Johnson, S. McFaddin
ELECTROCHEMISTRY	G. Cragnolino
ENGINEERING GEOLOGY/GEOLOGICAL ENGNG	
ENVIRONMENTAL SCIENCES	P. LaPlante
GEOCHEMISTRY	W. Murphy, R. Pabalan, E. Pearcy, J. Prikryl, D. Turner
GEOHYDROLOGY/HYDROGEOLOGY	R. Ababou, A. Bagtzoglou, R. Green, G. Wittmeyer, P. Lichtner (11/15)
GEOLOGY	J. Russell, M. Miklas
HEALTH PHYSICS	J. Hageman
INFORMATION MANAGEMENT SYSTEMS	R. Johnson, R. Marshall
MATERIAL SCIENCES	P. Nair, H. Manaktala, N. Sridhar
MECHANICAL, INCLUDING DESIGN & FABRICATION	C. Tschoepe
MINING ENGINEERING	S-M. Hsiung
NUCLEAR ENGINEERING	H. Karimi
NUMERICAL MODELING/ANALYSIS	J. Walton
PERFORMANCE ASSESSMENT	B. Sagar, R. Baca, B. Gureghian, R. Manteufel
QUALITY ASSURANCE	B. Mabrito, R. Brient
RADIOISOTOPE GEOCHEMISTRY	B. Leslie
REGULATORY ANALYSIS	S. Spector (Law)
ROCK MECHANICS	A. Chowdhury, M. Ahola, A. Ghosh (7/6)
SEISMOLOGY	R. Hofmann
SPENT FUEL DEGRAD./SOURCE-TERM	
STRUCTURAL GEOLOGY/SEISMO-TECTONICS	G. Stirewalt, S. Young
SYSTEMS ENGINEERING	D.T. Romine, A. DeWispelare
VOLCANOLOGY/IGNEOUS PROCESSES	

TABLE 3. FINANCIAL STATUS

Element, Project, FIN	FY92 Funds Authorized	FY92 Funds Costed to Date	FY92 Funds Uncosted	Commitments
GS	1,431,005	625,226	805,779	23,118
EBS	645,855	373,158	272,697	1,451
RDCO	955,653	606,182	349,471	52,918
WSEI	1,507,070	780,860	726,210	10,429
EQA	203,312	61,056	142,256	0
PA	1,190,514	681,759	508,755	9,907
COPS	2,392,067	1,408,342	983,725	7,233
HLW	8,325,476	4,536,583	3,788,893	105,056
OVERALL	269,240	140,806	128,434	10,327
GEOCHEM	249,000	154,876	94,124	171
THERMO	328,845	246,535	82,310	3,115
SEISMIC	399,122	204,635	194,487	70,127
IWPE	517,215	283,332	233,883	6,934
STOCH	210,731	123,963	86,768	6,315
ANALOGS	367,460	244,365	123,095	21,054
SORPTION	400,691	224,614	176,077	4,203
RES PA	484,622	259,989	224,633	1,578
VOLCAN	334,468	186,431	148,037	1,185
RES	3,745,330	2,069,546	1,675,784	125,009
LSSA	244,264	177,811	66,453	0
WSS	206,654	74,807	131,847	0
MRS	*	3,370		
TOTAL	12,521,724	6,862,117	5,662,977	230,065
* Operations Plan in development				

APPENDIX A -- PLANNED AND ACTUAL COSTS, AND COST VARIANCES



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	997202	948547	972654	994454	942097	926683	940939	960595	937303	904796	835015	819317	755561	8620474
Act. Period Cost	771847	780673	674713	608806	815282	783166	815761	799762	808800	0	0	0	0	6858810
Variance, $	225355	167874	297941	385648	126815	143517	125178	160833	128503	0	0	0	0	5076353
Variance, %	22.6	17.7	30.6	38.8	13.5	15.5	13.3	16.7	13.7	0.0	0.0	0.0	0.0	42.5
Est. FY Cumul	997202	1945749	2918403	3912857	4854954	5781637	6722576	7683171	8620474	9525270	10360285	11179602	11935163	
Act. FY Cumul	771847	1552520	2227233	2836039	3651321	4434487	5250248	6050010	6858810	0	0	0	0	
Percent Complete	6.5	13.0	18.7	23.8	30.6	37.2	44.0	50.7	57.5	0.0	0.0	0.0	0.0	
Variance, $	225355	393229	691170	1076818	1203633	1347150	1472328	1633161	1761664	0	0	0	0	
Variance, %	22.6	20.2	23.7	27.5	24.8	23.3	21.9	21.3	20.4	0.0	0.0	0.0	0.0	

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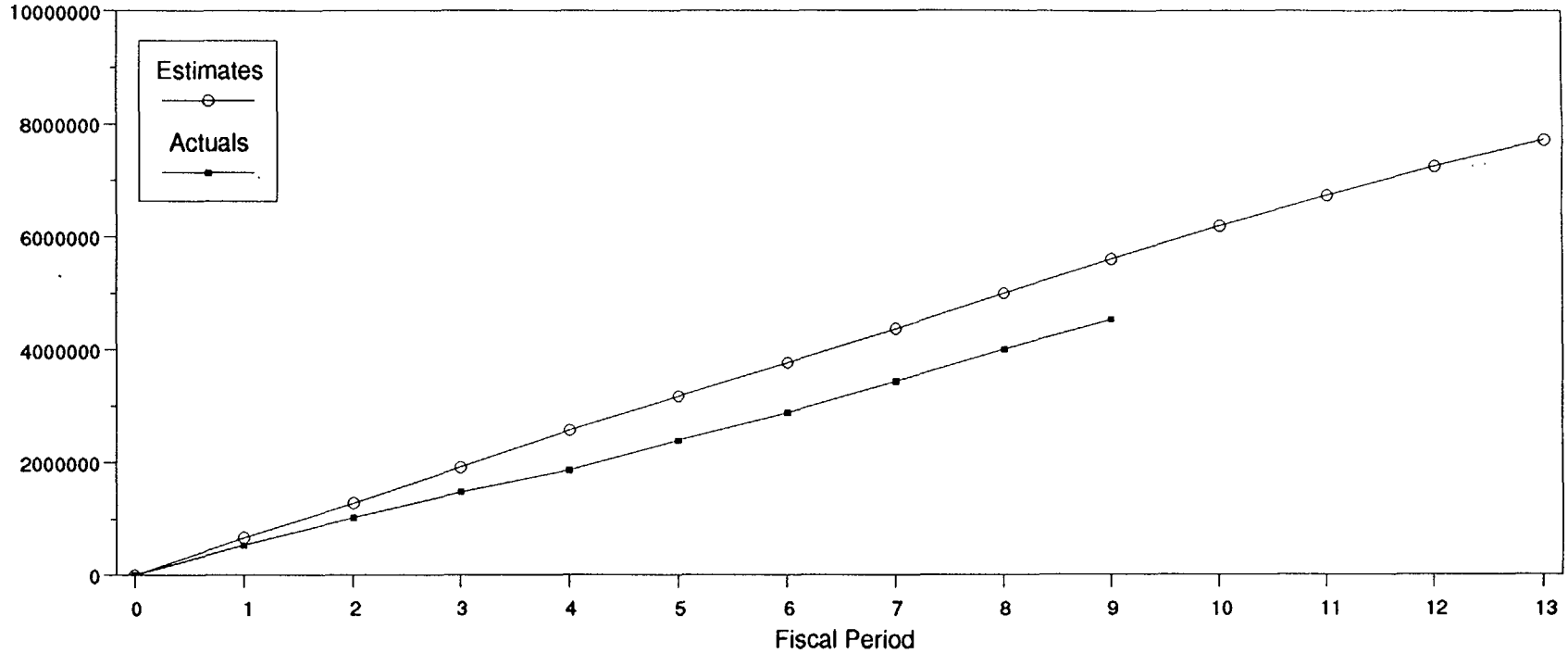
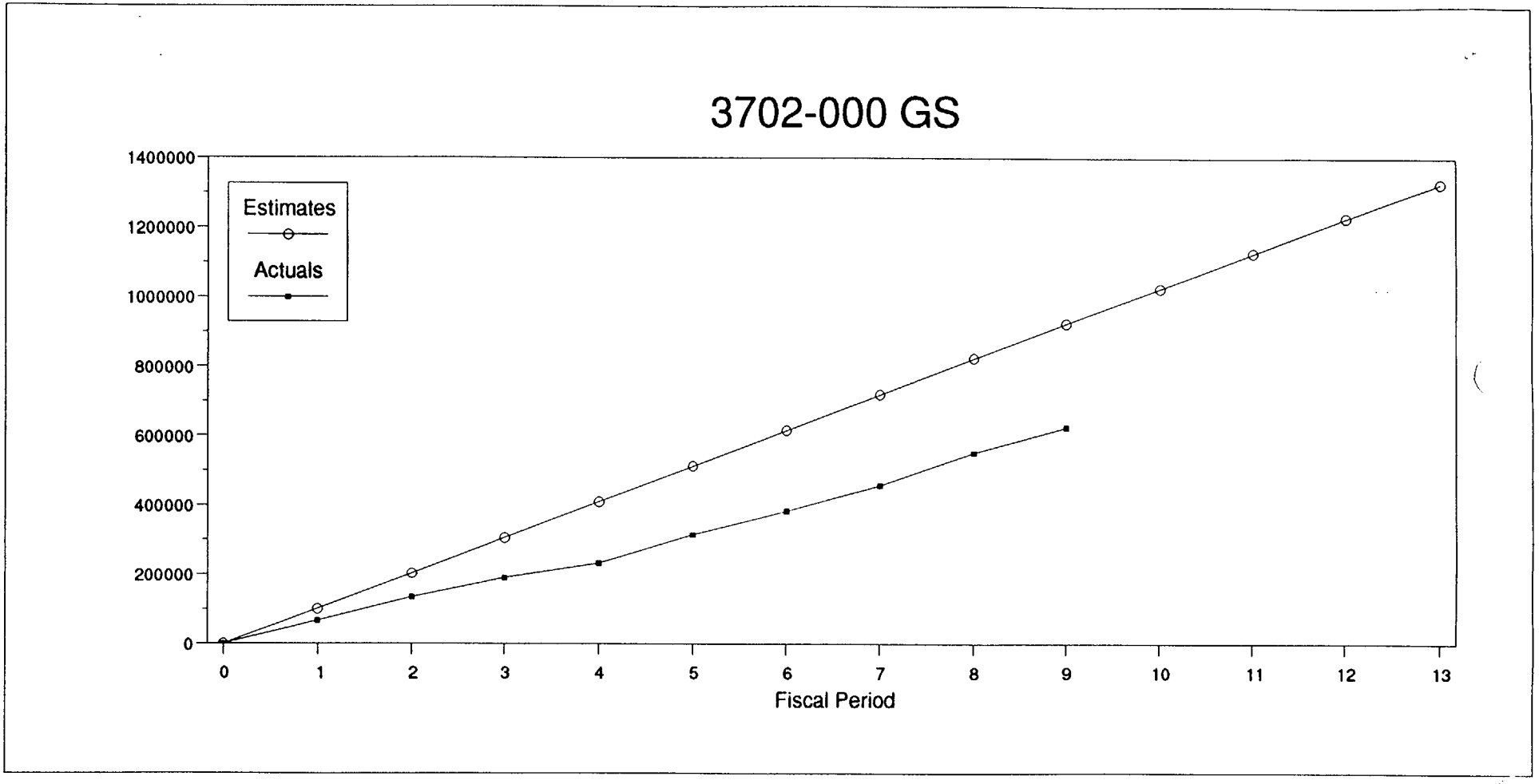
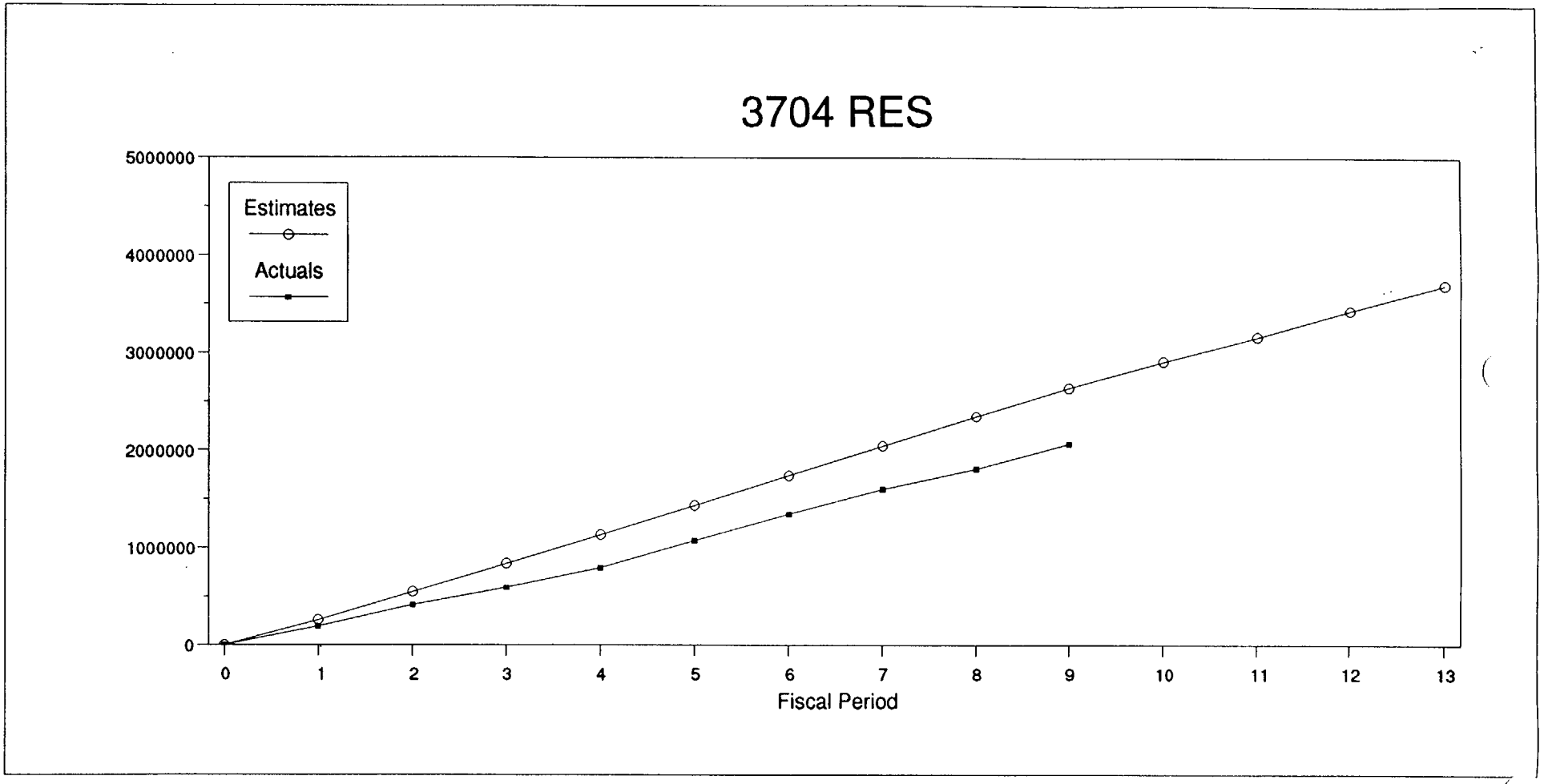


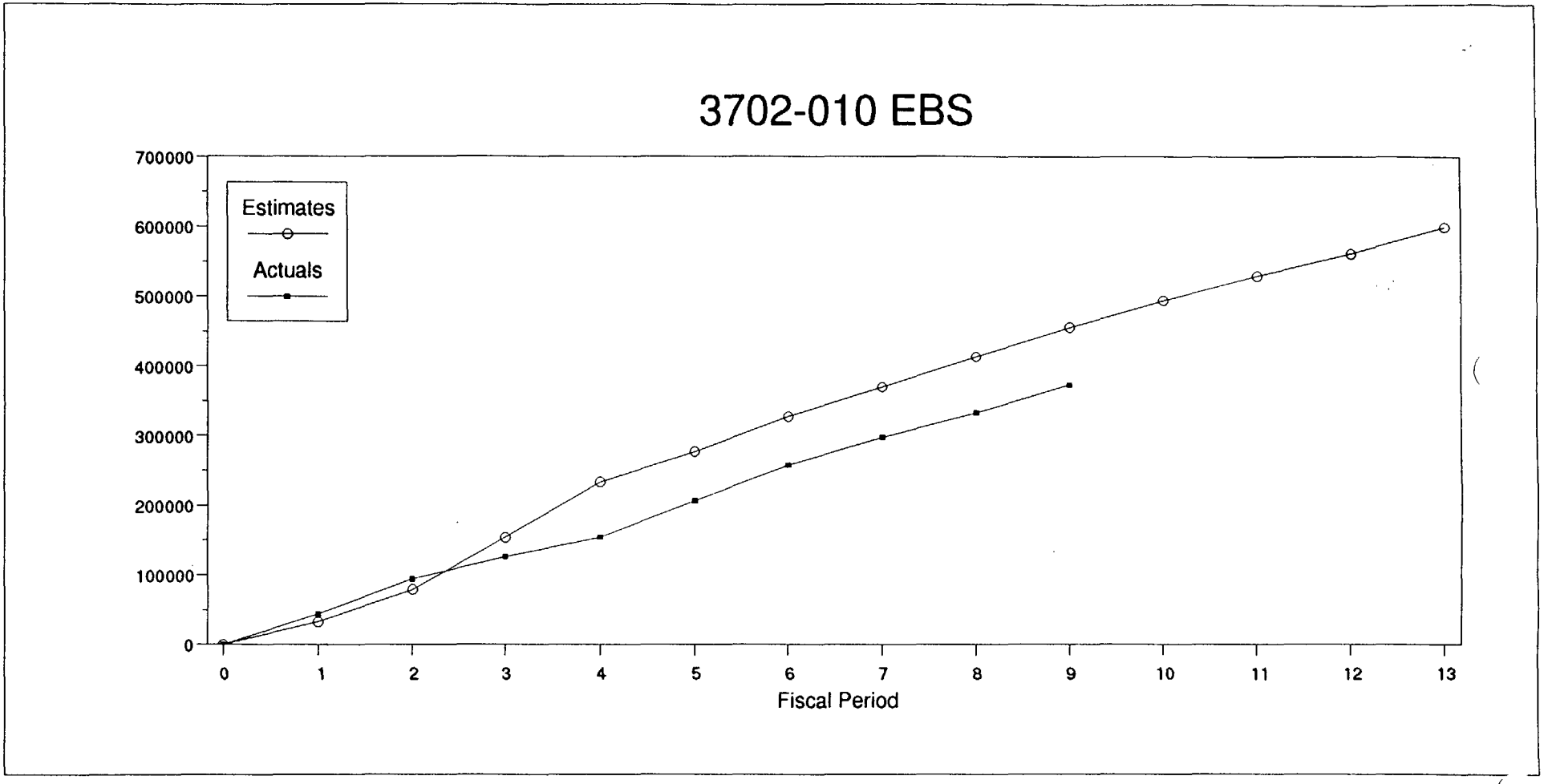
Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	661121	612903	636530	658829	602373	589972	605849	629639	607679	589829	540071	517200	465193	5604895
Act. Period Cost	528997	487028	459473	386036	522451	491982	556953	568063	535664	0	0	0	0	4536647
Variance, $	132124	125875	177057	272793	79922	97990	48896	61576	72015	0	0	0	0	3180541
Variance, %	20.0	20.5	27.8	41.4	13.3	16.6	8.1	9.8	11.9	0.0	0.0	0.0	0.0	41.2
Est. FY Cumul	661121	1274024	1910554	2569383	3171756	3761728	4367577	4997216	5604895	6194724	6734795	7251995	7717188	
Act. FY Cumul	528997	1016025	1475498	1861534	2383985	2875967	3432920	4000983	4536647	0	0	0	0	
Percent Complete	6.9	13.2	19.1	24.1	30.9	37.3	44.5	51.8	58.8	0.0	0.0	0.0	0.0	
Variance, $	132124	257999	435056	707849	787771	885761	934657	996233	1068248	0	0	0	0	
Variance, %	20.0	20.3	22.8	27.5	24.8	23.5	21.4	19.9	19.1	0.0	0.0	0.0	0.0	



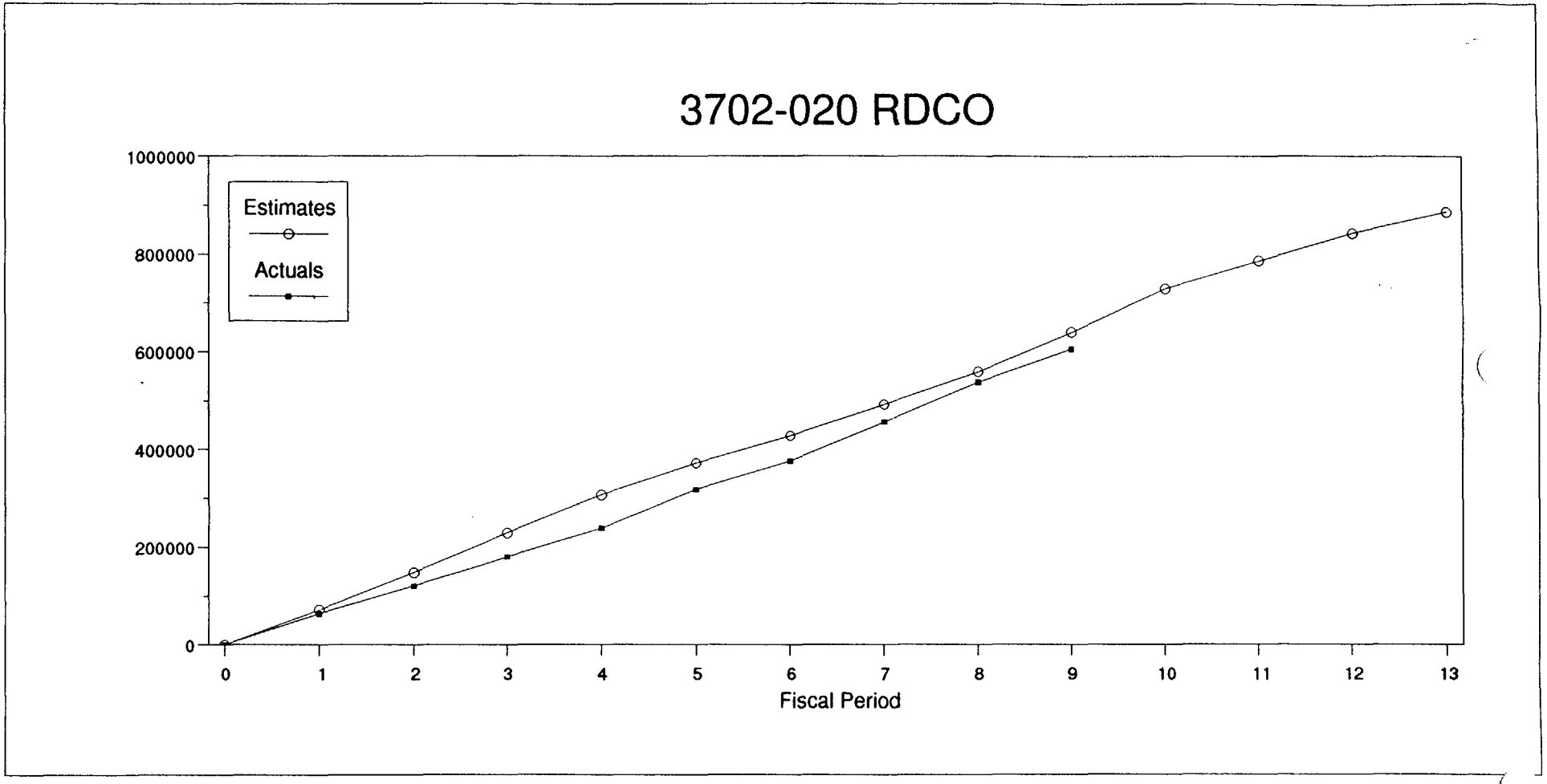
Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	100462	102453	103349	102932	102774	103487	103655	104650	101004	100855	101423	100394	98810	924766
Act. Period Cost	67019	67918	55816	41391	82654	68615	74152	93752	73909	0	0	0	0	625226
Variance, $	33443	34535	47533	61541	20120	34872	29503	10898	27095	0	0	0	0	701022
Variance, %	33.3	33.7	46.0	59.8	19.6	33.7	28.5	10.4	26.8	0.0	0.0	0.0	0.0	52.9
Est. FY Cumul	100462	202915	306264	409196	511970	615457	719112	823762	924766	1025621	1127044	1227438	1326248	
Act. FY Cumul	67019	134937	190753	232144	314798	383413	457565	551317	625226	0	0	0	0	
Percent Complete	5.1	10.2	14.4	17.5	23.7	28.9	34.5	41.6	47.1	0.0	0.0	0.0	0.0	
Variance, $	33443	67978	115511	177052	197172	232044	261547	272445	299540	0	0	0	0	
Variance, %	33.3	33.5	37.7	43.3	38.5	37.7	36.4	33.1	32.4	0.0	0.0	0.0	0.0	



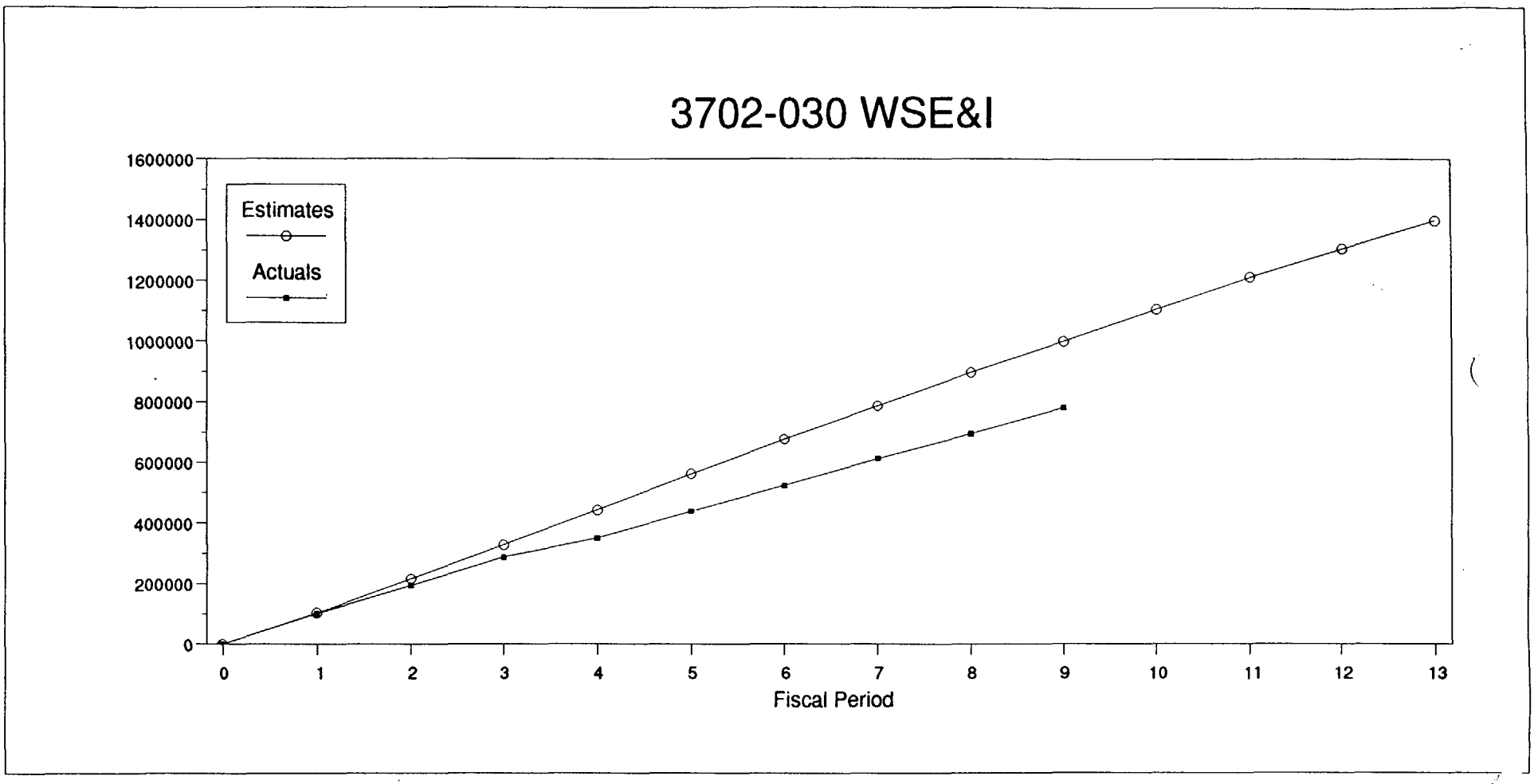
Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	258166	289926	288722	296369	301264	307480	304397	304505	293351	271547	254729	266620	261154	2644180
Act. Period Cost	193002	221970	176051	203444	277591	274364	254234	212267	256623	0	0	0	0	2069546
Variance, $	65164	67956	112671	92925	23673	33116	50163	92238	36728	0	0	0	0	1628684
Variance, %	25.2	23.4	39.0	31.4	7.9	10.8	16.5	30.3	12.5	0.0	0.0	0.0	0.0	44.0
Est. FY Cumul	258166	548092	836814	1133183	1434447	1741927	2046324	2350829	2644180	2915727	3170456	3437076	3698230	
Act. FY Cumul	193002	414972	591023	794467	1072058	1346422	1600656	1812923	2069546	0	0	0	0	
Percent Complete	5.2	11.2	16.0	21.5	29.0	36.4	43.3	49.0	56.0	0.0	0.0	0.0	0.0	
Variance, $	65164	133120	245791	338716	362389	395505	445668	537906	574634	0	0	0	0	
Variance, %	25.2	24.3	29.4	29.9	25.3	22.7	21.8	22.9	21.7	0.0	0.0	0.0	0.0	



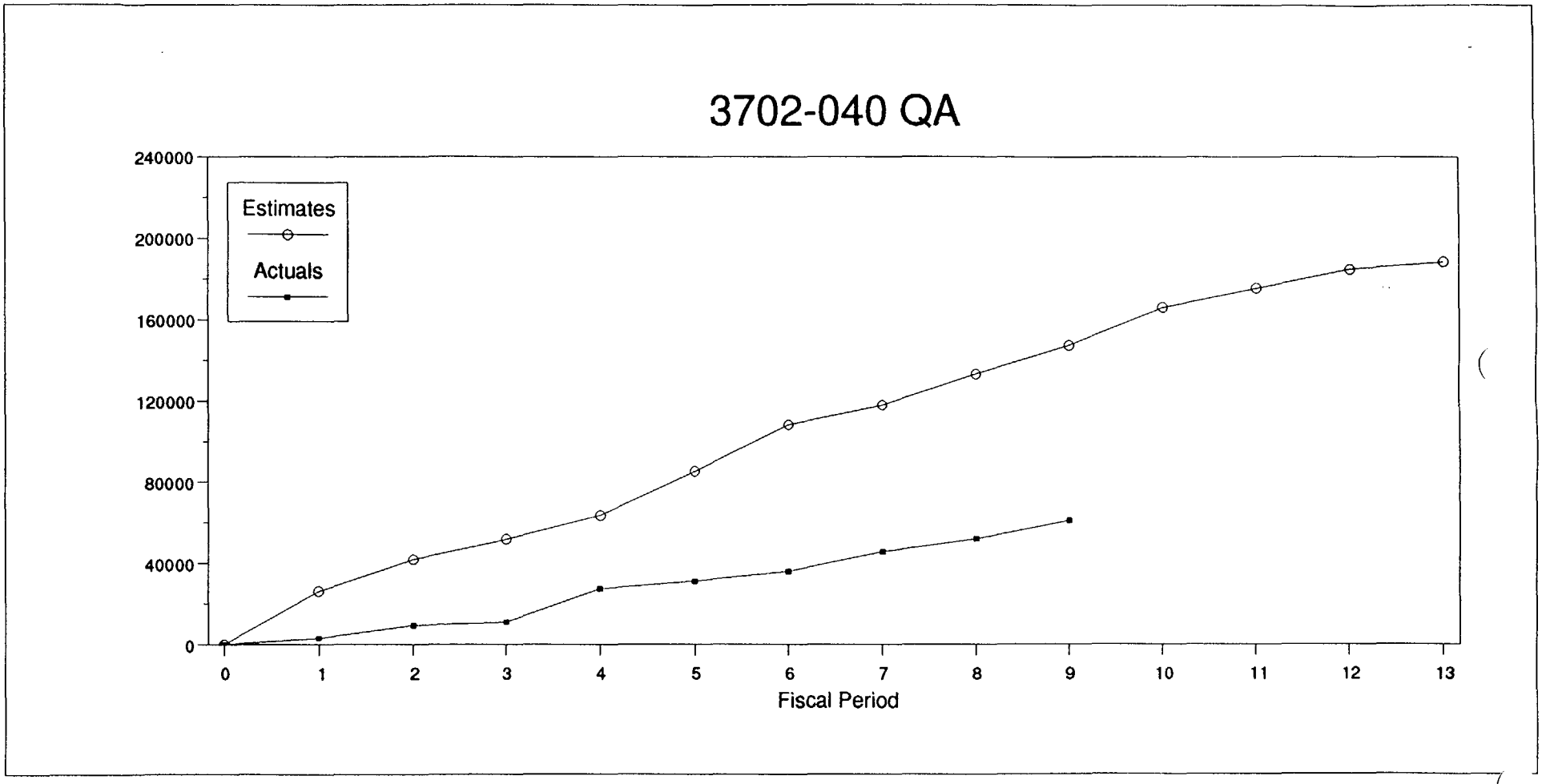
Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	32586	46280	74942	79513	43686	50435	42270	43598	42300	38293	35018	31794	38078	455610
Act. Period Cost	44050	50179	31852	28144	52285	51261	39838	35329	40220	0	0	0	0	373158
Variance, $	-11464	-3899	43090	51369	-8599	-826	2432	8269	2080	0	0	0	0	225635
Variance, %	-35.2	-8.4	57.5	64.6	-19.7	-1.6	5.8	19.0	4.9	0.0	0.0	0.0	0.0	37.7
Est. FY Cumul	32586	78866	153808	233321	277007	327442	369712	413310	455610	493903	528921	560715	598793	
Act. FY Cumul	44050	94229	126081	154225	206510	257771	297609	332938	373158	0	0	0	0	
Percent Complete	7.4	15.7	21.1	25.8	34.5	43.0	49.7	55.6	62.3	0.0	0.0	0.0	0.0	
Variance, $	-11464	-15363	27727	79096	70497	69671	72103	80372	82452	0	0	0	0	
Variance, %	-35.2	-19.5	18.0	33.9	25.4	21.3	19.5	19.4	18.1	0.0	0.0	0.0	0.0	



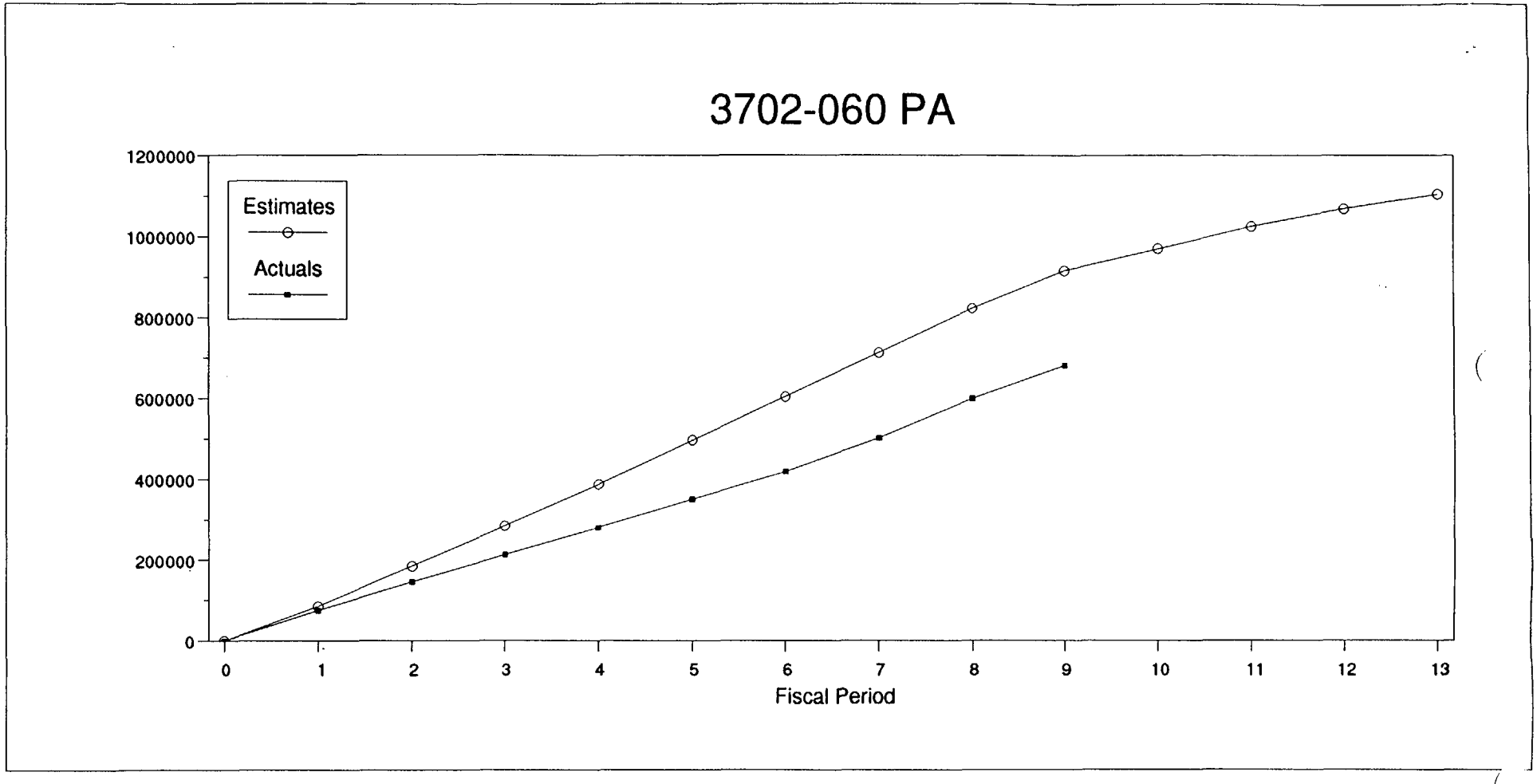
Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	71598	76282	81180	78049	64839	56151	64168	66695	81311	89157	56419	56518	43394	640273
Act. Period Cost	63878	56569	59841	58879	78396	58627	80503	81320	68169	0	0	0	0	606182
Variance, $	7720	19713	21339	19170	-13557	-2476	-16335	-14625	13142	0	0	0	0	279579
Variance, %	10.8	25.8	26.3	24.6	-20.9	-4.4	-25.5	-21.9	16.2	0.0	0.0	0.0	0.0	31.6
Est. FY Cumul	71598	147880	229060	307109	371948	428099	492267	558962	640273	729430	785849	842367	885761	
Act. FY Cumul	63878	120447	180288	239167	317563	376190	456693	538013	606182	0	0	0	0	
Percent Complete	7.2	13.6	20.4	27.0	35.9	42.5	51.6	60.7	68.4	0.0	0.0	0.0	0.0	
Variance, $	7720	27433	48772	67942	54385	51909	35574	20949	34091	0	0	0	0	
Variance, %	10.8	18.6	21.3	22.1	14.6	12.1	7.2	3.7	5.3	0.0	0.0	0.0	0.0	



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	102510	112691	112407	114998	118961	114682	109830	110730	103036	106240	106181	92457	91959	999845
Act. Period Cost	100333	92666	94252	63149	88456	84652	89032	82418	85902	0	0	0	0	780860
Variance, $	2177	20025	18155	51849	30505	30030	20798	28312	17134	0	0	0	0	615822
Variance, %	2.1	17.8	16.2	45.1	25.6	26.2	18.9	25.6	16.6	0.0	0.0	0.0	0.0	44.1
Est. FY Cumul	102510	215201	327608	442606	561567	676249	786079	896809	999845	1106085	1212266	1304723	1396682	
Act. FY Cumul	100333	192999	287251	350400	438856	523508	612540	694958	780860	0	0	0	0	
Percent Complete	7.2	13.8	20.6	25.1	31.4	37.5	43.9	49.8	55.9	0.0	0.0	0.0	0.0	
Variance, $	2177	22202	40357	92206	122711	152741	173539	201851	218985	0	0	0	0	
Variance, %	2.1	10.3	12.3	20.8	21.9	22.6	22.1	22.5	21.9	0.0	0.0	0.0	0.0	



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	26256	15601	9982	11751	21660	23025	9647	15284	14228	18637	9393	9281	3661	147434
Act. Period Cost	3224	6211	1699	16256	3786	4969	9504	6488	8983	0	0	0	0	61120
Variance, $	23032	9390	8283	-4505	17874	18056	143	8796	5245	0	0	0	0	127286
Variance, %	87.7	60.2	83.0	-38.3	82.5	78.4	1.5	57.6	36.9	0.0	0.0	0.0	0.0	67.6
Est. FY Cumul	26256	41857	51839	63590	85250	108275	117922	133206	147434	166071	175464	184745	188406	
Act. FY Cumul	3224	9435	11134	27390	31176	36145	45649	52137	61120	0	0	0	0	
Percent Complete	1.7	5.0	5.9	14.5	16.5	19.2	24.2	27.7	32.4	0.0	0.0	0.0	0.0	
Variance, $	23032	32422	40705	36200	54074	72130	72273	81069	86314	0	0	0	0	
Variance, %	87.7	77.5	78.5	56.9	63.4	66.6	61.3	60.9	58.5	0.0	0.0	0.0	0.0	



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	84881	100308	99197	102263	109361	108408	108897	109191	93209	53942	55218	42808	36475	915715
Act. Period Cost	75676	70660	67114	66265	70564	68617	83259	97839	81765	0	0	0	0	681759
Variance, $	9205	29648	32083	35998	38797	39791	25638	11352	11444	0	0	0	0	422399
Variance, %	10.8	29.6	32.3	35.2	35.5	36.7	23.5	10.4	12.3	0.0	0.0	0.0	0.0	38.3
Est. FY Cumul	84881	185189	284386	386649	496010	604418	713315	822506	915715	969657	1024875	1067683	1104158	
Act. FY Cumul	75676	146336	213450	279715	350279	418896	502155	599994	681759	0	0	0	0	
Percent Complete	6.9	13.3	19.3	25.3	31.7	37.9	45.5	54.3	61.7	0.0	0.0	0.0	0.0	
Variance, $	9205	38853	70936	106934	145731	185522	211160	222512	233956	0	0	0	0	
Variance, %	10.8	21.0	24.9	27.7	29.4	30.7	29.6	27.1	25.5	0.0	0.0	0.0	0.0	

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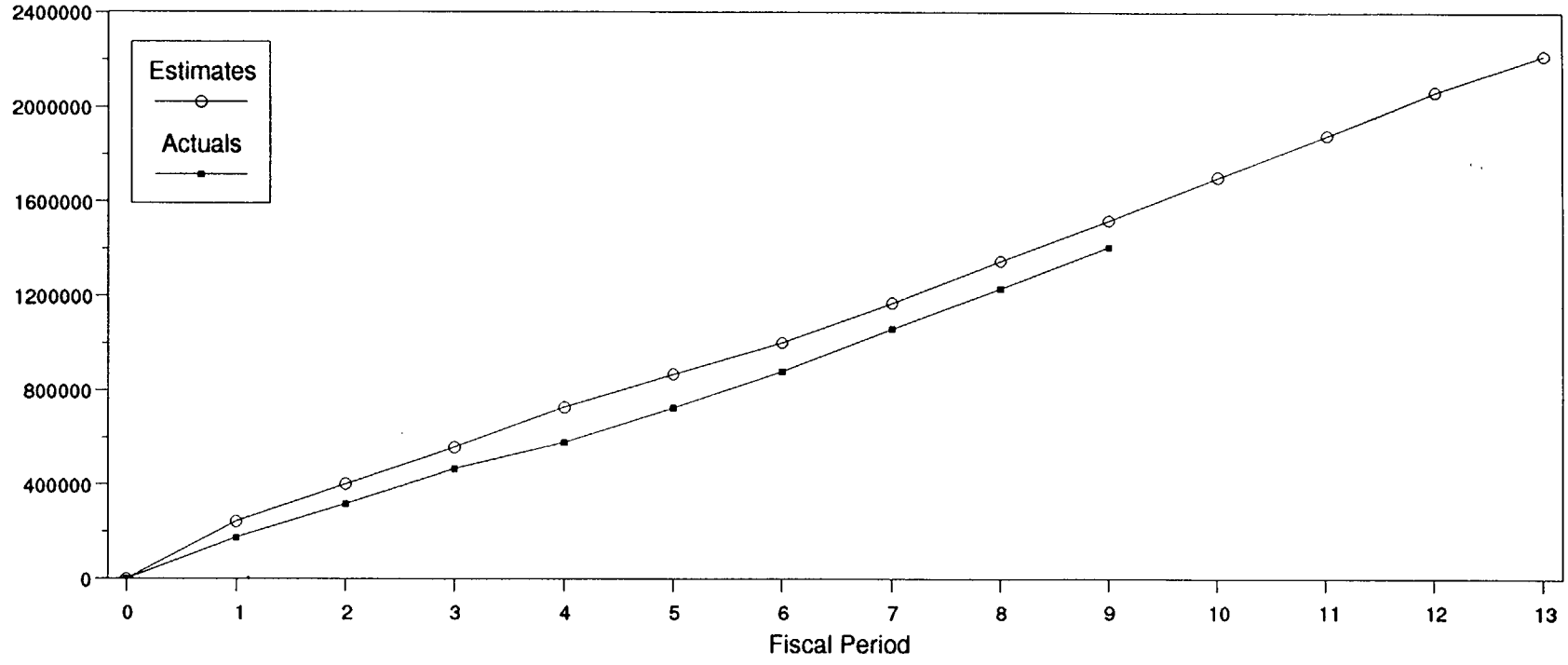
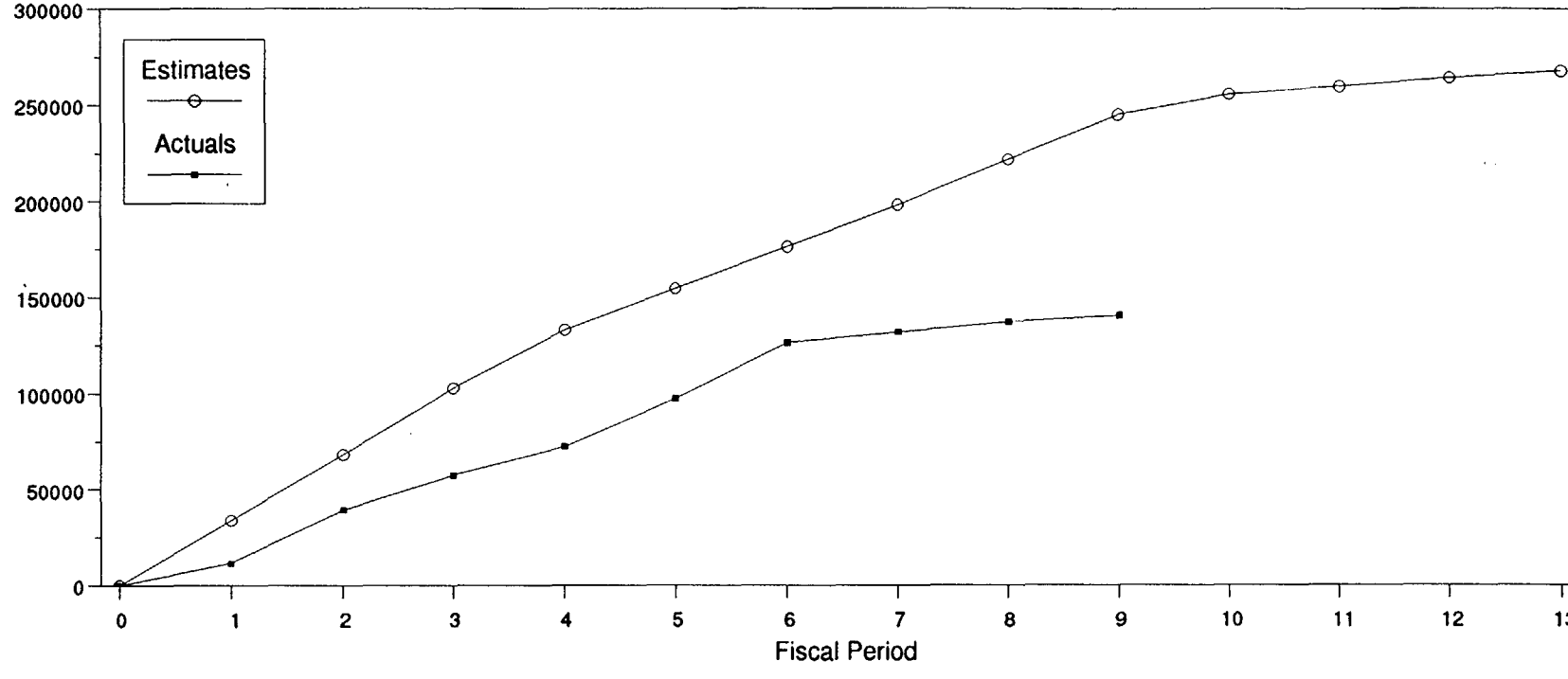
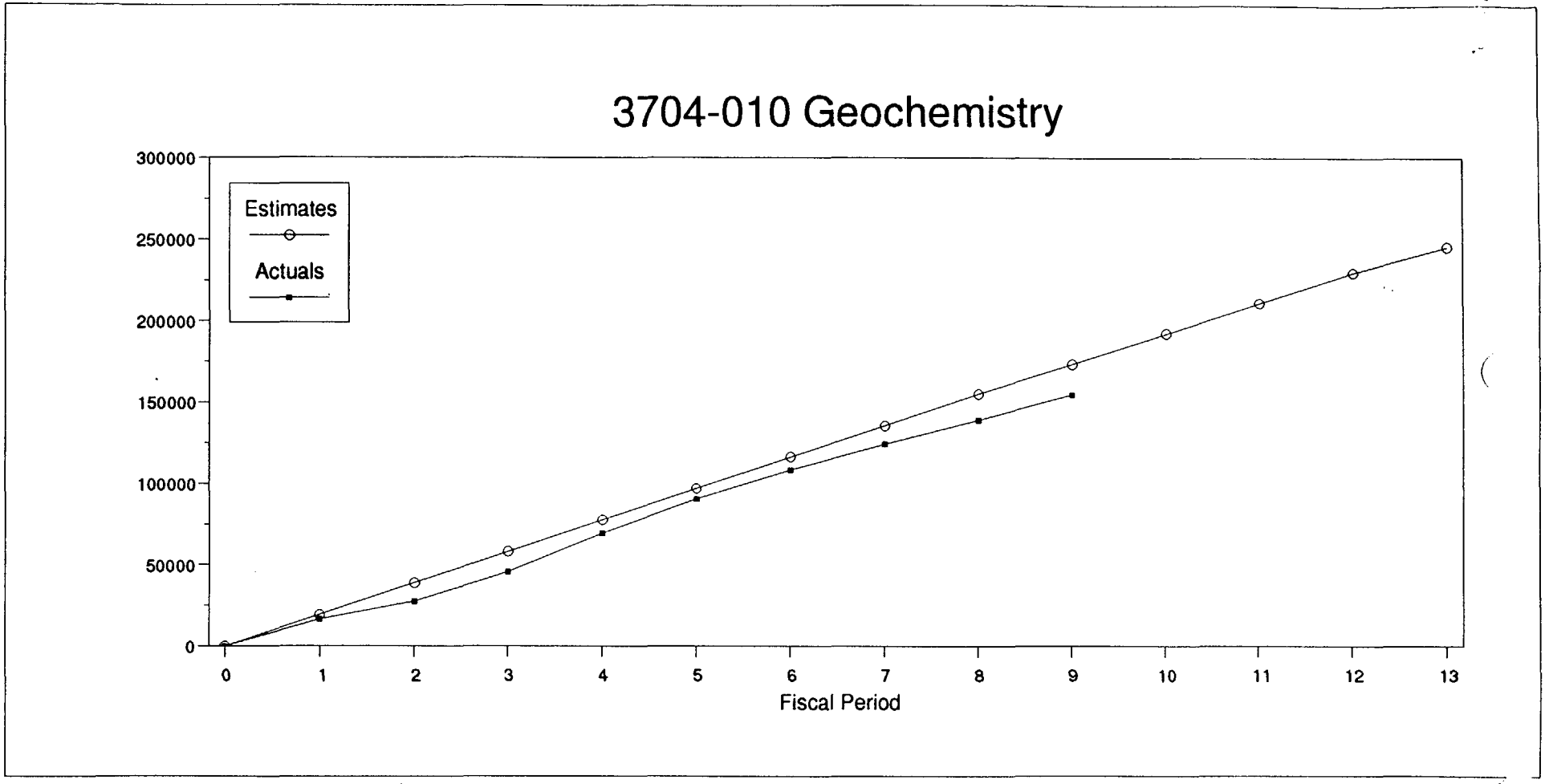


Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	242873	159288	155476	169320	141095	133783	167381	179492	172545	182704	176420	183947	152816	1521253
Act. Period Cost	174818	142823	148900	111952	146308	155242	180666	170916	176717	0	0	0	0	1408342
Variance, $	68055	16465	6576	57368	-5213	-21459	-13285	8576	-4172	0	0	0	0	808798
Variance, %	28.0	10.3	4.2	33.9	-3.7	-16.0	-7.9	4.8	-2.4	0.0	0.0	0.0	0.0	36.5
Est. FY Cumul	242873	402161	557637	726957	868052	1001835	1169216	1348708	1521253	1703957	1880377	2064324	2217140	
Act. FY Cumul	174818	317641	466541	578493	724801	880043	1060709	1231625	1408342	0	0	0	0	
Percent Complete	7.9	14.3	21.0	26.1	32.7	39.7	47.8	55.6	63.5	0.0	0.0	0.0	0.0	
Variance, $	68055	84520	91096	148464	143251	121792	108507	117083	112911	0	0	0	0	
Variance, %	28.0	21.0	16.3	20.4	16.5	12.2	9.3	8.7	7.4	0.0	0.0	0.0	0.0	

3704-000 Overall Research

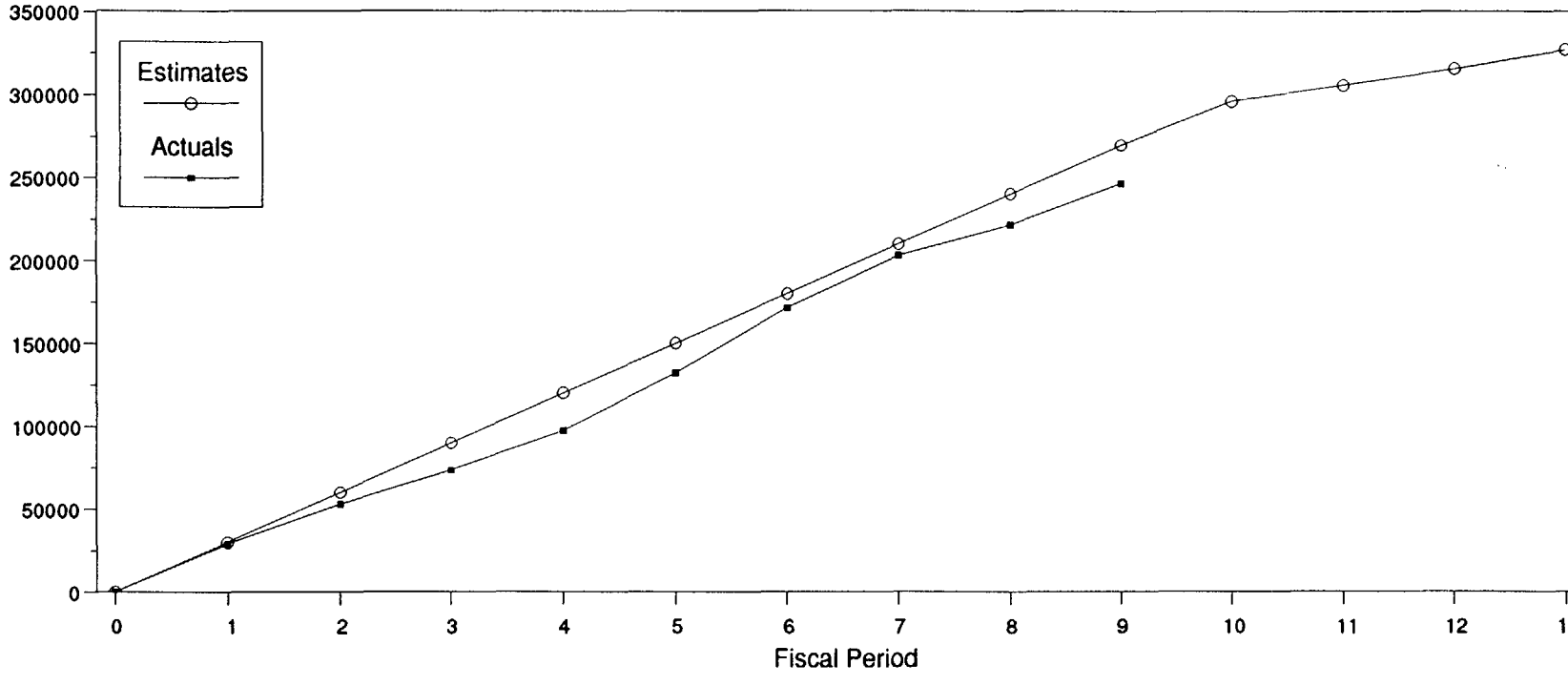


Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	34021	34246	34452	30426	21479	21801	21712	23584	23349	10591	4001	4570	3324	245070
Act. Period Cost	11699	27833	17908	15014	24828	29235	5445	5420	3424	0	0	0	0	140806
Variance, $	22322	6413	16544	15412	-3349	-7434	16267	18164	19925	0	0	0	0	126750
Variance, %	65.6	18.7	48.0	50.7	-15.6	-34.1	74.9	77.0	85.3	0.0	0.0	0.0	0.0	47.4
Est. FY Cumul	34021	68267	102719	133145	154624	176425	198137	221721	245070	255661	259662	264232	267556	
Act. FY Cumul	11699	39532	57440	72454	97282	126517	131962	137382	140806	0	0	0	0	
Percent Complete	4.4	14.8	21.5	27.1	36.4	47.3	49.3	51.3	52.6	0.0	0.0	0.0	0.0	
Variance, $	22322	28735	45279	60691	57342	49908	66175	84339	104264	0	0	0	0	
Variance, %	65.6	42.1	44.1	45.6	37.1	28.3	33.4	38.0	42.5	0.0	0.0	0.0	0.0	

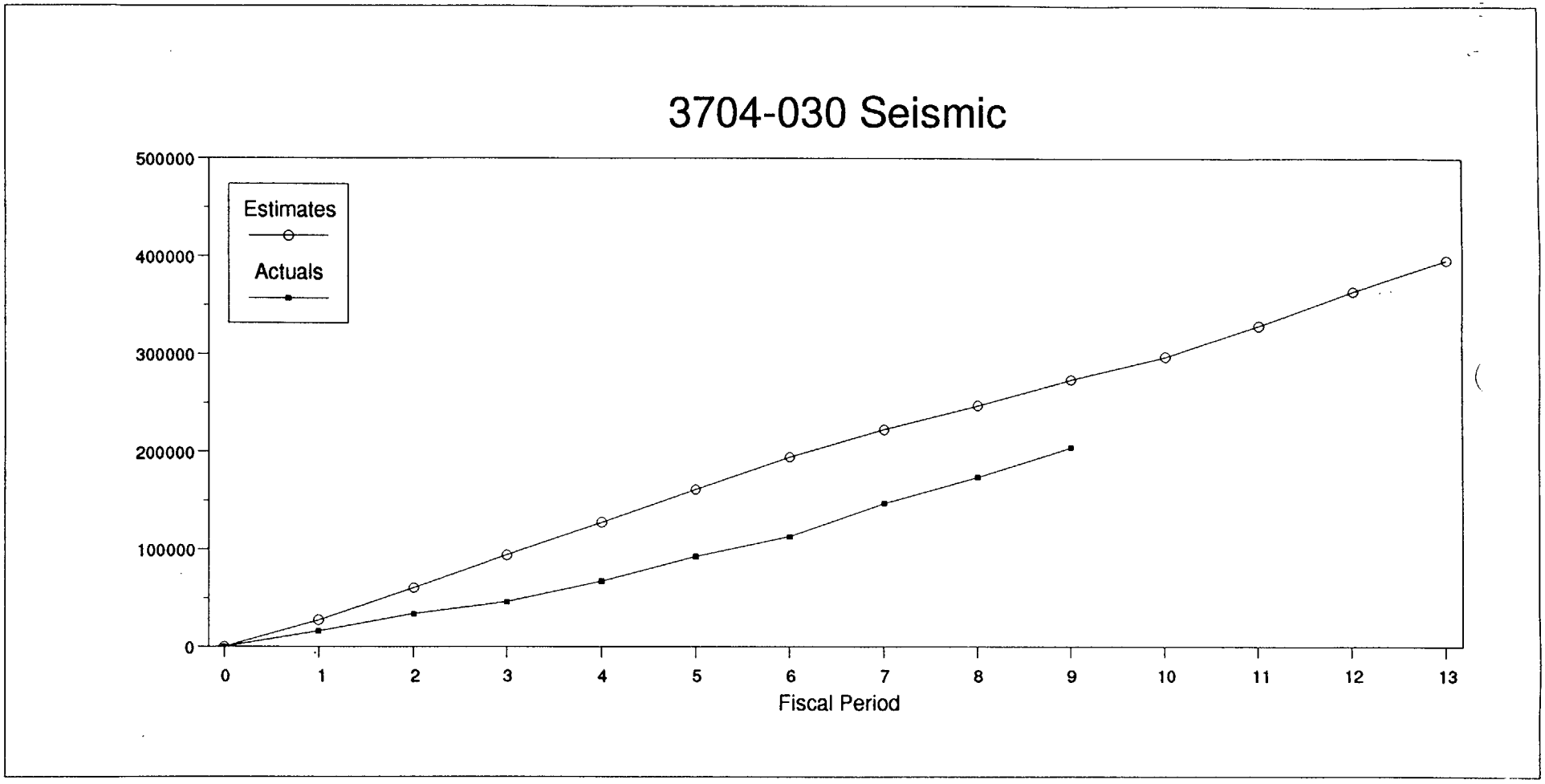


Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	19371	19573	19210	19528	19337	19432	19169	19551	18375	18904	18540	18702	15577	173546
Act. Period Cost	16663	11054	18090	23698	21032	17954	15813	14750	15822	0	0	0	0	154876
Variance, $	2708	8519	1120	-4170	-1695	1478	3356	4801	2553	0	0	0	0	90393
Variance, %	14.0	43.5	5.8	-21.4	-8.8	7.6	17.5	24.6	13.9	0.0	0.0	0.0	0.0	36.9
Est. FY Cumul	19371	38944	58154	77682	97019	116451	135620	155171	173546	192450	210990	229692	245269	
Act. FY Cumul	16663	27717	45807	69505	90537	108491	124304	139054	154876	0	0	0	0	
Percent Complete	6.8	11.3	ERR	28.3	36.9	44.2	50.7	56.7	63.1	0.0	0.0	0.0	0.0	
Variance, $	2708	11227	12347	8177	6482	7960	11316	16117	18670	0	0	0	0	
Variance, %	14.0	28.8	21.2	10.5	6.7	6.8	8.3	10.4	10.8	0.0	0.0	0.0	0.0	

3704-020 Thermo

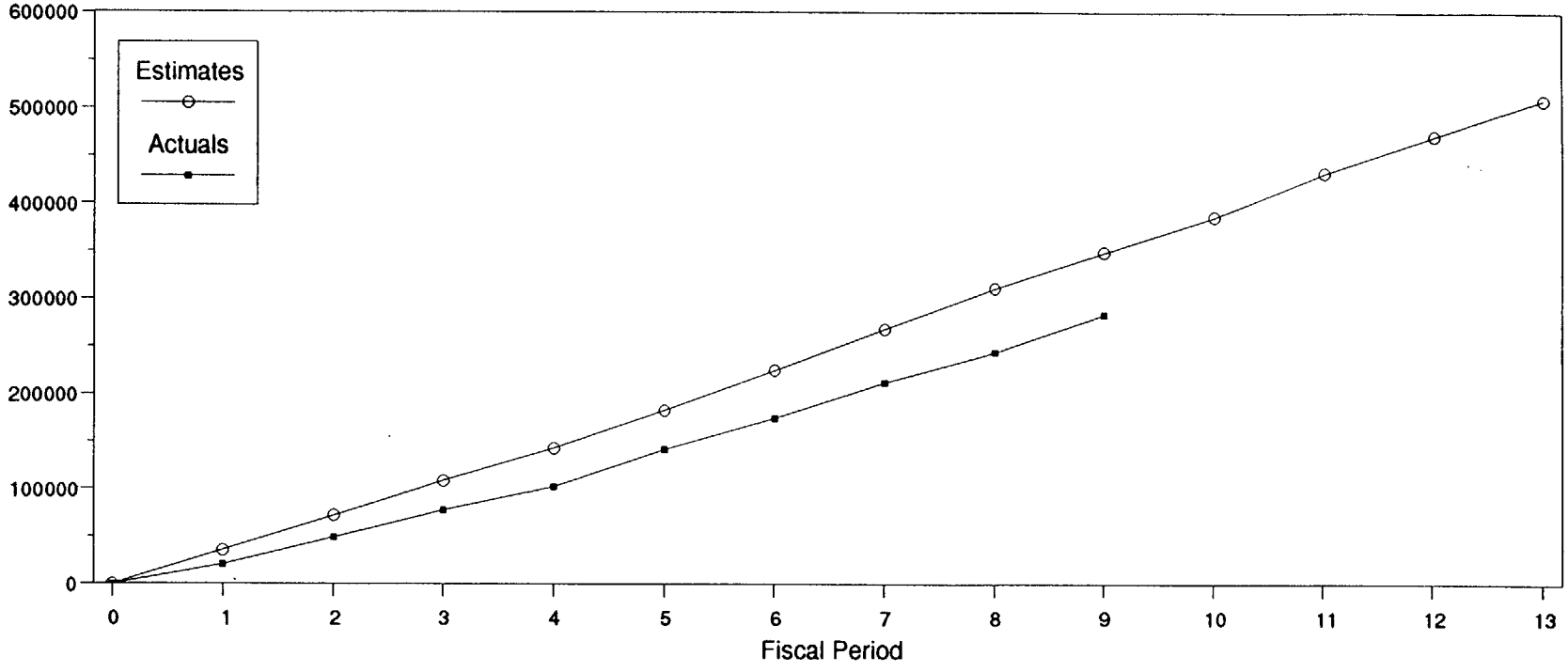


Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	29952	30046	29902	30099	29902	30070	29877	30249	29383	26379	9624	9812	11488	269480
Act. Period Cost	28901	24125	20523	23662	34924	39302	31530	18391	25177	0	0	0	0	246535
Variance, $	1051	5921	9379	6437	-5022	-9232	-1653	11858	4206	0	0	0	0	80248
Variance, %	3.5	19.7	31.4	21.4	-16.8	-30.7	-5.5	39.2	14.3	0.0	0.0	0.0	0.0	24.6
Est. FY Cumul	29952	59998	89900	119999	149901	179971	209848	240097	269480	295859	305483	315295	326783	
Act. FY Cumul	28901	53026	73549	97211	132135	171437	202967	221358	246535	0	0	0	0	
Percent Complete	8.8	16.2	22.5	29.7	40.4	52.5	62.1	67.7	75.4	0.0	0.0	0.0	0.0	
Variance, $	1051	6972	16351	22788	17766	8534	6881	18739	22945	0	0	0	0	
Variance, %	3.5	11.6	18.2	19.0	11.9	4.7	3.3	7.8	8.5	0.0	0.0	0.0	0.0	

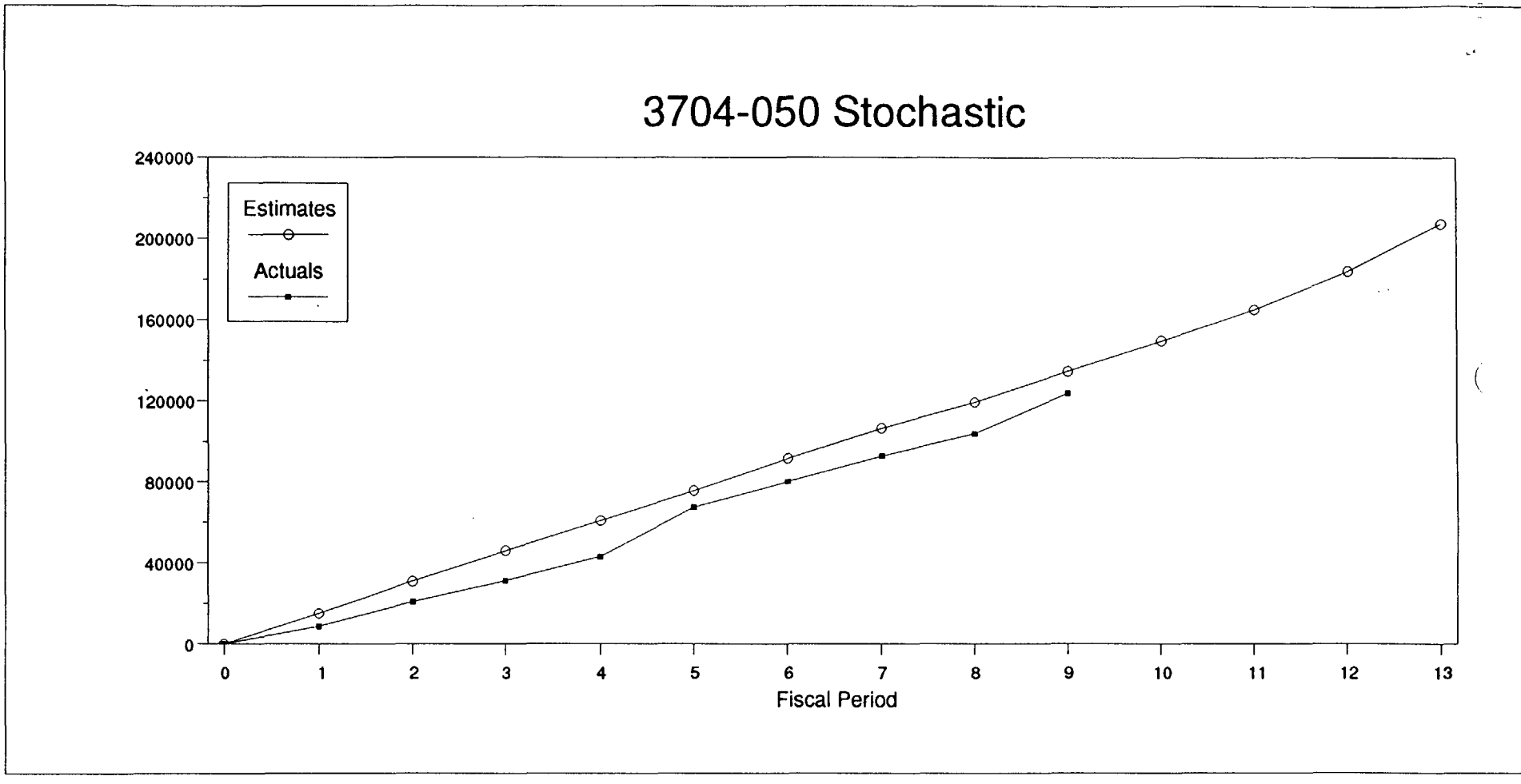


Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	27307	33146	33511	33604	33511	33394	28314	24471	26831	23368	31906	34881	31691	274089
Act. Period Cost	16132	17630	12178	21324	25280	20450	34133	27014	30494	0	0	0	0	204635
Variance, $	11175	15516	21333	12280	8231	12944	-5819	-2543	-3663	0	0	0	0	191300
Variance, %	40.9	46.8	63.7	36.5	24.6	38.8	-20.6	-10.4	-13.7	0.0	0.0	0.0	0.0	48.3
Est. FY Cumul	27307	60453	93964	127568	161079	194473	222787	247258	274089	297457	329363	364244	395935	
Act. FY Cumul	16132	33762	45940	67264	92544	112994	147127	174141	204635	0	0	0	0	
Percent Complete	4.1	8.5	11.6	17.0	23.4	28.5	37.2	44.0	51.7	0.0	0.0	0.0	0.0	
Variance, $	11175	26691	48024	60304	68535	81479	75660	73117	69454	0	0	0	0	
Variance, %	40.9	44.2	51.1	47.3	42.5	41.9	34.0	29.6	25.3	0.0	0.0	0.0	0.0	

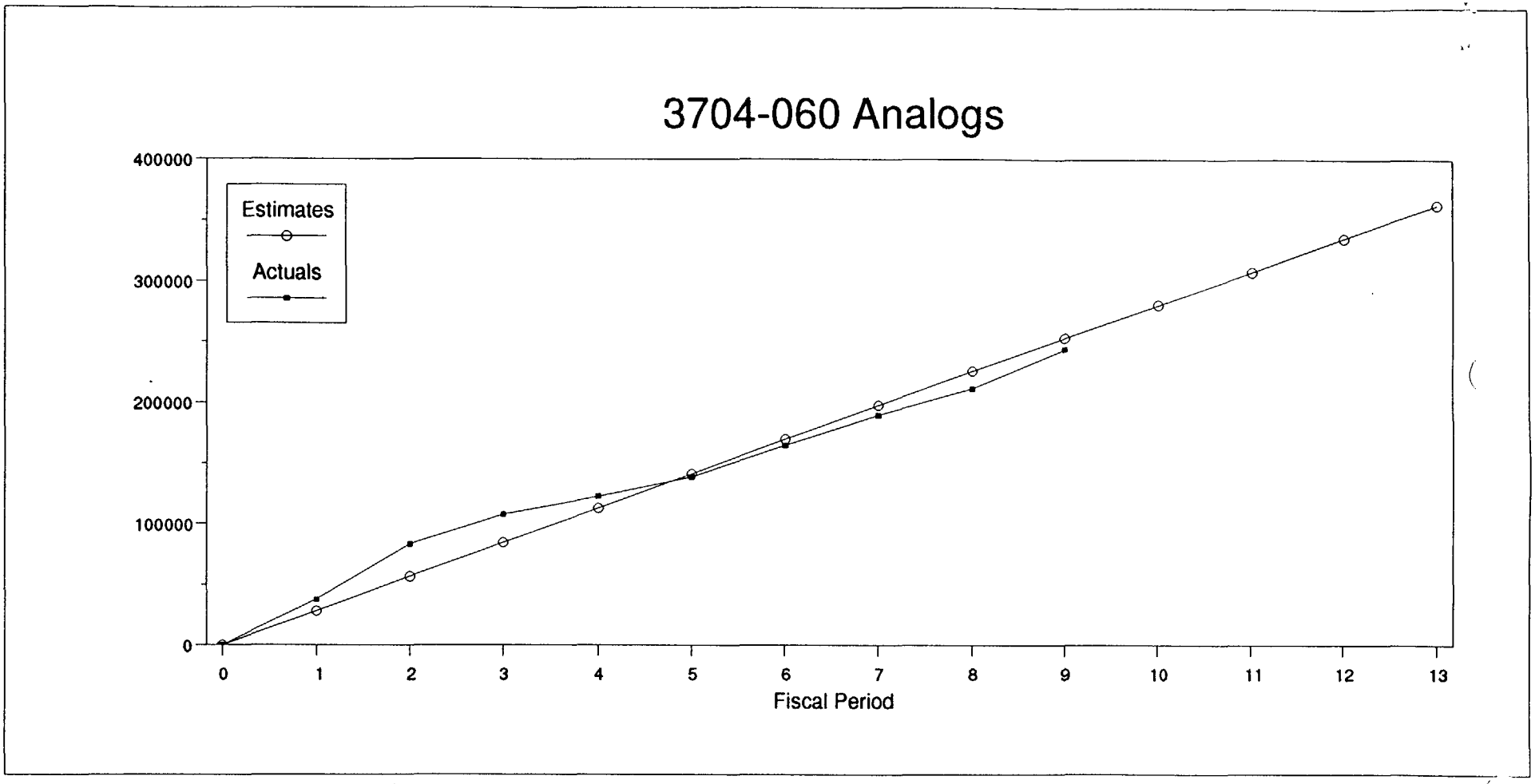
3704-040 IWPE



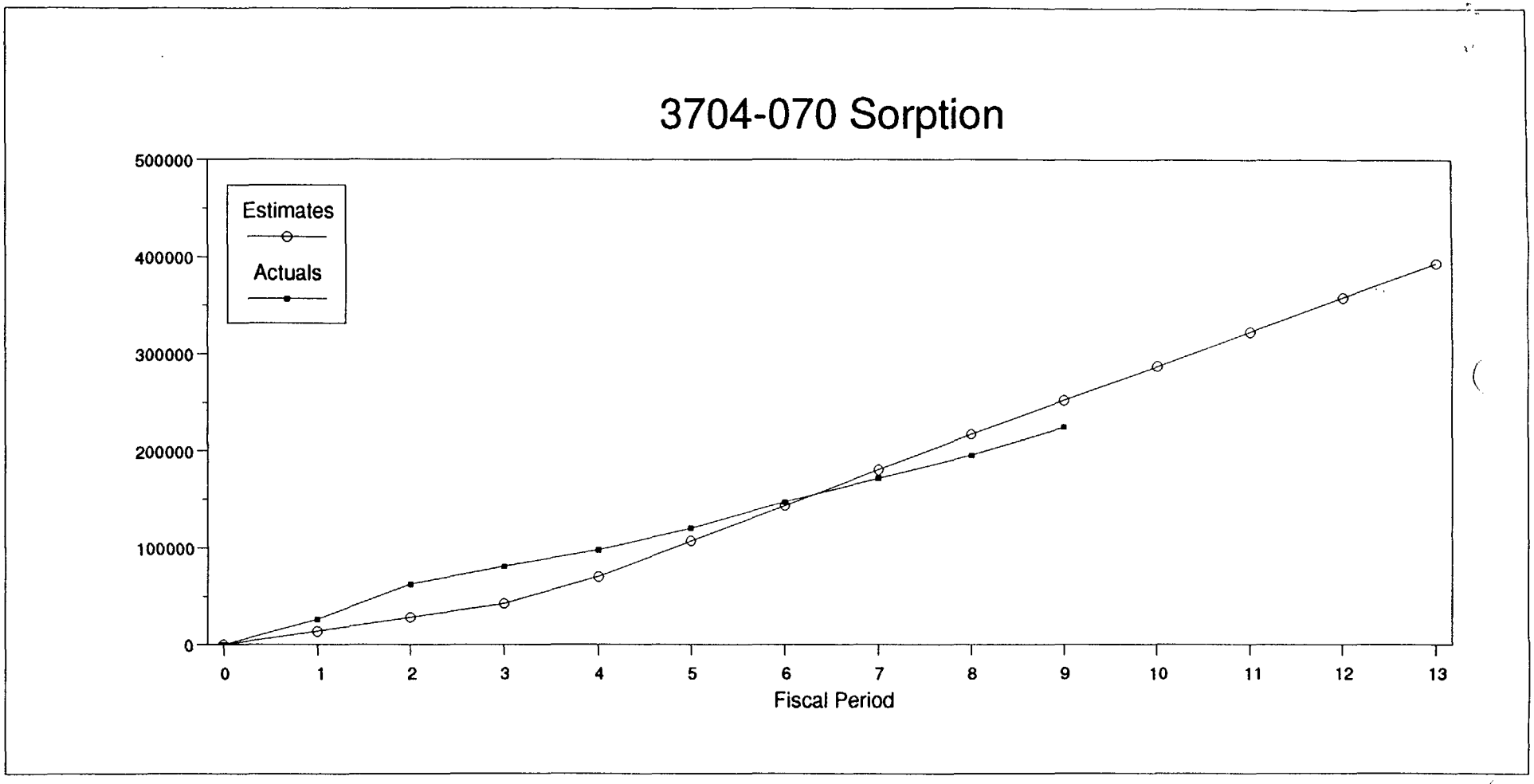
Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	35482	36645	36200	34268	39798	42349	43111	42893	38010	37505	45951	38775	37659	348756
Act. Period Cost	20416	28590	28574	24689	39281	32770	37602	31875	39535	0	0	0	0	283332
Variance, $	15066	8055	7626	9579	517	9579	5509	11018	-1525	0	0	0	0	225314
Variance, %	42.5	22.0	21.1	28.0	1.3	22.6	12.8	25.7	-4.0	0.0	0.0	0.0	0.0	44.3
Est. FY Cumul	35482	72127	108327	142595	182393	224742	267853	310746	348756	386261	432212	470987	508646	
Act. FY Cumul	20416	49006	77580	102269	141550	174320	211922	243797	283332	0	0	0	0	
Percent Complete	4.0	9.6	15.3	20.1	27.8	34.3	41.7	47.9	55.7	0.0	0.0	0.0	0.0	
Variance, $	15066	23121	30747	40326	40843	50422	55931	66949	65424	0	0	0	0	
Variance, %	42.5	32.1	28.4	28.3	22.4	22.4	20.9	21.5	18.8	0.0	0.0	0.0	0.0	



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	15050	15901	15019	14944	14763	15889	14988	12830	15371	15101	15392	18797	23427	134755
Act. Period Cost	8807	12025	10381	11861	24428	12741	12665	10968	20087	0	0	0	0	123963
Variance, $	6243	3876	4638	3083	-9665	3148	2323	1862	-4716	0	0	0	0	83509
Variance, %	41.5	24.4	30.9	20.6	-65.5	19.8	15.5	14.5	-30.7	0.0	0.0	0.0	0.0	40.3
Est. FY Cumul	15050	30951	45970	60914	75677	91566	106554	119384	134755	149856	165248	184045	207472	
Act. FY Cumul	8807	20832	31213	43074	67502	80243	92908	103876	123963	0	0	0	0	
Percent Complete	4.2	10.0	15.0	20.8	32.5	38.7	44.8	50.1	59.7	0.0	0.0	0.0	0.0	
Variance, $	6243	10119	14757	17840	8175	11323	13646	15508	10792	0	0	0	0	
Variance, %	41.5	32.7	32.1	29.3	10.8	12.4	12.8	13.0	8.0	0.0	0.0	0.0	0.0	

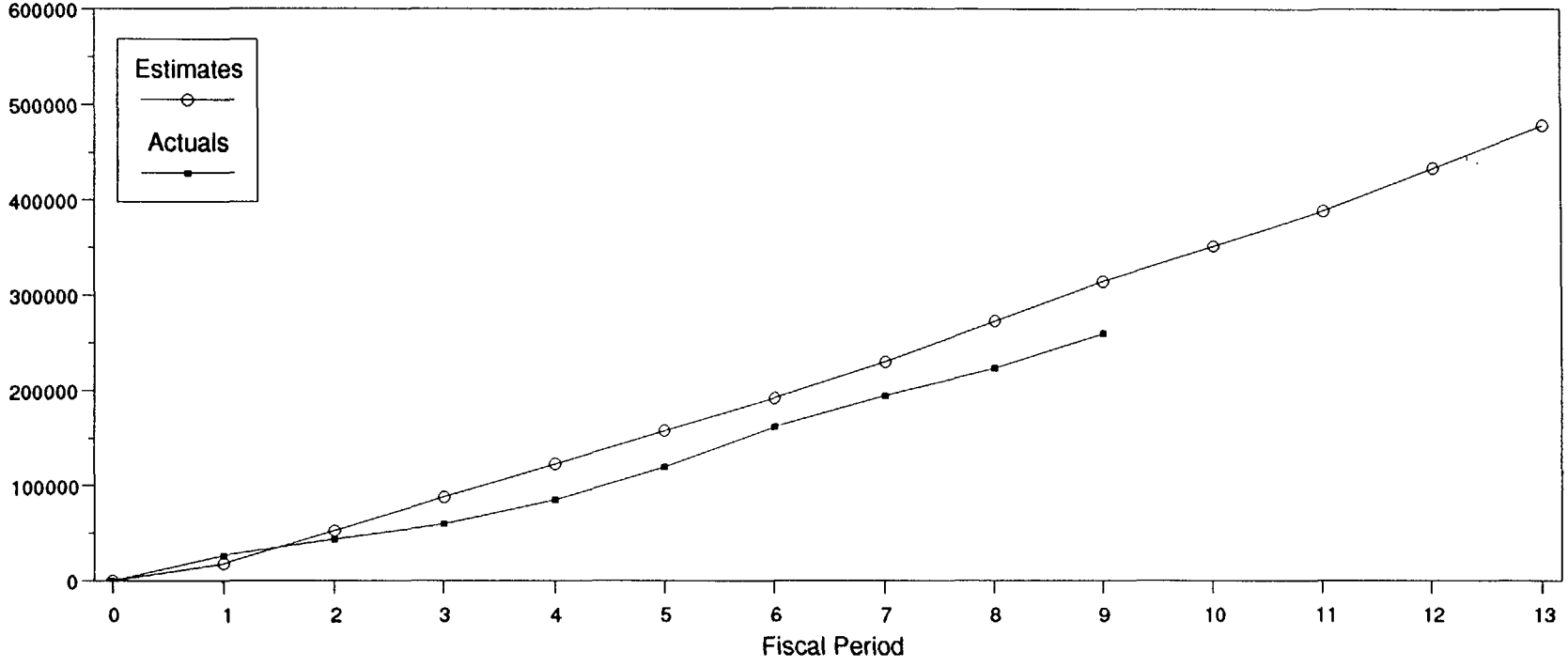


Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	28006	28663	27969	28273	28319	28465	28092	28292	27434	27198	27174	27376	27203	253513
Act. Period Cost	37625	45690	24536	14876	16045	25890	24948	21876	32879	0	0	0	0	244365
Variance, $	-9619	-17027	3433	13397	12274	2575	3144	6416	-5445	0	0	0	0	118099
Variance, %	-34.3	-59.4	12.3	47.4	43.3	9.0	11.2	22.7	-19.8	0.0	0.0	0.0	0.0	32.6
Est. FY Cumul	28006	56669	84638	112911	141230	169695	197787	226079	253513	280711	307885	335261	362464	
Act. FY Cumul	37625	83315	107851	122727	138772	164662	189610	211486	244365	0	0	0	0	
Percent Complete	10.4	23.0	29.8	33.9	38.3	45.4	52.3	58.3	67.4	0.0	0.0	0.0	0.0	
Variance, $	-9619	-26646	-23213	-9816	2458	5033	8177	14593	9148	0	0	0	0	
Variance, %	-34.3	-47.0	-27.4	-8.7	1.7	3.0	4.1	6.5	3.6	0.0	0.0	0.0	0.0	

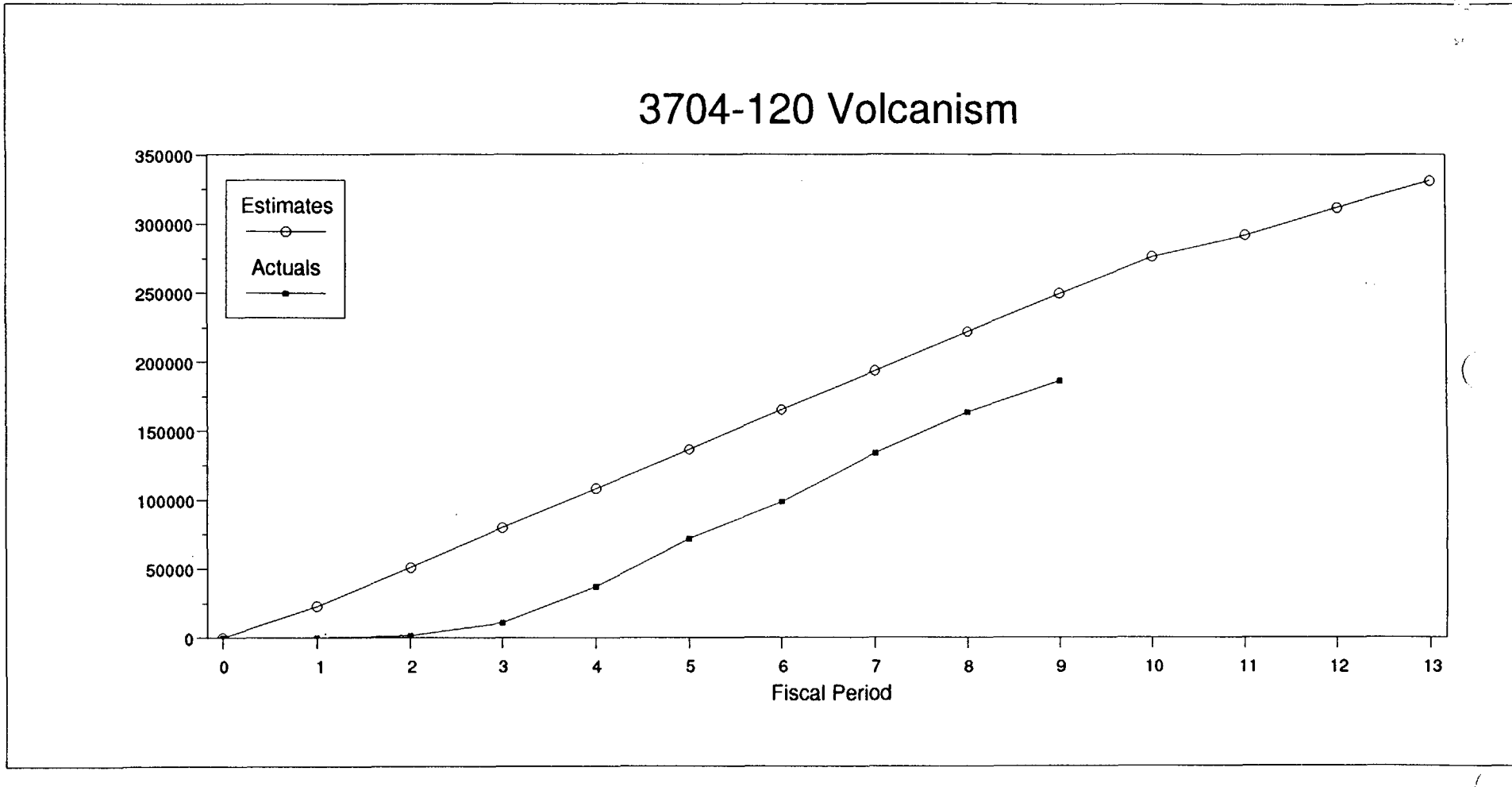


Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	13733	14421	14264	27808	36734	36503	37029	36545	35222	35201	35495	35352	35138	252259
Act. Period Cost	26210	36022	18568	17016	22407	27051	24433	23580	29327	0	0	0	0	224614
Variance, $	-12477	-21601	-4304	10792	14327	9452	12596	12965	5895	0	0	0	0	168831
Variance, %	-90.9	-149.8	-30.2	38.8	39.0	25.9	34.0	35.5	16.7	0.0	0.0	0.0	0.0	42.9
Est. FY Cumul	13733	28154	42418	70226	106960	143463	180492	217037	252259	287460	322955	358307	393445	
Act. FY Cumul	26210	62232	80800	97816	120223	147274	171707	195287	224614	0	0	0	0	
Percent Complete	6.7	15.8	20.5	24.9	30.6	37.4	43.6	49.6	57.1	0.0	0.0	0.0	0.0	
Variance, $	-12477	-34078	-38382	-27590	-13263	-3811	8785	21750	27645	0	0	0	0	
Variance, %	-90.9	-121.0	-90.5	-39.3	-12.4	-2.7	4.9	10.0	11.0	0.0	0.0	0.0	0.0	

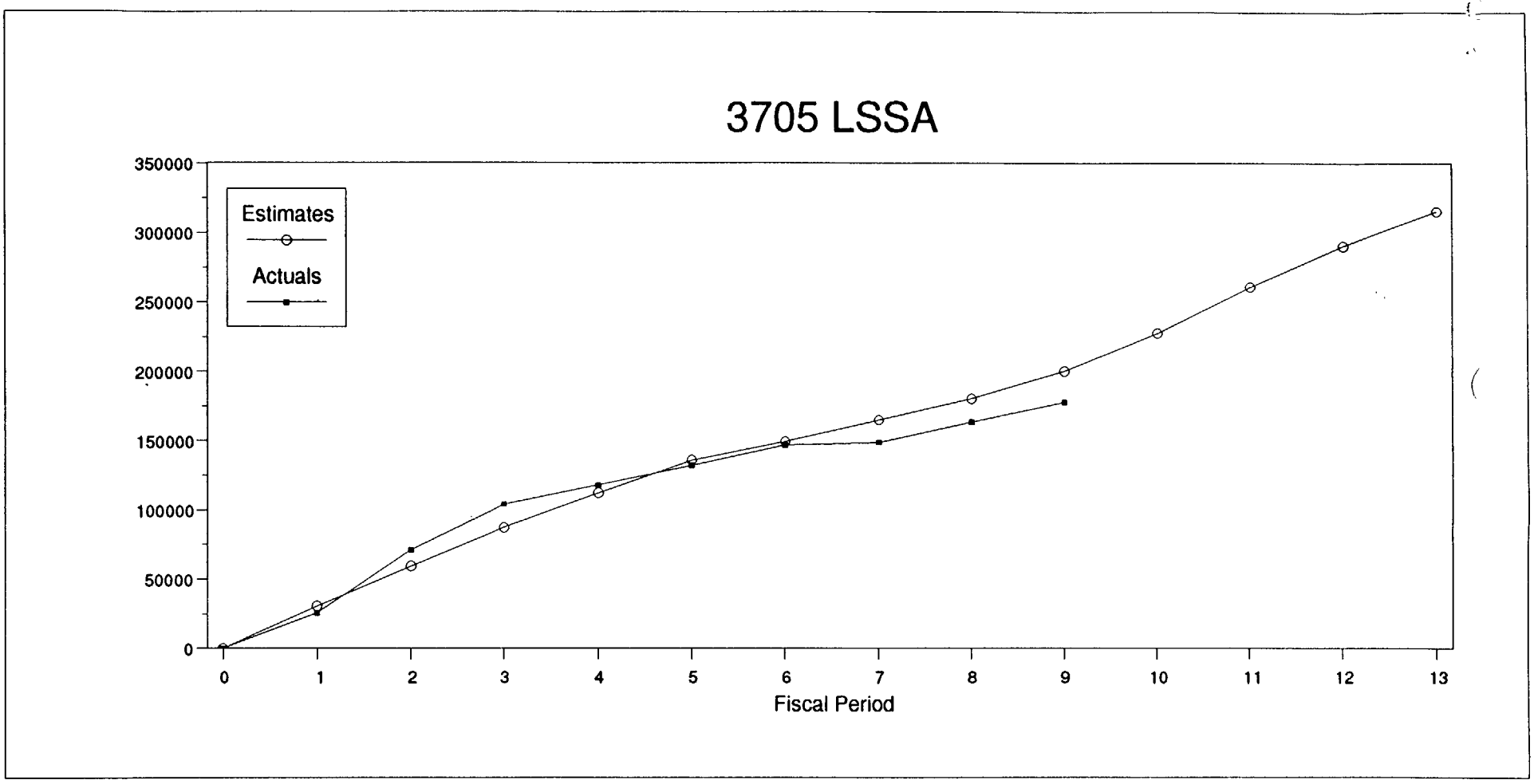
3704-110 PA Research



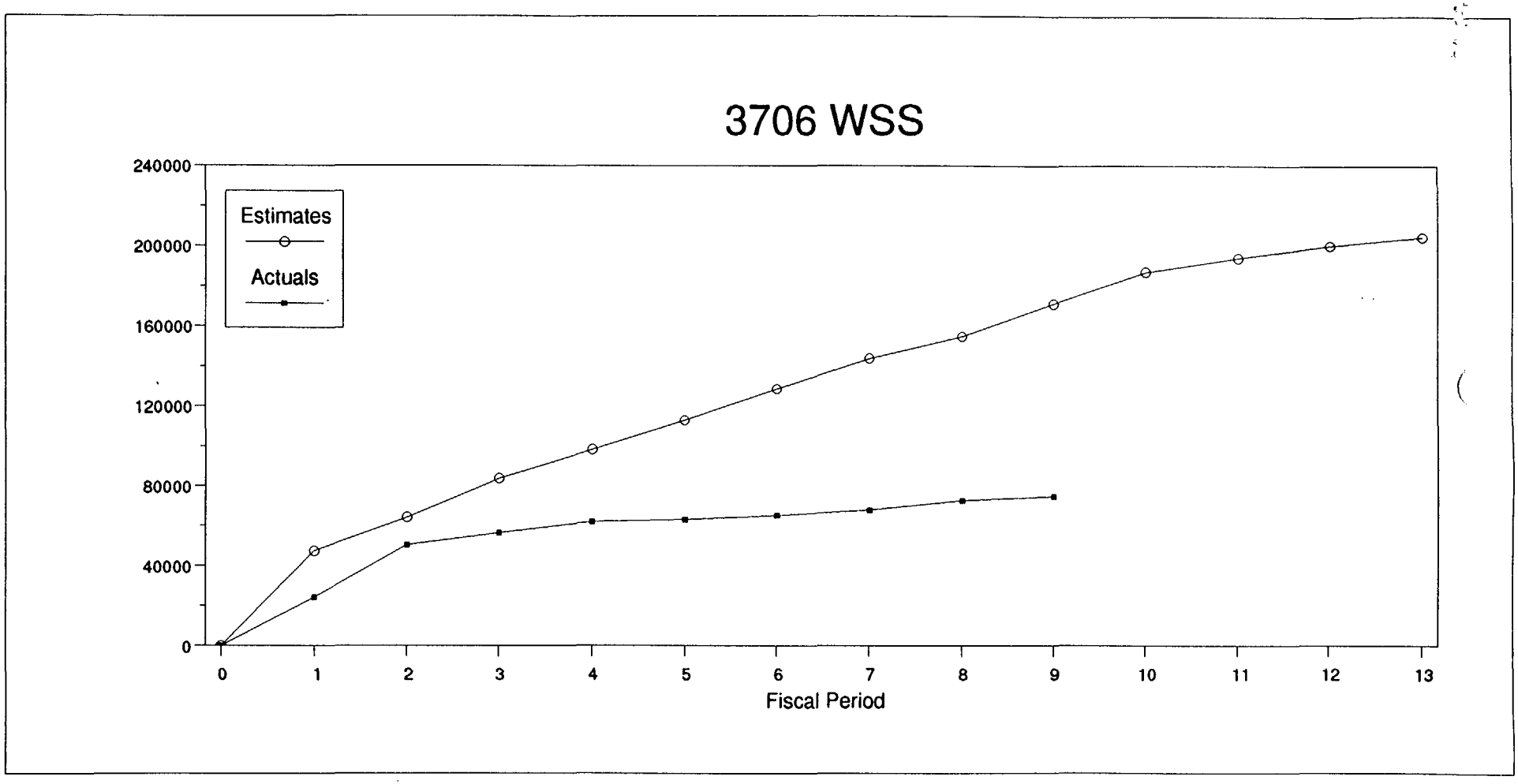
Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	18156	34686	35224	34706	34667	34644	37886	42756	42025	36919	37129	44788	44350	314750
Act. Period Cost	26550	17249	16267	25033	34500	42358	32444	28696	36892	0	0	0	0	259989
Variance, $	-8394	17437	18957	9673	167	-7714	5442	14060	5133	0	0	0	0	217947
Variance, %	-46.2	50.3	53.8	27.9	0.5	-22.3	14.4	32.9	12.2	0.0	0.0	0.0	0.0	45.6
Est. FY Cumul	18156	52842	88066	122772	157439	192083	229969	272725	314750	351669	388798	433586	477936	
Act. FY Cumul	26550	43799	60066	85099	119599	161957	194401	223097	259989	0	0	0	0	
Percent Complete	5.6	9.2	12.6	17.8	25.0	33.9	40.7	46.7	54.4	0.0	0.0	0.0	0.0	
Variance, $	-8394	9043	28000	37673	37840	30126	35568	49628	54761	0	0	0	0	
Variance, %	-46.2	17.1	31.8	30.7	24.0	15.7	15.5	18.2	17.4	0.0	0.0	0.0	0.0	



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	22811	28256	28693	28345	28361	28829	28223	28346	27763	26550	15554	19732	19520	249627
Act. Period Cost	0	1750	9027	26270	34867	26613	35221	29697	22986	0	0	0	0	186431
Variance, $	22811	26506	19666	2075	-6506	2216	-6998	-1351	4777	0	0	0	0	144552
Variance, %	100.0	93.8	68.5	7.3	-22.9	7.7	-24.8	-4.8	17.2	0.0	0.0	0.0	0.0	43.7
Est. FY Cumul	22811	51067	79760	108105	136466	165295	193518	221864	249627	276177	291731	311463	330983	
Act. FY Cumul	0	1750	10777	37047	71914	98527	133748	163445	186431	0	0	0	0	
Percent Complete	0.0	0.5	3.3	11.2	21.7	29.8	40.4	49.4	56.3	0.0	0.0	0.0	0.0	
Variance, $	22811	49317	68983	71058	64552	66768	59770	58419	63196	0	0	0	0	
Variance, %	100.0	96.6	86.5	65.7	47.3	40.4	30.9	26.3	25.3	0.0	0.0	0.0	0.0	



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	30505	28857	27885	24881	23770	13544	15452	15402	19883	27493	33272	29345	24930	200179
Act. Period Cost	25660	45324	33134	13710	14260	14782	1903	14630	14408	0	0	0	0	177811
Variance, $	4845	-16467	-5249	11171	9510	-1238	13549	772	5475	0	0	0	0	137408
Variance, %	15.9	-57.1	-18.8	44.9	40.0	-9.1	87.7	5.0	27.5	0.0	0.0	0.0	0.0	43.6
Est. FY Cumul	30505	59362	87247	112128	135898	149442	164894	180296	200179	227672	260944	290289	315219	
Act. FY Cumul	25660	70984	104118	117828	132088	146870	148773	163403	177811	0	0	0	0	
Percent Complete	8.1	22.5	33.0	37.4	41.9	46.6	47.2	51.8	56.4	0.0	0.0	0.0	0.0	
Variance, $	4845	-11622	-16871	-5700	3810	2572	16121	16893	22368	0	0	0	0	
Variance, %	15.9	-19.6	-19.3	-5.1	2.8	1.7	9.8	9.4	11.2	0.0	0.0	0.0	0.0	



Fiscal Period	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Est. Period Cost	47409	16862	19517	14375	14689	15687	15242	11049	16390	15927	6942	6152	4285	171220
Act. Period Cost	24188	26350	6056	5616	980	2039	2671	4801	2106	0	0	0	0	74807
Variance, $	23221	-9488	13461	8759	13709	13648	12571	6248	14284	0	0	0	0	129719
Variance, %	49.0	-56.3	69.0	60.9	93.3	87.0	82.5	56.5	87.2	0.0	0.0	0.0	0.0	63.4
Est. FY Cumul	47409	64271	83788	98163	112852	128539	143781	154830	171220	187147	194089	200241	204526	
Act. FY Cumul	24188	50538	56594	62210	63190	65229	67900	72701	74807	0	0	0	0	
Percent Complete	11.8	24.7	27.7	30.4	30.9	31.9	33.2	35.5	36.6	0.0	0.0	0.0	0.0	
Variance, $	23221	13733	27194	35953	49662	63310	75881	82129	96413	0	0	0	0	
Variance, %	49.0	21.4	32.5	36.6	44.0	49.3	52.8	53.0	56.3	0.0	0.0	0.0	0.0	