SSC-237

Superconducting Super Collider Laboratory

SSC-237

SSC Monthly Report

July 1989

July 1989 SSC Monthly Report

SSC-237

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SSCL REPORT

MAGNET PROGRAM

MSI Meeting

The MSI meeting was held at FNAL July 11–12.

T. Bush reported on the progress of staffing the SSCL Magnet Systems Division in Dallas. He stated that the goal is 100 people by the end of the calendar year.

LBL reported winding down the 1-m model dipole program and concentrating on developing quadrupoles for the SSC. An increased stability margin design, designated QB, is in the works. Tests of a passive superconducting sextupole and decapole multipole corrector look very promising in reducing magnetization multipoles as well as their drift and temperature dependence.

BNL reported development of a method for correcting random sextupole variations in dipoles, using appropriately spaced iron shims.

FNAL's long-magnet tooling is nearing completion and is expected to be completed by the end of August.

Planning for the SSCL magnet support facilities is under way. These facilities will consist of the Magnet Development Laboratory (MDL) for initial fabrication and testing of SSC magnets at one of four possible sites and, later, the Magnet Laboratory at the SSC campus.

Dipole DD0019, using BNL's new cross-flow cooling method, will be tested in September to investigate the effects of conditioning on magnet training.

General Activities

By the end of July the full-time MSD staff reached 46, with 25 individuals in residence in Dallas. The recruiting effort continued; MSD recruiters were present in a hospitality suite at a technical conference in Los Angeles. The four MSD Group Leader positions have been filled as follows:

P. Sanger	Head of Engineering Design Group
R. Malnar	Head of Production Group
J. Tompkins	Head of Testing and Analysis Group
C. Allen	Head of Quality Assurance Group

R. Schermer will serve as Acting Chief Scientist to the Magnet Systems Division.

Magnet Design Effort

The effort to capture magnet design details on the CAD cluster at SSC-Berkeley is nearly complete, and preparations are being made to move the cluster to SSCL. To improve flexibility, ME10 two-dimensional capability will be added to the two new Unigraphics machines. An effort is under way to determine whether the existing cluster will be sufficient to meet MSD needs until the site-wide system is selected and installed.

Machine-Related Activities

On July 6 a meeting was held with the Accelerator Systems Division to establish a method for controlling systems requirements, initially for dipole magnets and eventually for all magnet systems.

As input to studies of the footprint, the effect of tunnel floor slope on the magnet systems was considered. The tunnel slope has an impact on the cryogenic control system and affects magnet temperature variations around the ring. Because of other uncertainties, it was felt to be prudent to minimize the effect of tunnel slope by limiting the slope to less than 2 degrees.

Cable Tooling

The two industrially produced cable-measuring machines are in the final stages of assembly at Humbolt Machine Company. The documentation package for these machines is undergoing a final review and is expected to be released before the end of August.

A preliminary design review of the Dour insulation wrapping line was held under the auspices of SSCL at BNL on July 20. Action items are being prepared. DuPont, one of the suppliers of the insulation film to be applied by the wrapping line, is providing input to the design.

Magnet Industrialization Program

The new business strategy outlined in the June Monthly Report was further developed and refined. A new version of the RFP based on this strategy is being prepared; the new RFP will incorporate DOE foreign policy considerations.

Magnet Support Facilities

Planning continued for the Magnet Test Laboratory (MTL) and Magnet Prototype Development Laboratory (MPDL) to be located at or near the Dallas site. Following extensive internal review the MPDL layout was reviewed by a team including laboratory tooling experts from BNL and FNAL.

Magnet Alignment

The alignment of magnets during fabrication and during installation in the tunnel is receiving active consideration. Two MSD representatives attended a workshop on accelerator alignment held at SLAC at the end of July. At FNAL an SSCL consultant is performing alignment studies, reviewing data from existing magnets, and preparing plans for an improved method of carrying out alignment during assembly.

Magnet Analysis

The ANSYS C358 model of the dipole magnet was modified so that it can be run using the latest version of ANSYS, revision 4.4. Results from the revision 4.3 and 4.4 models of the C358 were compared and found to be in very good agreement. The newest revision of ANSYS contains features that will make finite-element analysis of the magnet easier and less time-consuming.

To further simplify analysis of the dipole, a new ANSYS model of the C358 cross section was developed. This new model will require no modification as new versions of ANSYS are developed and become available. With the new model, different geometric features can be changed simply by changing a parameter in the ANSYS input file. For instance, the location or size of the model's keyway or spot weld can be modified by changing one or two input parameters. Stress and deflection results using the new model are being studied and will be detailed in an internal MSD memo.

A series of studies is under way to determine if there is a reasonable alternative to the C358 dipole cross section that would provide additional operating margin. A mix of magnetic, mechanical, hand, and computer calculations was performed on both 4-cm-bore and 5-cm-bore possibilities.

A 4-cm-bore four-layer dipole design, suggested by G. Morgan (BNL), is under preliminary investigation. The two inner layers use cable containing 13 strands of the same 0.0318-inch diameter wire as is used in the inner layer of the present design; the two outer layers use 17 strands of the same 0.0255-inch diameter wire as is used in the outer layer of the present design. However, with fewer strands than the present design, full keystoning is possible and it is not necessary to use wedges for mechanical reasons. (It is not yet clear whether or not wedges will be required to satisfy the field quality specification.) The total coil thickness is 13 percent greater than that of the two-layer design, and the load-line slope should increase by a slightly larger factor, giving about a 4.5 percent increase in margin of safety. A specific design has not been completed at this time.

A structural finite-element analysis was completed on the proposed C550, 5-cm-bore dipole cross section. The analysis investigated several different collar designs in which the radial thickness of the collar and the location of the key were varied. The stresses and deflections in the

collars varied for the different designs but were within allowable limits for all of the designs considered.

Finite-element analysis was also used to investigate the quality of the magnetic field under several different loading conditions. A particular focus was on performing more accurate calculations of the sextupole moment produced by various deformations than had previously been possible by purely analytic methods. For the C358 dipole, the effects of assembly, energization, horizontal load, and vertical load were studied, as well as influences such as shimming and oversize coils. The models were developed and deflected shapes were determined using ANSYS. Deformed conductor configurations were input into a separate program that calculated mulipoles by summing the effects of all the individual conductor elements, assuming images generated by a circular iron boundary with infinite permeability. Complete dipole symmetry was assumed, so that only allowed multipoles were computed. For the undeflected configuration, the results can be checked against a direct Fourier analysis of the vector potential computed by ANSYS. Results show that shimming has the greatest influence on the magnetic field quality, increasing the sextupole by 0.37 units for every mil of shim on either the inner or outer coil—that is, 0.74 units for a one-mil shim on both coils. Sensitivity to coil size change is five to ten times smaller.

Quadrupole Review

A panel was convened at the end of June at LBL to conduct a technical review of the proposed QB-design, 1-m quadrupole. The panel consisted of individuals from SSCL, BNL and FNAL; presentations were made by LBL staff members. While considering technical details of the short magnet, the panel was asked to judge whether there were any particular features that would prevent scaling to full size. The deliberations produced a set of eleven Requests for Action and a final report. In general, the panel members thought that the design was quite conservative mechanically and believed it likely that the magnet would reach 6500 A without training. A recommendation was made to reconsider the proposed mechanical support of the collared coil within the iron yoke in light of the stringent alignment tolerances on the quadrupole—in particular, an angular tolerance of 0.5 mrad.

CONVENTIONAL CONSTRUCTION

Footprint Studies

As the results of the supplemental geotechnical investigation became available, footprint efforts concentrated on siting the test experimental halls in chalk. Initial efforts focused on maintaining the ring center with a small counter-clockwise rotation (~ 5 degrees) relative to the Texas proposal.

As the geotechnical program progressed, a large fault zone was discovered near the proposed location of the experimental halls. An additional counter-clockwise rotation of 3 degrees moved both halls south of this fault zone, greatly improving the contractibility of the halls.

Final adjustments were made to avoid surface features such as historical structures, flood plains, and other sensitive areas. Constant coordination with the SEIS group and frequent informal consultation with TNRLC helped avoid major problems with surface features. These final adjustments included minor translations (about 500 feet) as well as a 2.5-degree clockwise rotation about the west cluster experimental halls to retain their location in the preferred Austin chalk.

The ring profile included similar iterations, with comparative cost estimates prepared for each option. Cost trends indicated a shallow ring was least costly, unless a very deep ring, all in chalk, could be built. The deep ring increases cryogenic costs, however, so the shallow ring is preferred. Since a major change in ring profile has a very minor change in the ring footprint, the profile will not be finalized until further exploration on the east side is complete.

Magnet Division Support

An Alternate Site Feasibility Study draft was completed and forwarded to selected personnel for review. It is anticipated that the final report will be completed by September 6.

The CCD is also providing support to the Magnet Division for developing the criteria documents for the Magnet Prototype Development Laboratory, the Magnet Test Laboratory, and the Magnet Acceptance and Storage Facility. Draft documents are scheduled for a September 7 meeting.

Surveying

The four levels of survey and their requisite accuracies were reiterated:

- Level 1: Surveys in support of the geotechnical program
- Level 2: Surveys in support of the land acquisition program, in conjunction with aerial survey.
- Level 3: Surveys in support of construction of tunnel and surface facilities. Long-and short-term monitoring of land and monument motion to evaluate ground subsidence/inflation, long-term limits to accuracy of monument location.
- Level 4: Surveys in support of alignment of machine components.

Work on the Level 1 surveys is well along; some preliminary locations are available and a report is anticipated sometime in August.

In response to comments received from the survey group, J. Slonaker supplied a second draft of "Control Surveying for SSC Boundary Location" relating to Level 2 surveys. He noted that the 86-point primary control scheme of Scapuzzi in connection with recent developments in analytic continuation and aerial survey methods might be adequate for the land acquisition survey.

The high-accuracy Level 3 survey needs are the subject of continuing investigation, particularly with respect to monumentation and the means of employing (*viz*, through NGS/NOAA) the requisite GPS capability.

Several prominent members of the geodesy community have been identified and some have been contacted. The best means of acquiring advice in this area is still under investigation: panels, part-time consultants, conferences, and commercial service firms have all been suggested. D. Scapuzzi will check with Towill (San Francisco) for a representative range of services and prices. He also provided reference to the Tennessee Department of Transportation project as a model for Level 3 surveying.

The gravity data acquired from the National Geophysical Data Center and NOAA, and the need for it in the context of NAD27/vertical control datum of 1929 (VCD 29), were reviewed by D. Goss. The plan of having the geotech survey GPS monuments used as gravimeter measuring points by C. Aiken's graduate students (UT Dallas and NGS), with the resulting GPS/gravity information pooled between both groups, was approved.

C. Laughton will be coordinating the visit of M. Mayoud (CERN) in early August, following the Accelerator Alignment Symposium (July 31–August 2) at SLAC.

Experimental Facilities

Drawings were completed for the Test Beam Facilities concept; a cost estimate will be completed by August 21.

Drawings for underground experimental hall concepts were completed; cost estimates will be completed by August 21.

Programming for surface facilities began and is being integrated with the Campus and Test Beam area concept layout effort.

Study has been initiated on the feasibility of handling some of the large loads (possibly 1,200 tons) required by the L* experiment.

Experimental Area inputs are being prepared for the Footprint Specification and for the Supplemental Conceptual Design Report.

Project Procedures Manual

To establish project management, control, and quality assurance systems, CCD will prepare and publish a Project Procedures Manual (PPM). Designed to comprise eight books, the PPM's first two books are in preparation now. Lieu Smith briefed the PPM content and purpose to DOE's management review team on July 18.

CCD staff will prepare first and second drafts between July and December, 1989, concurrent with staffing-up and the early decisions on SSC Lab management systems. The final draft is scheduled to be ready for publication in January 1990. CCD discussions with the selected A-E/CM should precede final publication.

PROJECT PLANNING AND MANAGEMENT

Management Systems Development:

Work continued on various management systems needed by Project Management for the SSC construction projects. The implementation plans were developed and presented to DOE on July 17–18. These implementation plans included the following:

- Accounting System
- Personnel Administration System
- AAAP Development Plan
- Construction Program Management
- Project Support Services
- QA Management Systems
- EH&S Systems
- Engineering Management Systems
- Text and Evaluation Systems
- Work Authorization Systems
- Project Management Office
- Configuration Management System
- Document Control Systems
- Management Information System (MIS)
- Cost Estimating System.

Project Management Plans

Work continued on the Project Management Plan in anticipation of meeting the end-of-August target date for the first draft. The sections currently in progress include:

- Objectives
- Management Organization and Responsibilities
- Work Breakdown Structure
- Project Management, Measurement, and Planning and Reporting Systems
- Information and Reporting
- Responsibility Matrix.

Work Authorization

A draft Work Authorization Form was developed and is being reviewed. This form was also presented to DOE during the July review. It is planned to use the final Work Authorization Form for all work in FY90. The final form should be released to the Divisions in mid August for FY90 work.

PMRS

The PMRS Implementation Plan was reissued and reviewed. The plan includes all activities required to develop and implement a comprehensive PMRS and cost/schedule control system criteria (C/SCSC) capability for the SSC project.

D. Pells traveled to Grand Junction, Colorado for meetings with UNC and DOE to review their C/SCSC-validated and automated technical status systems. Copies of the PMRS implementation plan were sent to selected DOE and DOE contract or C/SCSC experts for comments. Telephone conversations were held with each of those reviewers (approximately 15 people) to obtain widespread "qualified" feedback and support on the approach being taken for implementing PMRS (C/SCSC). Two briefings to DOE on PMRS implementation plans and status were conducted during July, with full support indicated by those present. Several project management systems vendors made presentations to the PMRS office manager.

The PMRS Office Development Plan was prepared and approved. The plan includes projected PMRS staffing levels, organization and job descriptions, PMRS office space requirements and layout, PMRS office equipment needs, and a draft PM "War Room" plan.

Four PMRS (C/SCSC) professionals were hired. Three are for the central PMRS office and one is assigned to the Technical Services Division. At least four more PMRS professionals plus a secretary will be hired by September 15 to support System Development and Division Planning (C/SCSC activity). Interviews of additional candidates were conducted, with one offer extended. Procurement of office equipment for PMRS staff began, with setup anticipated in early August.

A comprehensive PMRS Automation/Software Implementation Plan was prepared and approved. Nine software vendors presented proposals; the software and the proposals were evaluated by a team of SSC PMRS experts with regard to SSC PMRS functional requirements and DOE's C/SCSC of DOE Order 2250.1c. An award will be made by August 15.

PMRS staff and SSC accounting systems management staff met to address interface requirements and to clarify responsibilities.

PMRS automation activity is on schedule with full operation of PMRS software expected by August 30.

A detailed PMRS Documentation Plan was drafted and reviewed. (PMRS documentation includes a System Description and Procedures Manual). Preparation of draft procedures began in

July. A requisition was placed for C/SCSC support services to assist in development of PMRS documentation.

A detailed PMRS Training Plan was drafted. A top-level DOE C/SCSC workshop was held in Dallas on July 26. SSC PMRS staff and several managers attended.

BNL REPORT

MODEL MAGNETS

Long Magnets

The yoke and shell assembly was completed for magnet DD0026.

Magnet DDA010 was installed in the test stand. During a pressure test to 14 atm internal pressure, the pipe used to support the cold mass bellows assembly buckled when the internal pressure reached about 210 psi; this caused the cold mass bellows at the feed can end to fail. Redesign is under way to eliminate this problem for future assemblies. The magnet was tested after the support post and bellows failure and found to have no electrical faults. All voltage taps were also intact.

Warm multipole measurements and final electrical tests were made on DD0019 prior to shipment to Fermilab.

Coils were insulated and assembled for DD0020.

The coils for DD0027 were equipped with voltage taps and impulse-tested.

Short Magnets

Inner and outer coils for magnets DSS019–DSS021 were wound and cured. The outer coils were made with varying epoxy content for evaluation of the effect of reduction of the epoxy content.

DSS015, the keyed-yoke model, was completed. Test facility top hat modifications are required prior to testing.

DSS018 was completed and is waiting for testing.

The new design "anti-ovalizing" collars were received for assembly into collar packs for testing in a recollared version of DSS013. This assembly will be known as DSR013.

Beam Tubes

The beam tube for DD0028, which contains a 10-meter sextupole trim coil, is nearing completion. The design of the beam tube plating strongback is complete and is being sent to the shop for fabrication.

Insulation Development

BNL personnel met with DuPont representatives in Wilmington to discuss collaboration on Kapton film insulation development and the formulation of the experimental cable insulation. DuPont will prepare this insulation and ship it to BNL for coil winding starting in September.

Miscellaneous

Design modifications to end saddles are in progress to improve the fit with the coil end.

Copper wedges were modified to allow wedge identification by means of length measurement.

Collaring tests were completed to measure stress and collar ovality at assembly with different ratios of vertical and side pressure on keys. A report is being written on this work.

Forty-five tons of 0.25-inch hot rolled yoke lamination steel were received from Inland Steel but shipped back for repackaging and proper marking. The steel will be shipped directly to Wisconsin Fine Blanking in August to produce 0.25-inch fine blanked laminations.

TOOLING AND EQUIPMENT

Coil tooling

Assembly of a short curing press dedicated to 1.8-m magnet fabrication continued. Drawings were completed for modifications to the coil-curing tooling for the inclusion of a midplane thermocouple and for formblock end modifications for a keyway filler to eliminate the keyway imprint in the coil end saddles.

Cryostat tooling

The cold mass insertion fixture table/stands are about 95 percent complete. Routing of the chain and supports for chain girdles remains to be done. The drive heads are about 50 percent complete with all parts available, and the motor drive table is about 30 percent complete. All parts necessary for the completion of the assembly were received.

Cold mass tooling

The design of the new collar pack assembly fixture was completed and is being checked. Additional components for the pre-production collaring press are being fabricated and ordered. These include the tapered key cassette alignment fixture, hardware, and cylinders for the key insertion.

Test equipment

After several hundred hours of use at FNAL, mole BII was returned to BNL for maintenance and recalibration. The parts for moles DIII and DIV are being fabricated in the shops. The design details for a new connector and additional components of the "D" series mole were completed.

SUPERCONDUCTOR

The Cable Task Force Group is in the process of determining the quality of cable produced prior to the new microscopic inspections procedures. Inspection of cables made on the old Kraft machine and the new Dour machine at NEEW will be reported during August.

TESTS AND MEASUREMENT

The 1.8-m magnet DSK013 was tested. This magnet made use of collars punched from Kawasaki high manganese steel strain-hardened to > 90,000 psi yield strength. The coils used were previously assembled as DSS013. The magnet was tested at three progressively lower temperatures (4.35 K, 3.85 K and 3.35 K), reaching a stable plateau after one or two quenches at each temperature. At the lowest temperature, the maximum central field exceeded 8 T. After warming to room temperature, the magnet was tested again, initially at 3.35 K with an initial quench at 7.4 T. In subsequent testing at 4.35 K, the magnet quenched on plateau with no retraining. The multipoles were a bit better than the average of the previously tested four DSS magnets.

FNAL REPORT

DIPOLE CRYOSTAT

The Heat Leak Test Facility is being reconfigured for 80-to-4.5 K insulation measurements. The heat meter will be recalibrated for this temperature range.

Work is complete on the design C cryostat preliminary design. The descriptive preliminary design package was transmitted to the SSCL. No further work on the design is planned for the immediate future.

Work continued on an alignment measurement bench for evaluation of the concept of using stretched wires for SSC magnet alignment. The initial version of the bench is planned to be available in August for alignment verification of DD0019.

Work continued on evaluation of the lateral elastic stability of the single-phase bellows when pressurized. The stability measurement program continued.

The program to study the deformation of the cold mass and vacuum vessel due to shipping and handling activities continued. The data for the cold mass and vacuum vessel shapes corresponding to the DSHIP activities is being analyzed. Preliminary analysis of the data indicates that cold mass deformations exist to the same order of magnitude as in DDA010. A program is being developed to determine the nature of possible deflection mechanisms and then to develop a method of controlling the deflections.

DSHIP over-the-road testing will be repeated in August. The testing will evaluate DSHIP on both soft-mount and hard-mount trailers with various combinations of axial restraints and purge gas end bells.

MAGNETIC MEASUREMENTS

The warm bore used in conjunction with the B2 mole was installed in DD0017 and evacuated. The magnet was cooled down and the normal system checkout performed. The first spontaneous quench for this, the third cooldown, occurred at 6603 A and appears to be at the short sample limit. The anomalous noise previously seen in some of the quarter-coil voltage taps was again present. The warm bore was let up to room temperature air, increasing the heat load to the magnet. The spontaneous quench current dropped to 5874 A as a result. An NMR field measurement scan was performed along the length of the magnet.

In an effort to locate the source of the noise on the voltage taps, the magnet was warmed to room temperature, opened at the feed-end interconnect, and the wiring associated with the signals was reinsulated and tested. The interconnect was closed and the magnet cooled down. The first spontaneous quench was at 6617 A, also at short sample, and there was noise on several of the

voltage taps. The noise is believed to be associated with the instrumentation and not with any problem with the magnet.

Mole measurements of the magnetic field of DD0018 were made at low current while the magnet was on the test stand at room temperature. A measurement of the field angle was also made with the tilt meter (Kuchnir) probe. DD0018 was then removed and the test stand prepared for the mounting of DD0019, anticipated in the fourth week of August. DD0019 arrived and was inspected. Instrumentation wiring was repaired and the checkout completed. The cryostating operation is proceeding on schedule.

COLD-MASS TOOLING

DD0019

The cold mass of DD0019 was received from BNL on July 26. The expected completion date is August 22.

DD0018

DD0018 is presently at MTF. DD0018 will be returned to production approximately the week of August 14. It will then be readied to send to BNL fully assembled.

DSHIP

The initial beam tube/vacuum vessel survey on DSHIP was completed on July 24. It was loaded for the on-site transport test and then unloaded and resurveyed upon completion of the test.

Miscellaneous

Two sets of cryostat subassemblies were prepared for shipment to BNL. This effort included boxing and packaging of all parts to be sent. Only one vacuum vessel was available for shipment. The parts were sent to BNL on the truck that delivered DD0019.

Curing Press

The curing press is mechanically complete. The hydraulic relief valves and limits still need to be set. The heat exchanger piping and insulation are now complete. Hoses for piping to molds are due to be received the first week in August. Quick-disconnect fittings, to connect molds to hoses, have not yet been received.

The transfer table is 85 percent complete. Half of the guide rails needed are due but not received as of the end of July.

Collaring Press

The collaring press is complete except for the guide-rail installation.

The insertion table cannot be completed until the collaring mold is complete. This has had lower priority, and final assembly will start about August 21.

Yoke/Skinning Press

The final mechanical alignment of the upper sections of the yoke/skinning press began. The expected completion date is about August 18. Final installation of the automatic welding system will take place starting the week of August 21.

Winding Table

The winding table was completed. It was then decided to replace one of the drive motors with one of a higher horse-power in order to increase the smoothness of the mandrel's side-to-side movement. The motor is due to arrive on August 10. The winding of inner practice coils will start August 14.

MAGNET DEVELOPMENT

F Series Model Program

F5 was collared on July 21. The collared coil is complete. The iron and skin are being placed on the magnet; it will be ready for testing by mid August. All capacitor gauges, voltage taps, and strain gauges are working properly.

F5 was built without collaring shims or collaring shoes. It will be autopsied after testing to see if any damage to ground wrap has occurred.

F6 coil winding began; F6 will be identical to F5.

Manufacturing of F7 end parts continues. FNAL machine shop personnel estimate that the return-end parts will all be done this month; winding of F7 will then begin.

End parts for one C358 magnet are being machined from aluminum. They will be coated with an insulating material and used in a short model. If they work, cast-aluminum parts may be considered for magnet ends.

Two new collar laminations are being ordered for C358 short models. One will use 304N or Nitronic 40 stainless steel. The other will use Kawasaki steel.

DSS012 has been shipped to Lab 2 for testing. It now has a vertically split yoke. The skin was welded in the new short yoke and skinning press.

LBL REPORT

SUPERCONDUCTOR AND CABLE

In order to obtain a fast but thorough evaluation of the production feasibility of SSC wire with 2.5-μm diameter filaments, contracts were placed with four companies. Each company will produce enough cable for one long dipole (both inner and outer layers). After this work is complete and the results are evaluated, a report will be made to SSCL management concerning the costs and technical risk associated with the 2.5-μm filament option.

The 14-inch diameter extrusion billet trial, scheduled for the second week in July, was postponed because of problems with the speed control on the extrusion press. Extrusion is now scheduled for the third week in August, when the 14-inch liner will again be installed. All three manufacturers reported that billet assembly was much improved for these 14-inch billets due to the larger rod size.

MAGNET MODELS

Dipole15B-2

This is the final LBL magnet with injection-molded "constant perimeter" ends planned for the SSCL program. The coils are still waiting to be collared; it was decided to use collars with bars at the outer layer pole. The required pieces are being assembled and should be ready for collaring in early September.

Dipole 15C-3

Dipole 15C-3 is fully assembled and ready for test.

Quadrupoles

QA-1 (1987) has been retested and autopsied.

QA-2, with fiberglass-epoxy dipole insulation, is ready to collar.

QA-3 coils, with all-Kapton insulation, are wound.

The design work on QB continued, following the July design review. The collar thickness was reduced to 18 mm to provide slightly more gradient and to increase iron saturation. Placement of coil tooling orders should begin this month. Yoke design alternatives are being explored in order to meet the SSCL goal of quadrupole-dipole "tracking" within 0.5 percent.

A preliminary design was made on a cross section with 21 turns per quadrant (the previous design QB had 20 turns). This cross section, QC, will be adopted for the initial 1-m quadrupole

models. It uses 18-mm aluminum alloy collars, which have only 0.1 mil greater deflection when energized as compared to 20-mm collars. The resulting gradient is about 212 T/m and the magnet should have an operating margin of at least 15 percent "along the load line." The vendor quotations for the collars have been received. The iron profile is being detailed. Approximately 25 percent of the tooling fabrication orders have been placed.

Magnet D16

This 5-cm-bore dipole is to be used for cable testing. It has 28-strand inner cable and 36-strand outer cable. Tooling to wind and cure the coils for this magnet is complete. An outer coil was wound and is ready for cure. The cavity heating system is being debugged and curing of the first inner and outer coils should be done in August. A successful trial assembly of two yolk blocks and shrink ring was made. The coil was simulated with a thin aluminum ring.

Final loads and dimensions on the assembly were as expected. The next trial will use real molded coils when they become available.

PROJECT COST DATA

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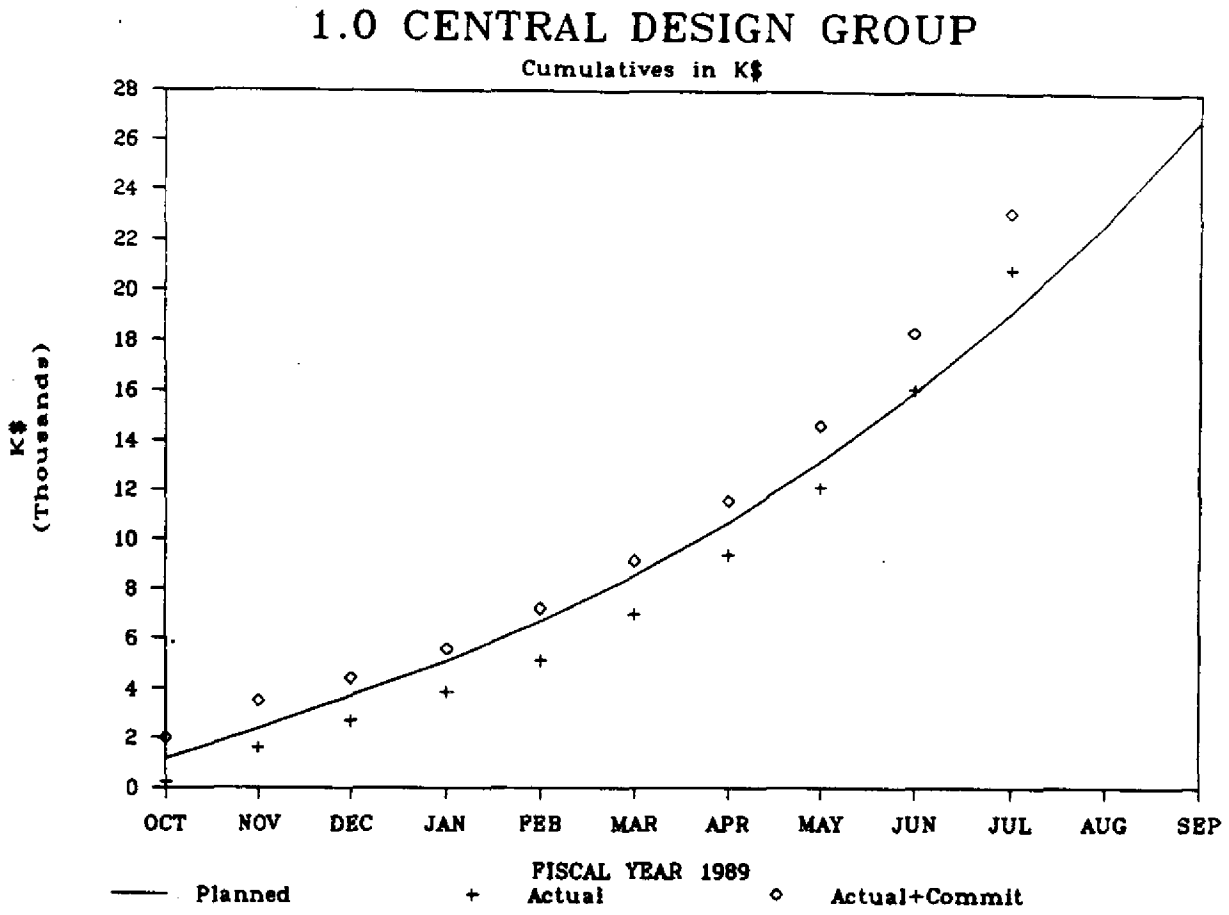
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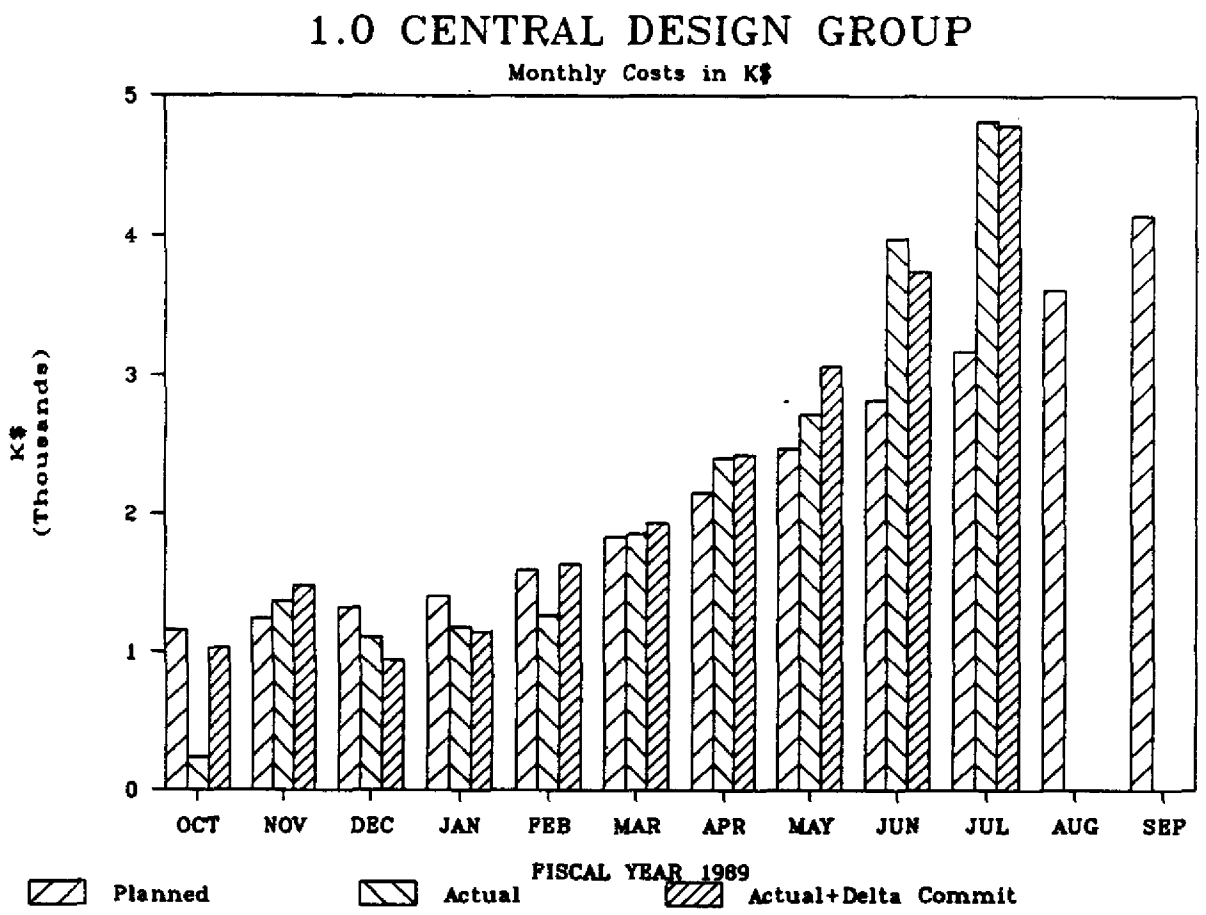
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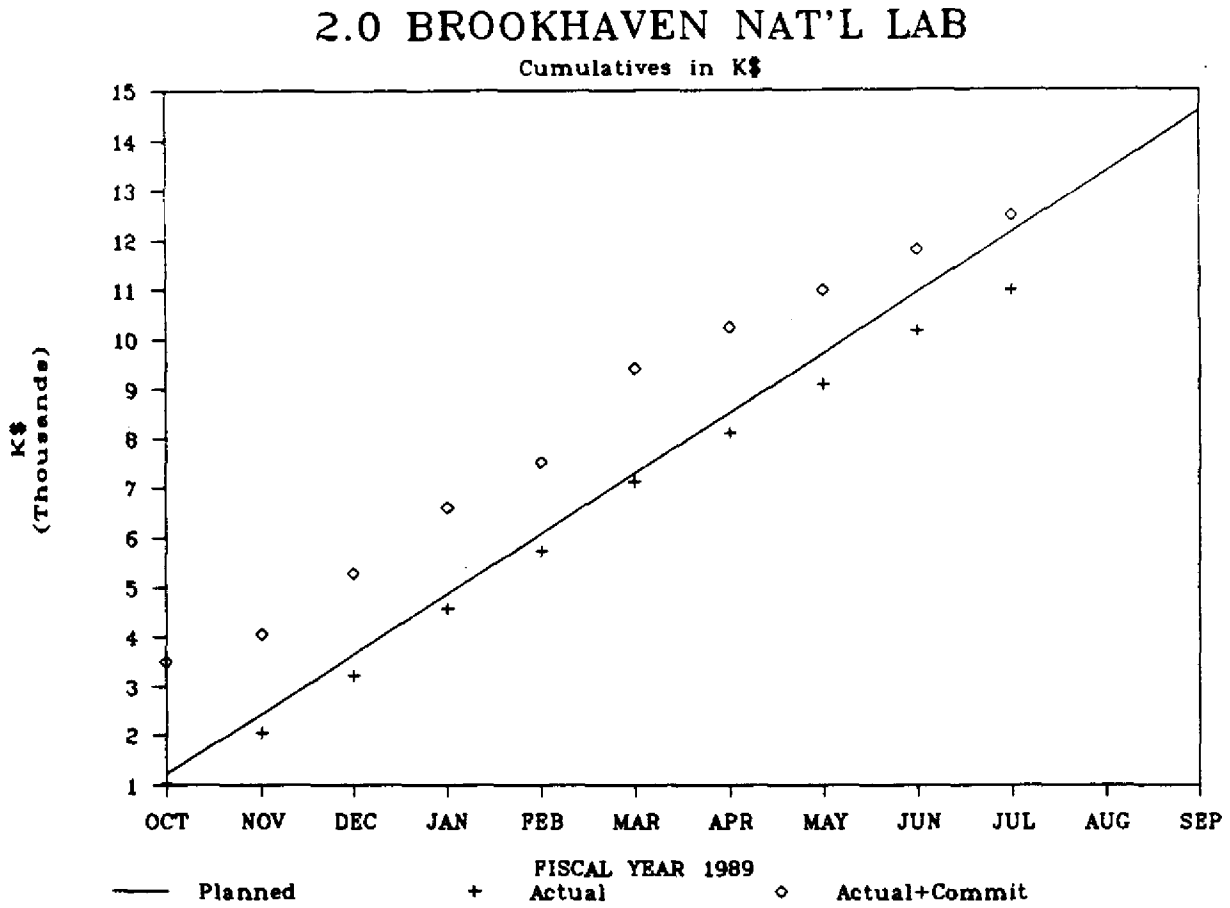
Figure 1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8
7
6
5
4
3
2
1
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Commit

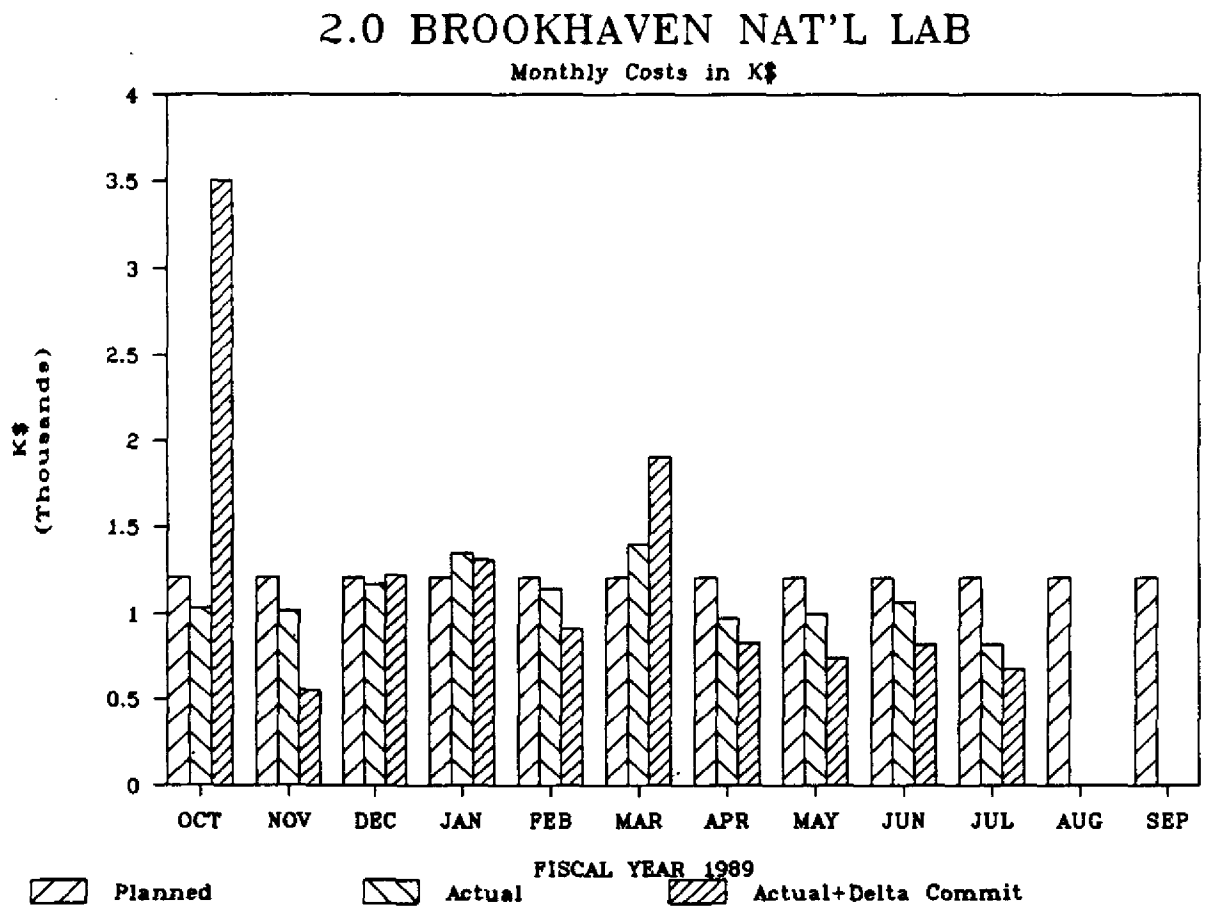
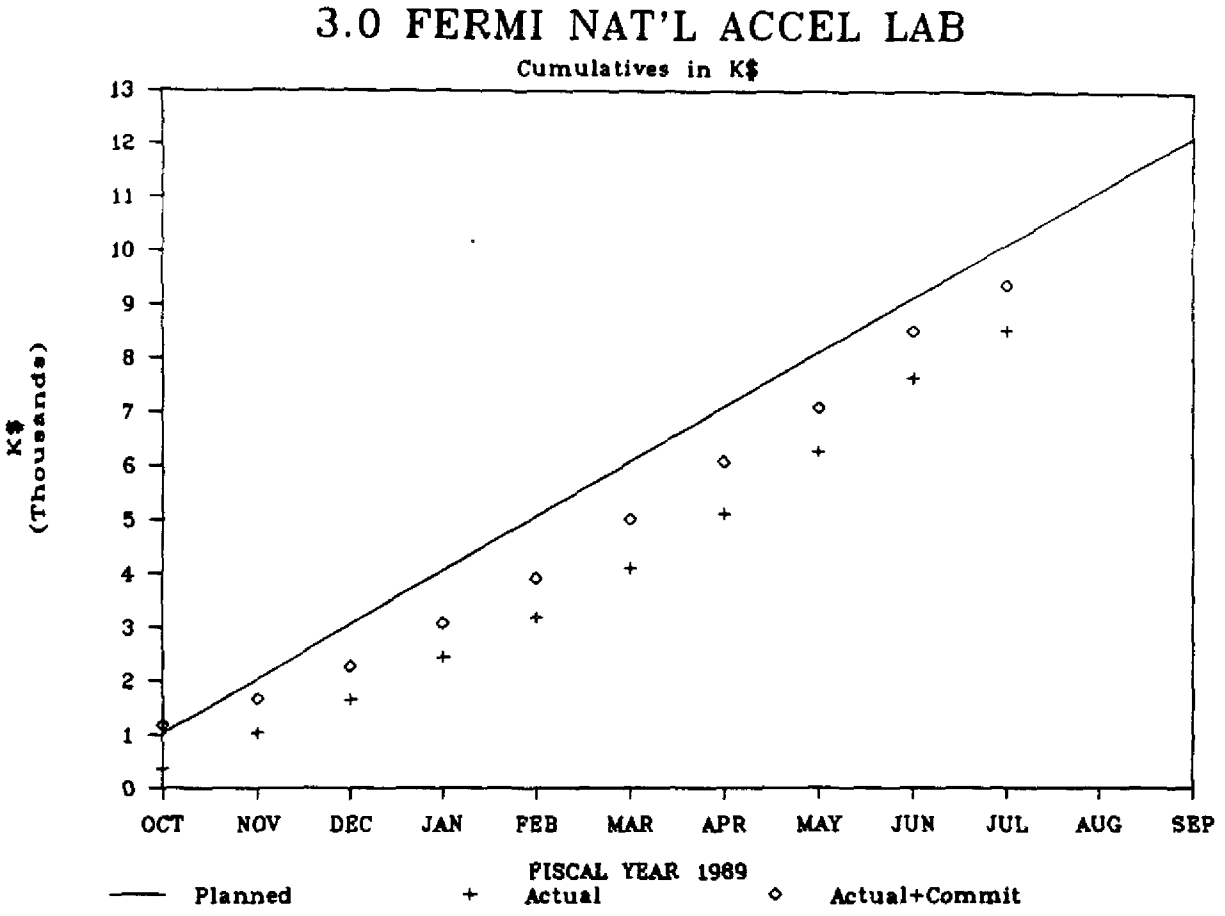

2.0 BROOKHAVEN NAT'L LAB
Monthly Costs in K$
K$ (Thousands)
4
3.5
3
2.5
2
1.5
1
0.5
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 2


3.0 FERMI NAT'L ACCEL LAB
Cumulatives in K$
K$ (Thousands)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Commit

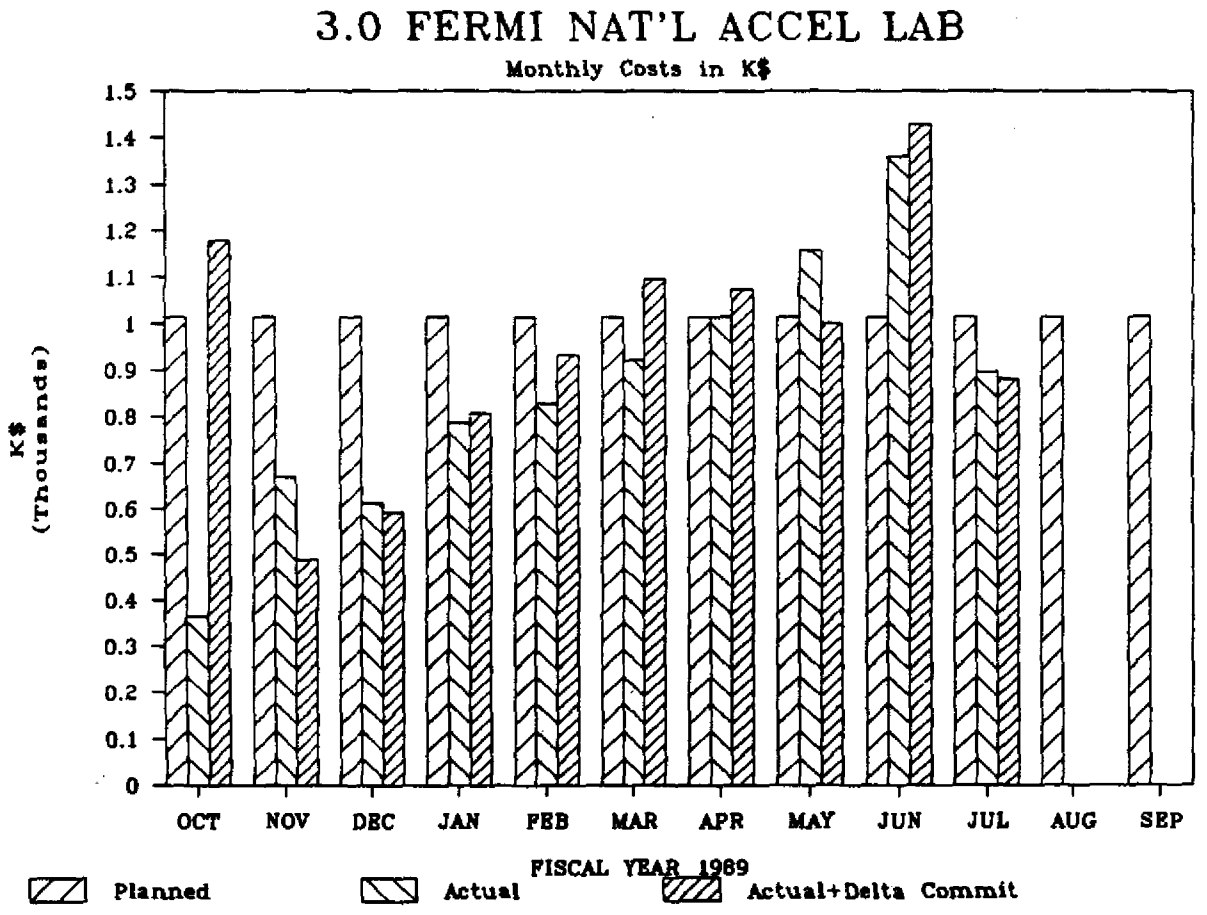
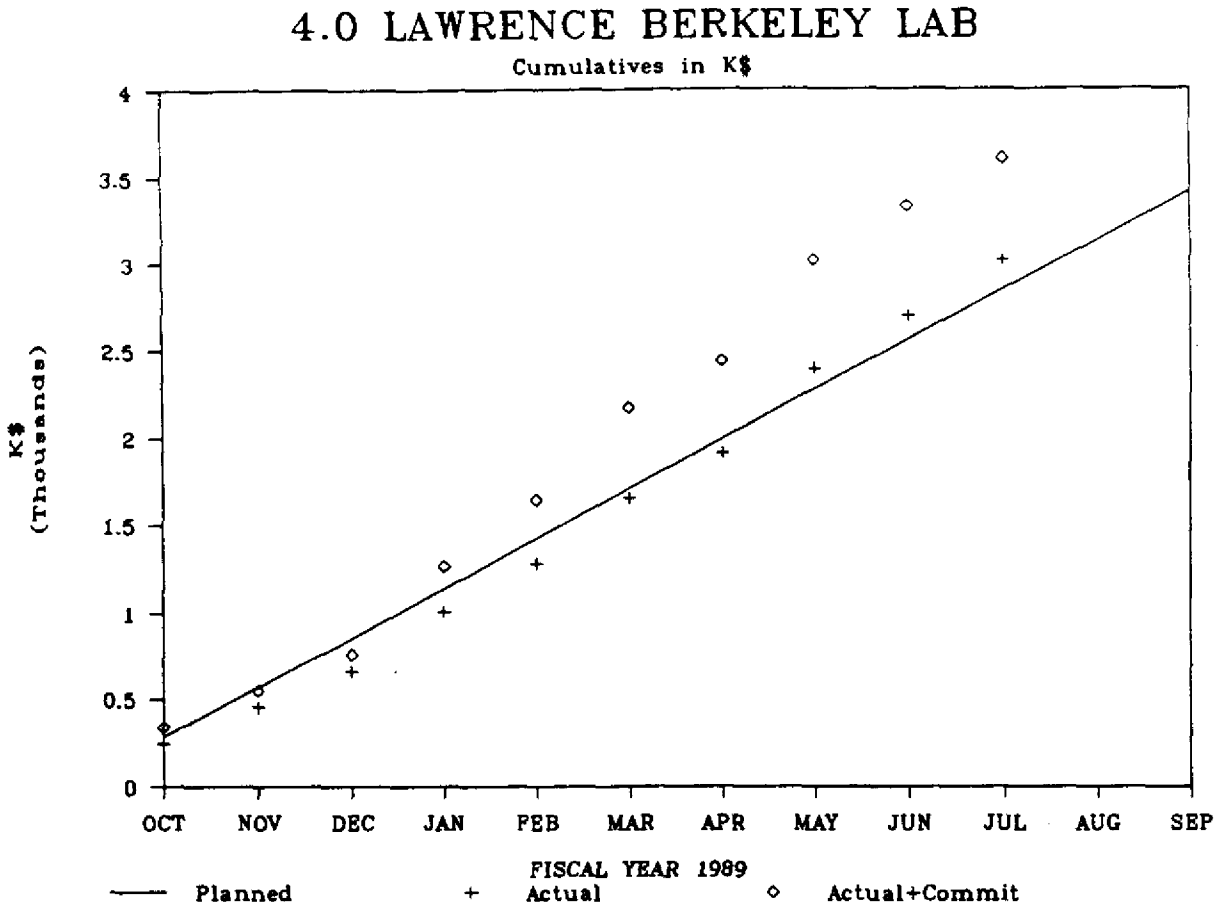

3.0 FERMI NAT'L ACCEL LAB
Monthly Costs in K$
K$ (Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 3


4.0 LAWRENCE BERKELEY LAB
Cumulatives in K$
K$ (Thousands)
4
3.5
3
2.5
2
1.5
1
0.5
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Commit

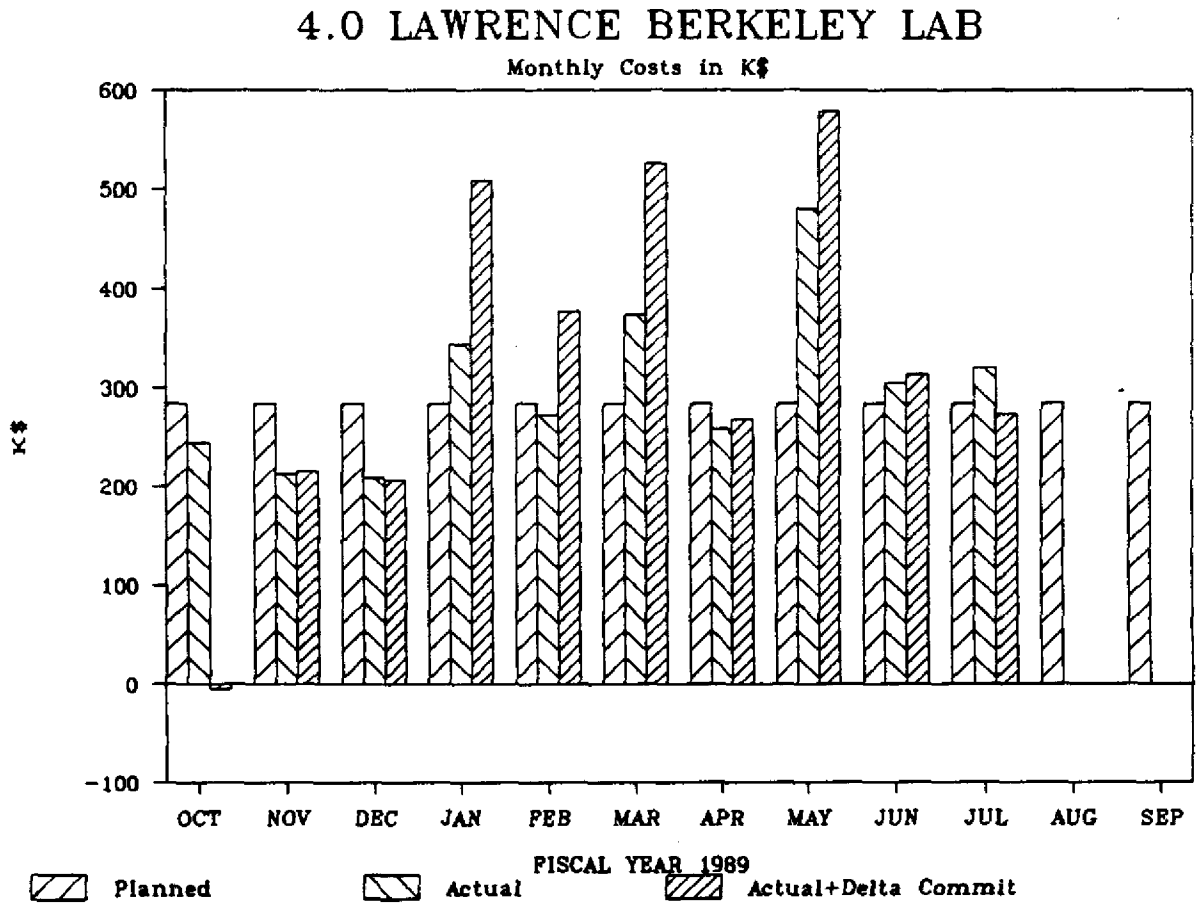
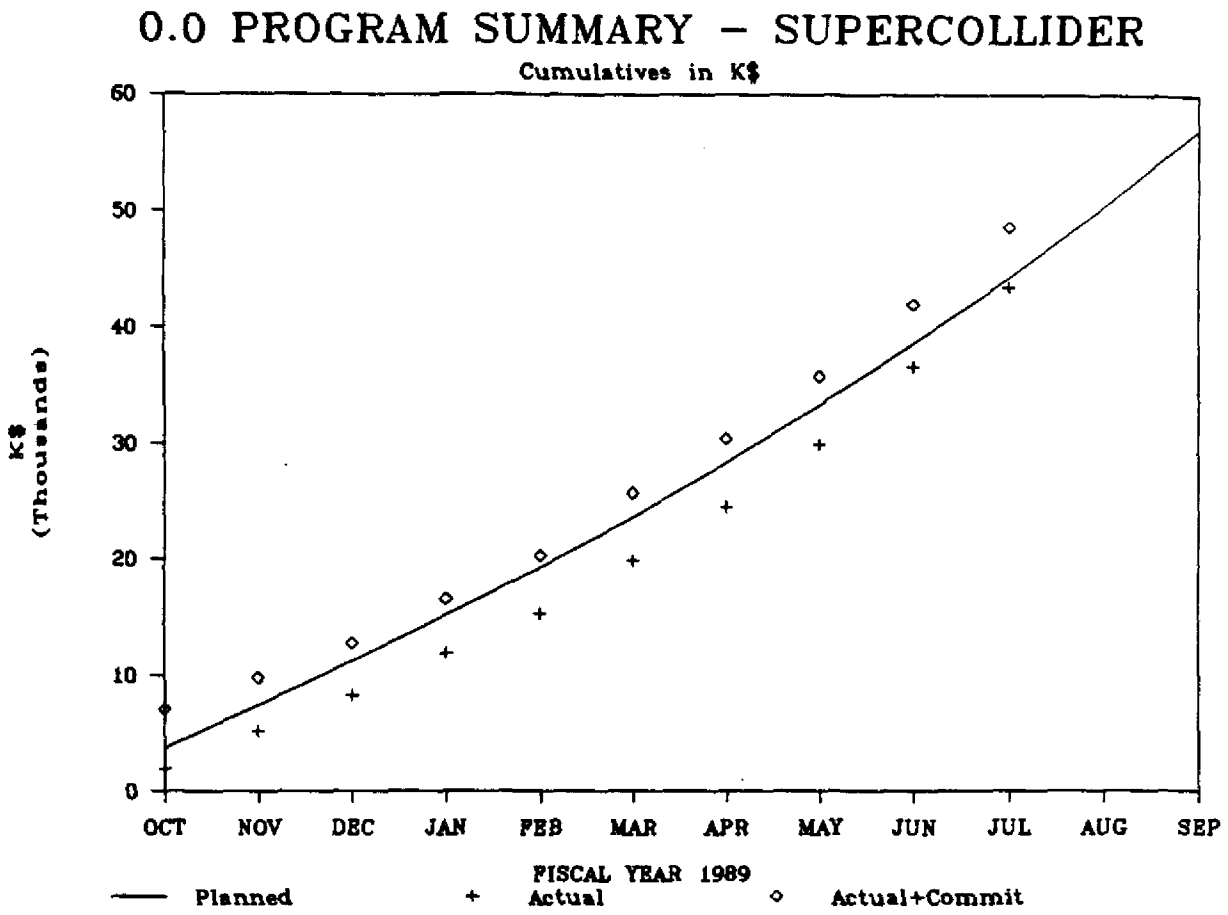

4.0 LAWRENCE BERKELEY LAB
Monthly Costs in K$
K$
600
500
400
300
200
100
0
-100
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 4


0.0 PROGRAM SUMMARY - SUPERCOLLIDER
Cumulatives in K$
K$ (Thousands)
60
50
40
30
20
10
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Commit

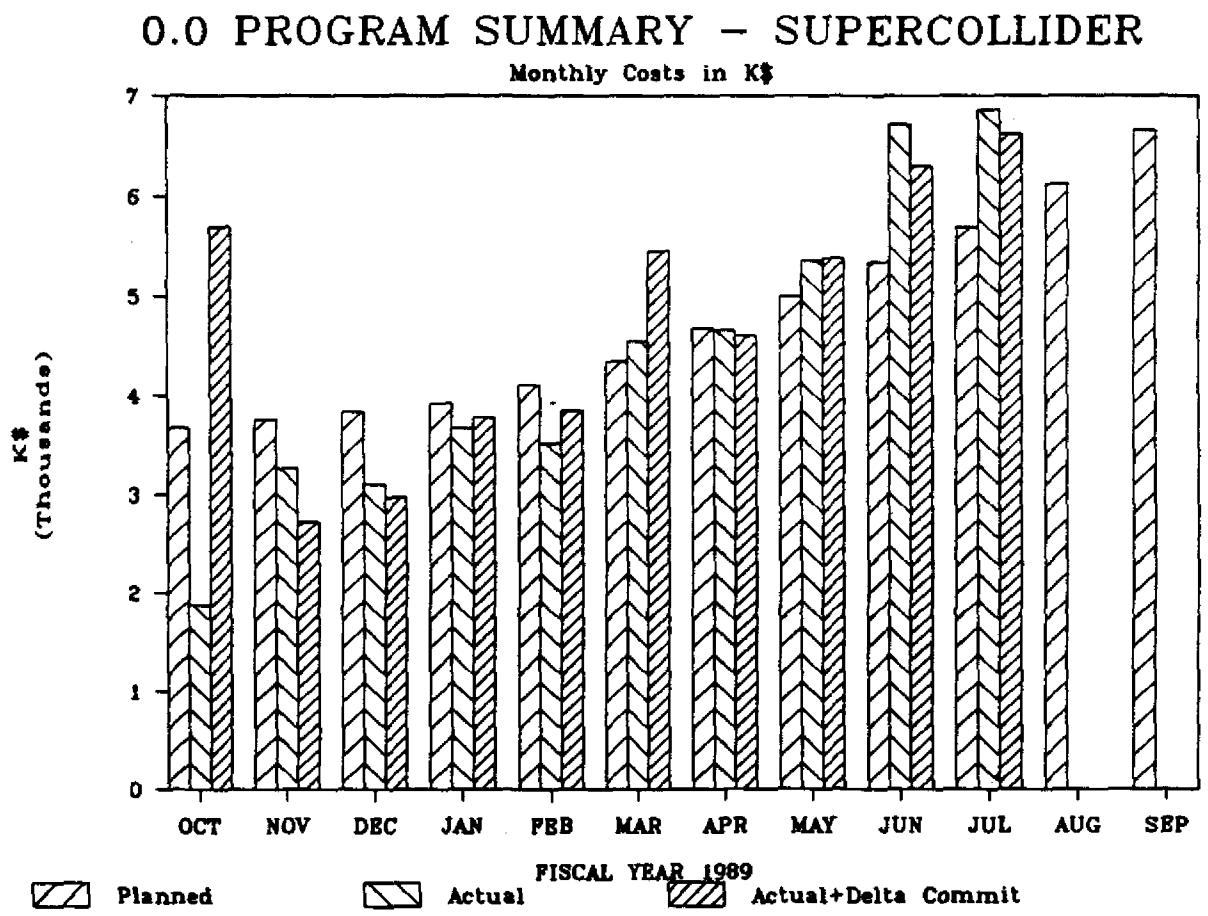

0.0 PROGRAM SUMMARY - SUPERCOLLIDER
Monthly Costs in K$
K$ (Thousands)
7
6
5
4
3
2
1
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 5

TABLE C-1
CENTRAL DESIGN GROUP
Jul-89

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
1.1	ADMINISTRATION	721.0	2038.6	-4.4	2755.1	8213.1	6246.0
1.2	PROGRAM PLANNING & MANAGEMENT	179.8	97.5	2.0	279.4	1091.8	1190.0
1.3	ACCELERATOR R & D	399.2	830.7	99.7	1329.5	7857.5	17004.0
1.4	CONVENTIONAL SYSTEMS DEVELOPMENT	234.0	175.8	16.8	426.6	2593.1	1740.0
	PROGRAM COSTS	1534.0	3142.6	114.0	4790.6	19755.6	26180.0
1.41	RTK COSTS	0.0	29.9	0.0	29.9	643.0	750.0
	CDG/RTK COSTS	1534.0	3172.5	114.0	4820.5	20398.5	26930.0
	COMMITMENTS					2257.7	
	DELTA COMMITMENTS					-31.4	
	EQUIPMENT COSTS		237.8			762.2	
	EQUIPMENT COMMITMENTS					1246.6	

TABLE C-2
BROOKHAVEN NATIONAL LABORATORY
Jul-89

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
2.1	MAGNET DESIGN	52.0	47.9	72.1	172.0	2193.0	3348.0
2.2	17-M COLD MASS FABRICATION	86.7	49.3	98.2	234.2	3784.6	4134.0
2.3	TOOLING & FIXTURES	0.0	0.0	0.0	0.0	914.5	640.0
2.4	BEAM TUBE DEVELOPMENT	8.7	29.7	27.7	66.0	518.0	538.0
2.5	1.8-M DIPOLE FABRICIATION	17.3	0.6	13.0	30.9	294.5	633.0
2.6	TRIM COIL DEVELOPMENT	17.3	30.4	34.5	82.2	458.8	752.0
2.7	MAGNET MEASUREMENT	86.7	0.0	62.6	149.4	1876.9	3341.0
2.8	INDUSTRIALIZATION	8.7	2.9	8.4	19.9	208.9	316.0
	MAGNET TOTALS	277.4	160.8	316.6	754.9	10249.0	13702.0
2.9	ACCELERATED LIFE TESTS	34.7	5.0	28.7	68.4	747.9	898.0
	BNL R & D TOTALS	312.1	165.8	345.3	823.3	10996.9	14600.0
	COMMITMENTS					1500.0	
	DELTA COMMITMENTS					-145.0	
	EQUIPMENT COSTS	106.3	241.7	0.0	348.0	1546.6	2947.0
	EQUIPMENT OPEN COMMITMENTS					549.0	

TABLE C-3
FERMI NATIONAL ACCELERATOR LABORATORY
Jul-89

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
3.1	GENERAL	0.0	11.3	4.4	15.7	228.9	222.0
3.2	LONG MAGNET FABRICATION	16.8	9.0	67.5	93.3	1603.8	1891.0
3.3	MAGNETIC MEASUREMENTS	75.0	12.3	38.9	126.2	1328.9	2168.0
3.4	COLD MASS FABRICATION	108.4	98.4	123.5	330.3	2657.4	3845.0
3.5	INDUSTRIALIZATION	0.0	2.1	0.0	2.1	143.6	417.0
3.6	CELL TESTS	0.0	0.0	0.0	0.0	0.0	0.0
3.7	ACCELERATOR STUDIES	4.4	0.0	1.7	6.1	87.8	71.0
3.8	HALF-CELL TESTS SUP. (REE)	2.5	0.0	3.9	6.4	49.3	466.0
3.9	CRYOGENIC R & D (RAC)	49.7	9.9	18.7	78.3	626.1	1009.0
3.10	GENERAL MAGNET R & D (RAE)	18.9	21.5	17.8	58.2	326.8	1384.0
3.11	MTF MODIFICATION (RAI)	19.3	9.1	16.2	44.6	418.9	278.0
3.12	DIPOLE TOOLING R & D (RAJ)	58.7	40.5	35.9	135.1	1056.3	417.0
	PROGRAM COSTS	353.7	214.1	328.5	896.3	8527.8	12168.0
	COMMITMENTS					862.4	
	DELTA COMMITMENTS					-16.8	
	EQUIPMENT COSTS	2.4	46.7	0.0	49.1	567.4	1640.0
	EQUIPMENT OPEN COMMITMENTS					469.4	

TABLE C-4
LAWRENCE BERKELEY LABORATORY
Jul-89

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
4.1	GENERAL	10.1	2.4	5.9	18.4	243.3	350.0
4.2	SUPERCONDUCTOR & CABLE	16.8	51.6	-0.6	67.8	617.6	1340.0
4.3	CABLE SHORT SAMPLE TEST FACILITY	41.7	7.6	23.4	72.7	358.1	50.0
4.4	DIPOLE MAGNET DEVELOPMENT	65.0	9.7	35.5	110.2	1197.9	760.0
4.5	QUADRUPOLE MAGNETS	20.4	1.3	10.3	32.0	248.1	260.0
4.6	COIL PROPERTIES	6.8	0.0	3.2	10.0	16.0	200.0
4.7	TECHNOLOGY TRANSFER TO INDUSTRY	0.0	0.0	0.0	0.0	50.0	50.0
	MAGNET R & D TOTALS	160.7	72.6	77.7	311.1	2730.8	3010.0
4.8	ACCELERATOR THEORY SUPPORT	6.0	0.6	3.1	9.7	292.0	410.0
	R & D COST TOTAL	166.7	73.2	80.8	320.8	3022.8	3420.0
	COMMITMENTS					588.0	
	DELTA COMMITMENTS					-46.0	

TABLE C-5
PROGRAM SUMMARY - SUPERCOLLIDER
Jul-89

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
1.	CDG PROGRAM	1534.0	3142.6	114.0	4790.6	19755.6	26180.0
1.41	RTK PROGRAM	0.0	29.9	0.0	29.9	643.0	750.0
2.	BNL SSC PROGRAM	312.1	165.8	345.3	823.2	10996.9	14600.0
3.	FNAL SSC PROGRAM	353.7	214.1	328.5	896.3	8527.8	12168.0
4.	LBL SSC PROGRAM	166.7	73.2	80.8	320.7	3022.8	3420.0
	TOTAL SSC PROGRAM COSTS	2366.5	3625.6	868.6	6860.7	42946.0	57118.0
	COMMITMENTS					5208.1	
	DELTA COMMITMENTS					-238.2	
	EQUIPMENT COSTS					2876.2	4587.0
	EQUIPMENT OPEN COMMITMENTS					2265.0	

TABLE C-6

MONTHLY AND CUMULATIVE SUMMARY
OF PLANNED AND ACTUAL COSTS AND COMMITMENTS

1.0 CENTRAL DESIGN GROUP - SUPERCOLLIDER

MONTH	MONTHLY PLANNED COSTS	FY PLANNED CUMULAT	MONTHLY ACTUAL COSTS	FY ACTUALS CUMULAT	MO ACT+ DELTA COMMITS	CUM ACT + COMMITS	CURRENT COMMITS	DELTA COMMITS
OCT	1158.0	1158.0	236.1	236.1	1027.3	2035.9	1799.8	791.2
NOV	1238.8	2396.8	1365.0	1601.1	1473.9	3509.8	1908.7	108.9
DEC	1319.6	3716.3	1105.8	2706.9	943.5	4453.3	1746.4	-162.3
JAN	1400.4	5116.7	1180.3	3886.9	1145.9	5598.9	1712.0	-34.4
FEB	1588.9	6705.6	1263.2	5150.1	1626.7	7225.6	2075.5	363.5
MAR	1831.2	8536.8	1848.2	6998.3	1931.7	9157.3	2159.0	83.5
APR	2154.4	10691.2	2406.8	9405.1	2430.5	11587.8	2182.7	23.7
MAY	2477.6	13168.8	2720.1	12125.2	3063.8	14651.6	2526.4	343.7
JUN	2827.7	15996.4	3978.3	15579.0	3741.0	17868.1	2289.1	-237.3
JUL	3177.7	19174.2	4820.5	20399.5	4789.1	22657.2	2257.7	-31.4
AUG	3608.6	22782.8						
SEP	4147.2	26930.0						

2.0 BROOKHAVEN NAT'L LAB - SUPERCOLLIDER

MONTH	MONTHLY PLANNED COSTS	FY PLANNED CUMULAT	MONTHLY ACTUAL COSTS	FY ACTUALS CUMULAT	MO ACT+ DELTA COMMITS	CUM ACT + COMMITS	CURRENT COMMITS	DELTA COMMITS
OCT	1216.7	1216.7	1033.8	1033.8	3502.9	3502.9	2469.1	2469.1
NOV	1216.7	2433.3	1017.1	2050.9	557.0	4059.9	2009.0	-460.1
DEC	1216.7	3650.0	1173.8	3224.7	1227.8	5287.7	2063.0	54.0
JAN	1216.7	4866.7	1355.4	4580.1	1316.4	6604.1	2024.0	-39.0
FEB	1216.7	6083.3	1147.9	5728.0	913.9	7518.0	1790.0	-234.0
MAR	1216.7	7300.0	1401.6	7129.6	1902.6	9420.6	2291.0	501.0
APR	1216.7	8516.7	973.6	8103.2	830.6	10251.2	2148.0	-143.0
MAY	1216.7	9733.3	1000.5	9103.7	743.5	10994.7	1891.0	-257.0
JUN	1216.7	10950.0	1071.4	10175.1	825.4	11820.1	1645.0	-246.0
JUL	1216.7	12166.7	823.3	10998.4	678.3	12498.4	1500.0	-145.0
AUG	1216.7	13383.3						
SEP	1216.7	14600.0						

3.0 FERMI NAT'L ACCEL LAB - SUPERCOLLIDER

MONTH	MONTHLY PLANNED COSTS	FY PLANNED CUMULAT	MONTHLY ACTUAL COSTS	FY ACTUALS CUMULAT	MO ACT+ DELTA COMMITS	CUM ACT + COMMITS	CURRENT COMMITS	DELTA COMMITS
OCT	1014.0	1014.0	366.1	366.1	1178.9	1178.9	812.8	812.8
NOV	1014.0	2028.0	670.2	1036.3	488.4	1667.3	631.0	-181.8
DEC	1014.0	3042.0	613.1	1649.4	593.5	2260.8	611.4	-19.6
JAN	1014.0	4056.0	787.2	2436.8	807.2	3068.2	631.4	20.0
FEB	1014.0	5070.0	829.0	3178.7	931.7	3912.8	734.1	102.7
MAR	1014.0	6084.0	921.9	4100.8	1095.7	5008.7	907.9	173.8
APR	1014.0	7098.0	1013.4	5114.4	1073.6	6082.5	968.1	60.2
MAY	1014.0	8112.0	1157.3	6271.9	999.1	7081.8	809.9	-158.2
JUN	1014.0	9126.0	1360.2	7632.3	1428.5	8510.5	878.2	68.3
JUL	1014.0	10140.0	896.3	8528.8	880.5	9391.2	862.4	-15.8
AUG	1014.0	11154.0						
SEP	1014.0	12168.0						

4.0 LAWRENCE BERKELEY LAB - SUPERCOLLIDER

MONTH	MONTHLY PLANNED COSTS	FY PLANNED CUMULAT	MONTHLY ACTUAL COSTS	FY ACTUALS CUMULAT	MO ACT+ DELTA COMMITS	CUM ACT + COMMITS	CURRENT COMMITS	DELTA COMMITS
OCT	285.0	285.0	244.6	244.6	-5.4	339.6	95.0	-250.0
NOV	285.0	570.0	212.2	456.8	215.2	554.8	98.0	3.0
DEC	285.0	855.0	208.8	665.6	206.8	761.6	96.0	-2.0
JAN	285.0	1140.0	343.9	1009.5	508.9	1270.5	261.0	165.0
FEB	285.0	1425.0	273.2	1282.7	377.2	1647.7	365.0	104.0
MAR	285.0	1710.0	373.5	1656.2	525.5	2173.2	517.0	152.0
APR	285.0	1995.0	258.8	1915.0	268.8	2442.0	527.0	10.0
MAY	285.0	2280.0	480.5	2395.5	578.5	3020.5	625.0	98.0
JUN	285.0	2565.0	305.2	2700.7	314.2	3334.7	634.0	9.0
JUL	285.0	2850.0	320.3	3021.0	274.3	3609.0	588.0	-46.0
AUG	285.0	3135.0						
SEP	285.0	3420.0						

0.0 PROGRAM SUMMARY - SUPERCOLLIDER

MONTH	MONTHLY PLANNED COSTS	FY PLANNED CUMULAT	MONTHLY ACTUAL COSTS	FY ACTUALS CUMULAT	MO ACT+ DELTA COMMITS	CUM ACT + COMMITS	CURRENT COMMITS	DELTA COMMITS
OCT	3673.7	3673.7	1880.6	1880.6	5703.7	7057.3	5176.7	3823.1
NOV	3754.4	7428.1	3264.5	5145.1	2734.5	9791.8	4646.7	-530.0
DEC	3835.2	11263.3	3101.5	8246.6	2971.6	12763.4	4516.8	-129.9
JAN	3916.0	15179.4	3666.8	11913.3	3778.4	16541.7	4628.4	111.6
FEB	4104.5	19283.9	3513.3	15339.5	3849.5	20304.1	4964.6	336.2
MAR	4346.9	23630.8	4545.2	19884.9	5455.5	25759.8	5874.9	910.3
APR	4670.1	28300.9	4652.6	24537.7	4603.5	30363.5	5825.8	-49.1
MAY	4993.2	33294.1	5358.4	29896.3	5384.9	35748.6	5852.3	26.5
JUN	5343.3	38637.4	6715.1	36087.1	6309.1	41533.4	5446.3	-406.0
JUL	5693.4	44330.8	6860.4	42947.7	6622.2	48155.8	5208.1	-238.2
AUG	6124.3	50455.1						
SEP	6662.9	57118.0						