SSC-231

Superconducting Super Collider Laboratory

SSC-231

SSC Monthly Report

June 1989

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PROJECT SUMMARY	1	SSC LABORATORY (SSCL)
	3	BROOKHAVEN NATIONAL LABORATORY (BNL)
	3	FERMI NATIONAL ACCELERATOR LABORATORY (FNAL)
	4	LAWRENCE BERKELEY LABORATORY (LBL)
SSCL REPORT	5	MAGNET PROGRAM
	10	ACCELERATOR SYSTEMS
	11	CONVENTIONAL CONSTRUCTION
BNL REPORT	15	MODEL MAGNETS
	16	TOOLING AND EQUIPMENT
FNAL REPORT	18	DIPOLE CRYOSTAT
	19	MAGNETIC MEASUREMENTS
	19	COLD-MASS TOOLING
	21	MAGNET DEVELOPMENT
LBL REPORT	22	SUPERCONDUCTOR AND CABLE
	22	MAGNET MODELS
	23	CABLE TEST FACILITY
PROJECT COST DATA	25	INDEX

PROJECT SUMMARY

SSC LABORATORY (SSCL)

Magnet Systems Division

Major effort was devoted to organization and staffing of the division, and the first general meeting of the new Magnet Systems Division was held in Dallas on June 21.

An MSI meeting was held June 8–9 at BNL.

The preparation of CAD-based magnet drawings continued; the cold mass subset is nearly complete.

Preliminary design review of a proposed cable-test facility was held June 13–14 at LBL. Procurement of cable-measuring machines and cable-wrapping machines continued on schedule.

The decision to place greater emphasis on full-scale engineering development resulted in significant changes in the plans for Phase II of the Magnet Industrialization Program. Support facilities at or near the site will include a magnet development laboratory for fabricating full-scale R&D magnets and a magnet test laboratory for testing R&D and pre-production magnets. Plans for construction of these facilities proceeded, having been given high priority.

The cooldown of DD0017 was hampered by instrumentation wire problems. Warm field measurements of DD0018 were made. Documentation was completed for dipole test-stand end racks and for most of the control room instrumentation.

Quench data files from DD0010 through DD0018 and FORTRAN routines for strain-gauge data analysis were transferred to the Sun and their formats converted. Conversion and transfer of the cryogenic data files continued.

In the database effort, the preliminary user interface was completed and modifications were begun for using new software.

Analysis tasks included a comparison of different collar materials for the dipole magnet as well as a comparison of yokes split vertically with those split horizontally.

Work started on two-dimensional analysis of 5-cm-bore dipole magnets.
Problems in measuring strain in the skin of long magnets were found to be caused by strain in the mounting tabs of temperature-compensating gauges. Alternate gauge schemes are being studied.

Accelerator Systems

Work in the Accelerator Division was concentrated in four major activities: staffing, footprint studies, aperture studies, and revision of the Conceptual Design Report.

An aggressive search was mounted to recruit experienced scientists and engineers into the key positions within the division.

The footprint issues being considered include tunnel elevation and tilt, experimental hall and bypass configuration, injector layout, development of the campus concept, and test beams.

An ongoing Collider Aperture Evaluation addresses, among other issues, beam lifetime, reducing accelerator complexity, and beam properties.

No real progress has been made on revision of the Conceptual Design Report since the machine aperture and footprint, which will have a large impact on this, are unresolved.

Conventional Construction Division

The Conventional Construction Division provided support to the Magnet Division in assessing alternate site locations for the facilities required for the development, testing, production, and repair of SSC magnets at the Waxahachie site.

Drawings were developed for the Test Beam Facilities and work began to estimate their cost.

Drawings and cost estimates are being developed for underground experimental halls considering various placements of large, medium, and small detectors.

Considerable effort was spent on validation of the collider footprint. Slight variations in the collider ring lattice are being incorporated, as is the basic concept layout of the injector facilities.

In RTK's "Report on a First Draft Survey Control Plan to Support the Land Acquisition for the SSC Project," two alternative control schemes were presented: a scheme with 180 tertiary, 66 secondary, and 51 primary control points (Alternative A) and a scheme with only 86 primary control points (Alternative B).
Most of the survey field work in support of the first part of the geotechnical program was completed by late June.

Alternate models of the spring 1989 machine configuration (bypass, 2 TeV injector) were prepared in-house and by RTK. Profiles showing several choices of long axis bearing (obliquity) strike and dip were prepared by RTK in support of the footprint characterization.

On June 24 the principal conventional construction records from the CDG arrived at the SSC Laboratory and will be housed in the Map Room reserved for this purpose.

A stand-alone Intergraph workstation and an operator were provided by RTK at the SSC Laboratory, beginning June 12.

Conceptual design work continued on detector and interaction hall concepts.

On June 16, RTK provided a final draft of its report, "Design of the Digital Footprint," which summarizes work done on the definition of the land boundary for the project.

A study of a rotated footprint was undertaken to determine if the near cluster experimental halls may be founded in Austin Chalk.

The initial increment of the geotechnical characterization program for the SSC site was essentially completed. The initial task on the subcontract with Halliburton Geotechnical Services, Inc., for surveying to support the geotechnical field program, was completed.

BROOKHAVEN NATIONAL LABORATORY (BNL)

Final cold mass assembly of DD0019 was essentially completed.

DD0020 reached the coil assembly stage, and its ten-meter sextupole trim coil was attached to the bore tube.

DD0026 was collared, and DD0027 was prepared for collaring.

Outer coils for DD0028 were wound and cured. All coils for FY89's long magnet program will be complete when the inner coils for this particular magnet are finished.

Shell welding operations for DSS15 were completed. DSK13 was installed in the vertical test facility and cooled down; vertical tests began in the last week of June.

FERMI NATIONAL ACCELERATOR LABORATORY (FNAL)

DSHIP is a long magnet model designed for studying the dynamics and mechanical stability of SSC magnets during transport. The first tests using DSHIP began.

In preparing for cooldown, DD0017 was found to have an abnormally low hipot. The problem was traced to an instrumentation wire and the wire was repaired. Preparations are under way for measuring DD0017 (cold) and DD0018 (warm) with the mole.

Cryostats are being prepared for shipment to BNL. Long magnet tooling progressed.

LAWRENCE BERKELEY LABORATORY (LBL)

A series of inner-layer cables was made with varying keystone angles and varying amounts of compaction. The samples were then sent to BNL where the critical-current degradation was measured in the standard SSC short-sample cable test. There was no I_c degradation for the sample made to SSC specifications—a keystone angle of 1.6 degrees and a mid-thickness value of 0.0574 inch. The degradation increased with keystone angle and compaction (decrease in mid-thickness). It appears that any departure from the present optimized parameters will likely incur a penalty in terms of increased I_c degradation.

In preparation for the FY90 dipole magnet program, the SSC production cabling machine at New England Electric Wire is being upgraded with a new cable-measuring machine and software, and an improved procedure for aligning the mandrel and Turkshead.

D15B-2, a constant-perimeter end model, is ready for collaring. D15C-2, the second flared-end SSC-model dipole, was tested from June 1 to June 22. Several changes in mechanical constraints were made compared to D15C-1. The training was fairly poor both at 4.3 K and 1.8 K; the majority of quenches originated in the ends. The end quenches have been attributed to slippage of end adjustment screws. A new passive multipole connection scheme was tested in a second cooldown; the results showed excellent compensation of magnetization effects, including temperature effects and drift with time.

A test was made of the circuit-board-type voltage taps for the Cable Test Facility (CTF). Measurements indicate that a 720-Hz-current ripple requirement for the CTF magnet power supply should be 0.1 percent or better.

The extruded aluminum tube for squeezing the samples has been ordered.
Construction proceeded on the CTF prototype magnet D16B-1. A trial assembly using dummy coils is planned.

SSCL REPORT

MAGNET PROGRAM

MSD General Meeting

On June 21, the first Magnet Systems Division general meeting was held at the SSC Laboratory offices in Dallas. More than 30 current and prospective Magnet Division personnel attended and were welcomed by T. Bush. He emphasized the importance of the task facing the division: there are indications that significant magnet production funding may be made available only when a successful test of a string of 50 magnets has been demonstrated. Presentations at the meeting summarized various aspects of the magnet program. A second general meeting is planned for August 15, by which time many of the new staff will have taken up residence in the Dallas area.

Magnet Systems Integration Meeting

The MSI meeting was held at BNL on June 8–9.

T. Bush stated that the division's next phase of work, to continue for three years until the start of dipole production, will be called Engineering Development rather than Research and Development.

LBL reported on the testing of another flared-end dipole (D15C2), and the retest of quadrupole QA1 with higher prestress. The quadrupole training was disappointing. A new quadrupole design, QB, will have more robust collars and greater stability margins.

FNAL reported on the first shipment of a cryostated magnet rather than just a cold mass. DDA010 was shipped to BNL for testing in BNL's Horizontal Test Facility.

BNL reported that testing of long SSC magnets will begin this year, starting with DDA010, DD0020, and DD0027. Development of improved Kapton insulation continued at BNL.

The possibility of using 2.5-μm material is still being investigated.

The initial draft of an Engineering Development plan for long dipoles for FY89 through FY92 was presented by the SSC Laboratory. Input from the national laboratories will be solicited.

The long-dipole test plan for the remainder of FY89 includes three magnets to be tested at FNAL and three at BNL. FNAL's short-magnet program continued in preparation for long-magnet construction.

Initial design considerations for a 5-cm-aperture dipole were discussed.

General Activities

A primary focus of Magnet Division activities was restructuring the division organization, filling key vacancies, and adding qualified staff at all levels. EG&G placed two production engineers at BNL for familiarization with magnet construction techniques and has identified candidates for similar activities at FNAL.

T. Bush announced that R. Coombes will be deputy division head and that candidates have been identified and will be announced shortly for each of the four Magnet Division group leader positions.

Magnet Design Effort

Work continued on CAD-based drawings which will capture all design details of the current 17-m, 4-cm-aperture dipole magnet. Following the completion of final assembly drawings and the resolution of a few inconsistencies in coil details, the cold-mass package will be ready for final review before being released as part of the RFP package. The cryostat package will not be complete at the time the RFP is issued, and FNAL drawings will be substituted as required.

A CAD cluster consisting of three ME-10 two-dimensional workstations and two Unigraphics-based three-dimensional workstations is being assembled at the SSC-Berkeley as an interim system to cover the needs of the Magnet Division during the next six months to one year. New staff members will be trained on the system at LBL and will then participate in the gradual move of the entire effort to Dallas, to be complete by the end of the fiscal year.

Cable Tooling

The procurement of industrially fabricated cable-measuring machines is now well advanced. Following the assembly of a complete documentation package, parts for three measuring machines were procured from industry. The first machine was assembled and tested at LBL before being shipped to New England Electric Wire to replace an older version of the machine. The older machine will be upgraded to incorporate the latest features before being reassigned. The other two machines are currently being assembled at Humboldt Machine Co. and will be tested there before shipment. Earlier inconsistencies between LBL and BNL cable size measurements were eliminated.

The contract placed with DOUR Industries for the production of a high-speed line for wrapping insulation on cable proceeded on schedule and a preliminary design review is to be held at BNL on July 20.

Cable Test Facility

The specifications for superconducting cable for the SSC include a critical-current requirement. BNL is currently the only organization with facilities for verifying that delivered cable meets the I_c requirements; it will be necessary for the SSCL to develop its own cable-testing facility (CTF) for the large number of tests that will be required during production. With the support and encouragement of the CDG, LBL developed systems requirements and a conceptual design; these systems requirements were reviewed by the Stiening committee in November 1988.

A panel was convened on June 13 to conduct a preliminary design review of the CTF proposed by LBL. The panel consisted of individuals from the SSCL, FNAL, and BNL; presentations were made by LBL staff members. It was decided, after further deliberations at the SSCL and discussion with LBL staff, that (1) the SSCL will develop an RFP for the procurement from industry of a CTF based on the R&D and documentation produced by LBL, and (2) LBL will support the CTF program through continued development of specific components, design and construction of the required magnets, and provision of technical input to the procurement documentation.

Magnet Industrialization Program

On June 23, a meeting was held at DOE Germantown regarding new developments in the business strategy for Phase II of the Magnet Industrialization Program. The driving force behind this change is a much greater degree of contractor involvement in Engineering Development. Under the new plan the contractor(s) will engage in full-scale engineering development, including design, development, testing, and possibly installation of the magnets. The program proposed by the SSCL would narrow Phase II industrial participation to a smaller number of magnet vendors and would include one year of magnet production. The reduced number of participants would concentrate the Phase II focus on the overriding concern of sufficient design margin in a repetitively produced magnet. The extension of Phase II to include initial production should allow smooth transition from development and rapid scale-up to the required production rates.

Magnet Support Facilities

The Magnet Division continued planning construction over the next two years of a Magnet Development Laboratory (MDL). The MDL will consist of a Magnet Prototype Development Laboratory (MPDL), at which R&D magnets will be built, and a Magnet Test Laboratory (MTL), at which R&D magnets and pre-production magnets will be tested.

Preliminary designs and specifications are being developed for the major systems of the MDL, and an overall preliminary plan for the MDL will be completed and reviewed in July. An

RFP was written for the MTL cryogenic system; it was reviewed and will be issued shortly. Progress was made in preparing preliminary layouts for the MDL.

Magnet Testing

Warm field measurements of magnet DD0018 were performed. The effort to cool down magnet DD0017 and make cold magnetic measurements was hampered by instrumentation wire problems. Investigators found ways to begin working around those problems.

The documentation of end racks for the two SSC dipole test stands and for most of the control room instumentation was completed. Revised schematic diagrams of the magnet cabling were also developed.

Data Analysis and Software Development

All quench data files from magnets DD0010 through DD0018 were converted to the SDS format and transferred to the Sun 4/280 server. Shell procedures were developed to allow easy access to the SDS quench data files for analysis programs. Documentation describing how to run the routines VT_ANALX and MPLOT_SDS was created and resides on the Sun.

FORTRAN routines for strain-gauge data analysis were transferred from the Vax to the Sun and converted to the Sun/Unix operating system. These routines are now being tested.

Work continued on conversion of the cryogenic data files into the SDS format and loading the files into the Sybase database. New routines were written to make the conversion. Additional software is being developed to manipulate the SDS files within the database.

Database Work

Effort was divided between completion of the preliminary user interface and, following testing, modifications to it employing the new database software. The completion process consists of systematically working through the forms one by one to determine where improvements or corrections are necessary. With the new database software, maintenance of the user interface can be done by a non-programming Sybase expert.

The automatic forms generator was used to create all 69 forms. During testing it became apparent that roughly 30 forms with large numbers of fields will need simplification, and work is under way to reduce the number of fields in those forms.

Two utility programs, DBCONV and DBDUMP, are being developed to handle specific database tasks. DBCONV will convert a Sybase database from one naming scheme to another. Used in conjunction with a conversion program, SYBASE TO RBASE, all or part of the SSC database, SSC_CABLE, may be translated to Rbase format and back again. DBDUMP will dump the table definitions for a given database to a file, permitting tracking of changes to the database at the level of table definitions.

Recent changes in the operating system on the LBL Vax cluster required modification to the Vax-to-Sun utility programs that are used in data transfer. The latest cable magnetization table was imported from BNL and copied into the appropriate columns and rows of the official cable database.

The magnet and coil names in the cable database were changed to correspond to the new official magnet names as defined in the database documentation.

Magnet Analysis

Finite-element analysis of the C358 dipole continued. In one study, the effects of changing the collar material to high manganese steel were investigated, and it was shown that coil prestress losses due to magnet cooldown would be considerably greater than in a magnet using Nitronic 40 collars (4100 psi versus 1500 psi for a free-standing magnet). The mechanical performance during magnet energization was essentially the same for the two materials.

Another study compared the effective stiffness of the cold mass assembly for the horizontally split yokes with that of the vertically split yokes. The ability of the skin to close a gap between the two yoke halves was determined. The response was non-linear, the final stiffness with the vertically split yoke at a skin prestress of 30 ksi being 1.65×10^{-6} psi compared to 1.28×10^{-6} psi with the horizontally split yoke.

Work began on a two-dimensional finite-element model of a proposed 5-cm dipole. The model is based upon expanded models of the NC-9 and C358 4-cm cross sections and includes automatic interface generation (courtesy of Dell'Orco, LBL) which permits, with minimal effort, parametric studies of different collar designs. The model has been used to calculate collar deflections and stresses due to room-temperature coil prestress for several different collar geometries. Future work will include calculating and applying the Lorentz forces in order to study the two-dimensional response of the cross section to magnet energization.

It was discovered that the temperature-compensating shell gauges, especially rosette-style strain gauges, on previous long magnets may not have been functioning properly. The compensating shell gauges are mounted on stainless-steel tabs, and these tabs are then welded to the shell across one face of the tab. Finite-element analysis of this design has revealed that large stresses develop in these tabs during cooldown, and the deflections associated with these stresses affect measurements by the compensating shell gauges. This problem is especially pronounced when wide tabs are used and when the gauge is mounted very close to the weld. It appears that the gauge should be mounted to the tab at a distance away from the weld of no less than twice the width of the tab. However, other compensating gauge schemes are also being studied.

Conversion of the ANSYS C358 model of the dipole from version 4.3 to version 4.4 is under way, so that some of the new features of version 4.4 can be used.

Data recently published by the Furukawa Co. show the effects of overall packing factor and keystone angle on degradation of critical current; an increase in either factor causes an increase in

degradation. In report SSC-N-640 these data are replotted with the thin-edge packing factor as the independent variable. The data points for three different keystone angles and three different overall packing factors for each keystone angle fall close to a common curve. Although the data are sparse, the thin-edge packing factor appears to be the dominant factor affecting degradation. Experiments at LBL in cooperation with BNL, which will supply more data, are under way.

KEK, in cooperation with Furukawa, has proposed a design for a two-layer, 5-cm-bore dipole, prominent features of which are the use of "fully keystoned" conductor and the elimination of wedges. Various features of the design are discussed in report SSC-N-642. It appears that wedges are required to optimize field quality. The greater keystoning, resulting in a smaller thin-edge thickness, results in more turns in each layer and a greater transfer function by about 15 percent at the expense of only about 2 percent additional degradation. That would apply to either a 4-cm or 5-cm bore diameter.

The effects of perturbations of various magnet parameters on the operating point (intersection of load line with conductor critical curve) are discussed in report SSC-N-643. For magnets exhibiting negligible iron saturation—the SSC ring dipoles and quadrupoles, for example—only two parameters are required to evaluate such effects: the field at the unperturbed operating point and the critical field extrapolated to zero current (given as a function of temperature in a graph in the report). For the SSC dipoles, for example, an increase in transfer function of 1 percent gives an increase of 0.31 percent in the operating field.

ACCELERATOR SYSTEMS

Work in the Accelerator Division was concentrated in four major activities: staffing, footprint studies, aperture studies, and revision of the Conceptual Design Report.

Staffing

Ten offers of employment were made to accelerator scientists and engineers. A hiring plan for the coming months was developed. An aggressive search was mounted to recruit experienced scientists and engineers into the key positions within the division.

Footprint

The footprint issues being considered are:

- tunnel elevation and tilt for best siting of tunnel and experimental halls
- experimental hall and bypass configuration
- injector layout

- development of the campus concept
- test beams

Aperture Studies

An ongoing Collider Aperture Evaluation addresses the following issues:

- beam lifetime and emittance growth at injection
- reducing accelerator complexity to include some technical contingency factor in the design
- beam properties (tune, coupling, chromaticity, etc.) should be easily measurable and insensitive to small perturbations (e.g., orbit distortions)

In this regard, the impact of the following are being evaluated:

- stronger focusing half-cell length (115m → 90m)
- higher injection energy (1 TeV → 2 TeV)
- larger superconductor magnet coil radius (4-cm diameter → 5-cm diameter)
- smaller superconductor filaments (6 μ → 2.5–3μ)

Conceptual Design Report

No real progress has been made on revision of the Conceptual Design Report since the machine aperture and footprint have a large impact on this. These should be resolved before Accelerator Division work on the CDR can be fully effective.

CONVENTIONAL CONSTRUCTION

Magnet Test Laboratory

The Conventional Construction Division provided support to the Magnet Division in assessing alternate site locations for the short- and long-term laboratory support facilities required for the development, testing, production, and repair of SSC magnets at the Waxahachie site. A study plan has been drawn up and an implementation schedule developed. This schedule calls for a completed draft report by August 8.

The analysis is intended to identify rough order-of-magnitude construction-cost differences among proposed sites and rank sites based on their ability to satisfy certain coordination and integration issues identified as important site location requirements.

Experimental Facilities

Drawings were developed for the Test Beam Facilities and work began to estimate their cost. This effort should be complete by August 4.

Drawings and cost estimates are being developed for underground experimental halls considering the following options:

- Large and small detectors on the west side of the collider ring with medium detectors on the east side. Hall floor to grade: 200 feet on the west side, 450 feet on the east side.
- Large and small detectors on the west side of the collider ring with medium detectors on the east side. Hall floor to grade: 250 feet on the west side, 300 feet on the east side.
- Large and medium detectors on the west side, small detectors on the east side. Hall floor to grade: 200 feet on the west side, 450 feet on the east side.
- Large and medium detectors on the west side, small detectors on the east side. Hall floor to grade: 250 feet on the west side, 300 feet on the east side.

This work should be 70 to 80 percent complete by August 4, 1989.

Footprint

Considerable effort was spent on validation of the collider footprint. The latest geologic data from the ongoing coring program is being studied to determine effects on the collider ring position and profile. This work is aimed at confirming the appropriateness of the Texas proposal and making minor adjustments as appropriate.

Concurrently, slight variations in the collider ring lattice are being incorporated, as is the basic concept layout of the injector facilities.

This "footprinting" work with regard to the overall ring layout and corresponding footprint area will be brought to a conclusion in mid-August, 1989.

Survey Progress

In response to the document "Control Surveying and Boundary Location: SSC Land Acquisition," authored by J. Slonaker and presented by him at the May 26, 1989 survey meeting, D. Scapuzzi (RTK) presented the "RTK Report on a First Draft Survey Control Plan to Support the Land Acquisition for the SSC Project." Two alternative control schemes were

presented: a scheme with 180 tertiary, 66 secondary, and 51 primary control points (Alternative A) and a scheme with only 86 primary control points (Alternative B). Vertical control could probably be done using GPS, with considerable savings.

E. Hesse reported on monumentation studies. Costs, relative stability, and recommended usage categories were detailed.

Most of the survey field work in support of the first part of the geotechnical program was completed by late June, but horizontal and vertical locations were not available.

"Borehole Recovery Notes" were written to guide surveyors in locating the boreholes of 1987, drilled in support of the regional and state proposals.

Alternate models of the spring 1989 machine configuration (bypass, 2 TeV injector) were prepared in-house and by RTK. Profiles showing several choices of long axis bearing (obliquity) strike and dip were prepared by RTK in support of the footprint characterization.

Documentation

On June 24 the principal conventional construction records from the CDG arrived at the SSC Laboratory. Included in the records are office files, reports and periodicals, and maps and charts, as well as site selection documentation pertaining to those sites constituting the best qualified list of sites—in particular the Waxahachie site. The material will be housed in the Map Room reserved for this purpose.

RTK Contributions

The Intergraph interact (dual screen) workstation was removed from CDG offices at LBL. RTK continued to provide an Interpro 32C workstation which is tied into the mainframe at RTK. A stand-alone Intergraph workstation and an operator (S. Hamilton) were provided by RTK at the SSC Laboratory, beginning June 12.

Conceptual design work continued on detector and interaction hall concepts using Intergraph. A report on this effort will be published.

Cost estimates and schedules for four different experimental hall configurations (Case 5) are being revised to reflect a more shallow tunnel profile and cut-and-cover construction, using Texas labor rates and material costs.

On June 16, RTK provided a final draft of its report, "Design of the Digital Footprint," which summarizes work done on the definition of the land boundary for the project in the Texas Coordinate System. Comments received were incorporated as appropriate. The report is to be published approximately July 31.

A study of a rotated footprint was undertaken to determine if the near cluster experimental halls may be founded in Austin Chalk.

Two drawings, SC-1 and SC-2, were prepared to show required monumentation for the land acquisition program.

The initial increment of the geotechnical characterization program for the SSC site was essentially completed. This included the footprint validation task of the overall plan and included nine core or rotary wash holes, structural zone studies, and vibration monitoring studies.

The TNRLC continued to assist with land access and environmental clearances on behalf of specific geotechnical field activities.

The initial task on the subcontract with Halliburton Geotechnical Services, Inc., for surveying to support the geotechnical field program, was completed. This included 36 GPS control points and 54 field survey points for locating the drilling and other field activities.

BNL REPORT

MODEL MAGNETS

Long Magnets

Shell

Parts drawings for the longitudinal shell welding fixture were all finished and released to the machine shops. When manpower is available assembly will commence.

A representative from Teledyne Metal Forming visited BNL on June 8 to discuss SSC shell forming. In addition, Trent Tube forwarded (at no cost) sample lengths of SSC formed shell halves; inspection showed the samples to be of fairly high quality.

Horizontal Magnet Test Facility

Wiring and fabrication for hookup of the DDA010 cold mass/cryostat assembly to the HTF was finished and electrical checkout was performed. Power-supply cabling to the HTF main leads is now 90 percent complete. Installation of low-temperature and pressure-measuring instrumentation in the feed and return cans was completed.

Test Equipment

The coil drive and encoder actuator motors for mole DII were assembled, and coil winding for the mole commenced. The design of the new DII connector was approved.

Design work on SSC mole components was delayed due to shuffling of personnel, but is now back on track. Work in the shops on components for moles III and IV continued on schedule.

FNAL REPORT

DIPOLE CRYOSTAT

Measurement of the insulation system 300-to-80 K performance continued. A blanket with a staggered sewn-seam design was tested in the Heat Leak Test Facility (HTLF). The blanket configuration meets the SSC specification—0.6 W/m^2 for radiant heat leak between 300 and 80 K. The blanket demonstrated very good performance, remaining flat under degraded vacuum conditions. This completes the 300-to-80 K insulation measurement program. The HTLF will be reconfigured for 80-to-4.5 K insulation measurements.

Work continued on the design C cryostat. A descriptive preliminary design package, consisting of layout drawings and a supporting narrative, will be completed in July.

Work continued on SSC cryostat alignment. The magnet alignment data have been evaluated and a summary report prepared.

An alignment measurement bench concept employing stretched-wire techniques is being developed. The initial use of the bench is planned for assembly of DD0019 in August.

Work continued on evaluation of the lateral instability of the single-phase bellows when pressurized.

A program is being formulated to study the deflection of the cold mass and vacuum vessel that occurred during the shipment of DDA010 to BNL. Initial studies will evaluate the mechanisms that can cause such deformations. Acceleration data from the DSHIP dynamic structural responses measurements program will be used to estimate shipping-induced loads and stresses in the cold mass and vacuum vessel assemblies.

Work continued on the conceptual design of a 5-cm aperture SSC magnet cryostat.

DSHIP

The DSHIP model was subjected to modal analysis in a variety of configurations, including the magnet on the floor, the magnet equipped with an axial shipping restraint on the floor, the magnet equipped with an axial restraint installed on a soft-mount trailer, and the magnet equipped with an axial restraint installed on a hard-mount trailer.

Following modal analysis, the magnet was transported on-site and off-site over a variety of road conditions. This was done with both the soft- and hard-mount trailers. The DSHIP magnet assembly survived the ride. The cold mass and vacuum vessels will be surveyed to determine if any shipping-induced deflections occurred. Unfortunately, the data recorder that was mounted in the tractor cab did not respond well to its dynamic environment and recorded erroneous data. The data recorder supplier began evaluating the recorder with shaker tables and expressed confidence that the problem can be corrected. Repeat DSHIP over-the-road measurements are planned to begin in late July.

MAGNETIC MEASUREMENTS

In preparing DD0017 for cooldown in order to perform magnetic measurements, a hipot attempt to reach 1500 V in 5 atm of helium failed at around 500 V. Considerable effort was expended in trying to ascertain where the failure was occurring, in order to determine whether to continue or to open the cryostat up for diagnosis and repair. It was finally decided that the cryostat should be opened and repaired once the original breakdown had been converted into a consistent leakage on the instrumentation side rather than on the coil side of one of the 200-ohm series resistors.

The failure to reach the desired hipot voltage on DD0017 resulted from a breakdown of a voltage tap instrumentation wire. When the feed-end single phase of DD0017 was opened, the fault was visually identified as one of the wires entering the ABFT. These wires on test stand 5 had not yet been reinsulated, as the magnet has been in place ever since the original problem with these feed-throughs was identified. Since further tests on this magnet will emphasize magnetic field quality rather than quench initial location determination, all feed-end auxiliary voltage taps were disconnected to reduce the probability of future failures. DD0017 was again readied for cool down. It has now successfully passed a 2500 V hipot in air and a 1500 V hipot in 5 atm of helium.

Operation of the B2 mole has uncovered a problem with one of the gravity sensors. Upon discussion with BNL staff it was determined that this sensor is not needed for operation, and that operation without it should not jeopardize other mole functions. In the process of solving this problem, unreliable connector assembly was discovered in the mole tether system, and repair was undertaken.

Improved shell compensating gauge mounts are being built for DD0019 using 0.002-inch copper sandwiched between two strips of 0.1-inch stainless steel. The copper will extend 0.5 inch beyond the width of the steel and will be soldered to the magnet shell.

COLD-MASS TOOLING

DD0019

DD0019 is due from BNL during the week of July 24.

DSHIP

Work was done with the Engineering Lab and P. Pellessier with regard to the modal analysis and transportation tests on DSHIP.

Curing Press

The hydraulic assembly is complete except for control wiring, on which work is under way. The new upper and lower beams were installed. The upper insulation sandwich was installed. Installation of the lower sandwich began. The expected completion date is August 7.

Installation and alignment of the transfer table stands began. The table is expected to be complete in mid-August.

Collaring Press

The collaring press is complete except for the mold-guide rail. The insertion table was installed and aligned. After the collaring mold is completed, the chain drive will be installed to pull the tooling into the press.

Yoke/Skinning Press

The main structure of the yoke/skinning press is complete except for the final alignment of top to bottom. The lower mold stacking is complete. A short dummy cold mass will be placed in the lower mold and used for aligning the top of the press. Hydraulic cylinders were installed. The final parts for the hydraulic pump are due at the end of July. The final automatic welder installation is scheduled for the last week in August. Weld development and welder training on the system will also be done at that time.

Winding Table

Modifications to winding mandrels were completed. Installation of the inner mandrel on the winding table began, as did final alignment of mandrel supports and drives. The expected completion date is July 26.

Miscellaneous

Parts were pulled for the two complete cryostats to be shipped to BNL at the end of July.

Installation of the heat exchanger to the curing press piping is now complete. Pipes will be insulated on July 19.

Manifolding of the curing molds began, with completion anticipated by July 21. The molds will then be complete.

Short sections of the lower collaring mold have now been placed on the collaring insertion table and are ready for final assembly. This will not be completed until the end of August.

The header on the heat exchanger has been relocated, insulated, and system leak-checked. The drain tank must be fabricated and the complete system tested. The expected completion date is about the end of July.

F Series Model Program

F5 is packaged and ready for collaring, scheduled for July 19.

F5 was built without collaring shims or collaring shoes. Shims were placed at the parting plane to take up the azimuthal distance normally filled by the collaring shim.

Capacitor gauges were placed at the inner coil parting place of F5 to measure preload.

All tooling except retainers is now on hand to wind and cure C358 short models.

Manufacture of F7 end parts continues. The machine shop estimates completion within a month.

A two-foot sample section of tooling designed to collar C358 magnets was completed. It will be tested during July.

MAGNET DEVELOPMENT

DSS012 was yoked with vertically split iron laminations. The skin was welded using the newly built small yoke and skin press.

The collared coil was twisted by about six degrees over its free-state length. It is now straight. The magnet will be shipped to Lab 2 for testing after strain gauges are applied to the outside of the skin.

LBL REPORT

SUPERCONDUCTOR AND CABLE

Results reported at the IISSC meeting in February by representatives of KEK and Furukawa Electric suggested that a fully keystoned cable might be made with acceptable critical-current degradation. In order to check this, a series of inner layer cables was prepared with varying keystone angles and varying amounts of compaction. The samples were then sent to BNL where the critical-current degradation was measured in the standard SSC short-sample cable test. There was no I_c degradation for the sample made to SSC specifications—a keystone angle of 1.6 degrees and a mid-thickness value of 0.0574 inch. The degradation increased with keystone angle, reaching a value of 6 percent for a 3-degree keystone angle and the same mid-thickness value. The degradation also increased as the amount of compaction was increased (mid-thickness decreased), reaching a maximum of 16 percent for a 2.7-degree keystone angle and a mid-thickness value of 0.0547 inch. These experiments show that the present parameters of the SSC inner cable are optimized to give minimum I_c degradation and maximum compaction. Any departure from these parameters will incur penalty in terms of increased I_c degradation. A report of these results is forthcoming.

In preparation for the FY90 dipole magnet program, the SSC production cabling machine at New England Electric Wire (N.E.E.W.) is being upgraded. The upgrades include a new cable measuring machine and software, and an improved procedure for aligning the mandrel and Turkshead. An additional 200 spools are being fabricated at LBL so that the wire manufacturers can load wire directly onto cabling machine spools and not be required to respool the wire at N.E.E.W.

MAGNET MODELS

Dipole 15B-2

Dipole15B-2 is the second of this series with re-designed end pieces fabricated with injection-molded Lexan. The coils for this constant-perimeter end model are assembled and ready for collaring.

Dipole D15C-2

D-15C-2, the second flared-end SSC-model dipole, was tested from June 1 to June 22. Several changes in mechanical constraints were made compared to D-15C-1. These are the major changes: a metal bar was inserted between the outer layer pole and pole turn, the iron was

moved back from the aluminum collars, the end shells were replaced with end collars, and new adjustment screws were installed between the end plates and coil ends.

The training was fairly poor both at 4.3 K and 1.8 K; the majority of quenches originated in the ends. After magnet disassembly it was observed that some of the end adjustment screws had slipped down from the coil ends and cocked against the heavy metal inner cone. The end quenches have been attributed to this error. At 4.3 K, the initial quench was at 5746 A ; the plateau value of 6860 A was reached on the eleventh quench. Training in helium II was also slow; 8600 A was reached on the ninth quench at 1.8 K.

Extensive magnetic measurements, including injection field decays, were taken at 4.3 K and 1.8 K. A new passive multipole connection scheme was tested in a second cooldown; the results showed excellent compensation of magnetization effects, including temperature effects and drift with time. This work will continue.

DI5C-3

This magnet, the third flared-end dipole model, is fully assembled and ready for test. The collars are fully clamped in the yoke as in model D15C-1. The ends are clamped with the DI5C-1 bolted end clamps (special end collars were used in DI5C-2). The coil end shoes are individually loaded in the axial direction as in D15C-2. Three types of gauges are used for measuring coil stresses.

CABLE TEST FACILITY

Sample Holder

A test was made of the circuit-board-type voltage taps. A 1.2-m-long assembly of cable samples, circuit boards, and appropriate insulators was compressed to about 5500 psi in a drawn-down aluminum, inserted into the bore of a 1-m SSC dipole, and cooled to 4.3 K. The voltage taps apparently survived the compression loading and the cooldown. The magnet current was modulated at about 6.7 Hz with a peak-peak amplitude of 70 A and the voltage induced in the taps was recorded as a function of angle between the applied field and the normal to wide face of the conductor. From these measurements it appears that the effective flux-linking area is 2.4×10^{-4} m^2 normal to the wide face and $4.6 \times 10^{-4} m^2$ parallel to the wide face. This results in a 720-Hz-current ripple requirement for the CTF magnet power supply of 0.1 percent or better.

An order was placed for an extruded aluminum tube which will be evaluated as a sample holder.

Magnet D16

This close-in-iron dipole for the short sample test facility will deliver a maximum dipole field (short sample performance) of approximately 7.7 tesla at 4.35 K and 6625 A. The effect of iron saturation between 5 and 7 tesla is less than 5 units. Construction of the CTF prototype magnet D16B-1 proceeded. The yolk components were ordered and design of end parts (end plates, splice plates, tie rods, etc.) began. A trial assembly using dummy coils should occur in August.

The inner coil winding mandrel parts were made.

PROJECT COST DATA

INDEX

SSC PROGRAM	Table	Figure
Central Design Group	C-1	1
Brookhaven National Laboratory	C-2	2
Fermi National Accelerator Laboratory	C-3	3
Lawrence Berkeley Laboratory	C-4	4
SSC Program Summary	C-5	5
Monthly and Cumulative Summary	C-6	

TABLE C-1
CENTRAL DESIGN GROUP
JUNE 1989

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
1.1	ADMINISTRATION	436.6	669.5	121.2	1227.3	5491.9	6246.0
1.2	PROGRAM PLANNING & MANAGEMENT	110.1	31.1	27.6	168.8	812.4	1190.0
1.3	ACCELERATOR R & D	784.4	673.9	282.7	1740.9	6986.0	17004.0
1.4	CONVENTIONAL SYSTEMS DEVELOPMENT	545.7	211.7	30.0	787.3	2199.1	1740.0
	PROGRAM COSTS	1876.7	1586.2	461.4	3924.3	15489.4	26180.0
1.41	RTK COSTS	0.0	54.0	0.0	54.0	614.0	750.0
	CDG/RTK COSTS	1876.7	1640.2	461.4	3978.3	16103.4	26930.0
	COMMITMENTS					2289.1	
	DELTA COMMITMENTS					-237.3	
	EQUIPMENT COSTS					33.5	
	EQUIPMENT COMMITMENTS					663.3	

TABLE C-2
BROOKHAVEN NATIONAL LABORATORY
JUNE 1989

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
2.1	MAGNET DESIGN	55.4	237.9	111.8	405.1	2021.0	3348.0
2.2	17-M COLD MASS FABRICATION	97.0	145.2	92.3	334.5	3550.4	4134.0
2.3	TOOLING & FIXTURES	0.0	0.0	0.0	0.0	914.5	640.0
2.4	BEAM TUBE DEVELOPMENT	9.2	0.3	3.6	13.0	452.0	538.0
2.5	1.8-M DIPOLE FABRICIATION	18.5	7.6	9.9	36.0	263.6	633.0
2.6	TRIM COIL DEVELOPMENT	18.5	0.4	7.2	26.1	376.6	752.0
2.7	MAGNET MEASUREMENT	92.3	0.0	35.2	127.6	1727.5	3341.0
2.8	INDUSTRIALIZATION	9.2	2.6	4.5	16.2	189.0	316.0
	MAGNET TOTALS	300.1	394.0	264.6	958.8	9494.4	13702.0
2.9	ACCELERATED LIFE TESTS	64.6	16.9	31.1	112.6	679.5	898.0
	BNL R & D TOTALS	364.7	410.9	295.7	1071.4	10173.9	14600.0
	COMMITMENTS					1645.0	
	DELTA COMMITMENTS					-246.0	
	EQUIPMENT COSTS	100.2	199.3	0.0	299.5	1198.6	2947.0
	EQUIPMENT OPEN COMMITMENTS					625.0	

TABLE C-3
FERMI NATIONAL ACCELERATOR LABORATORY
JUNE 1989

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
3.1	GENERAL	0.0	11.6	3.1	14.7	213.2	222.0
3.2	LONG MAGNET FABRICATION	15.9	330.5	28.4	374.8	1510.5	1891.0
3.3	MAGNETIC MEASUREMENTS	78.8	23.5	56.9	159.2	1202.7	2168.0
3.4	COLD MASS FABRICATION	141.9	183.0	103.4	428.3	2327.1	3845.0
3.5	INDUSTRIALIZATION	-7.2	2.2	2.9	-2.1	141.5	417.0
3.6	CELL TESTS	0.0	0.0	0.0	0.0	0.0	0.0
3.7	ACCELERATOR STUDIES	4.6	0.1	2.9	7.6	81.7	71.0
3.8	HALF-CELL TESTS SUP. (REE)	2.5	7.7	1.6	11.8	42.9	466.0
3.9	CRYOGENIC R & D (RAC)	41.1	8.2	18.3	67.6	547.8	1009.0
3.10	GENERAL MAGNET R & D (RAE)	25.1	21.9	9.6	56.6	268.6	1384.0
3.11	MTF MODIFICATION (RAI)	14.8	28.0	69.5	112.3	374.3	278.0
3.12	DIPOLE TOOLING R & D (RAJ)	61.5	33.0	34.9	129.4	921.2	417.0
	PROGRAM COSTS	379.0	649.7	331.5	1360.2	7631.5	12168.0
	COMMITMENTS					878.2	
	DELTA COMMITMENTS					68.3	
	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
JUNE 1989

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
4.1	GENERAL	6.8	9.5	7.8	24.1	224.9	350.0
4.2	SUPERCONDUCTOR & CABLE	17.3	6.1	11.1	34.5	549.8	1340.0
4.3	CABLE SHORT SAMPLE TEST FACILITY	48.7	6.8	26.4	81.9	285.4	50.0
4.4	DIPOLE MAGNET DEVELOPMENT	65.0	9.7	35.5	110.2	1087.7	760.0
4.5	QUADRUPOLE MAGNETS	18.7	0.3	9.1	28.1	216.1	260.0
4.6	COIL PROPERTIES	0.0	0.0	0.0	0.0	6.0	200.0
4.7	TECHNOLOGY TRANSFER TO INDUSTRY	0.0	-0.8	-0.4	-1.2	50.0	50.0
	MAGNET R & D TOTALS	156.4	31.6	89.5	277.6	2419.7	3010.0
4.8	ACCELERATOR THEORY SUPPORT	17.0	1.7	8.9	27.6	282.3	410.0
	R & D COST TOTAL	173.4	33.3	98.4	305.2	2702.0	3420.0
	COMMITMENTS					634.0	
	DELTA COMMITMENTS					9.0	

TABLE C-5
PROGRAM SUMMARY - SUPERCOLLIDER
JUNE 1989

	PROGRAM ELEMENT	LABOR	MAT'L & SERVICES	G & A	MONTH TOTAL	YEAR TO DATE	ANNUAL BUDGET
1.	CDG PROGRAM	1876.7	1586.2	461.4	3924.3	15489.4	26180.0
1.41	RTK PROGRAM	0.0	54.0	0.0	54.0	614.0	750.0
2.	BNL SSC PROGRAM	364.7	410.9	295.7	1071.3	10173.9	14600.0
3.	FNAL SSC PROGRAM	379.0	649.7	331.5	1360.2	7631.5	12168.0
4.	LBL SSC PROGRAM	173.4	33.3	98.4	305.1	2702.0	3420.0
	TOTAL SSC PROGRAM COSTS	2793.8	2734.1	1187.0	6714.9	36610.8	57118.0
	COMMITMENTS					5446.3	
	DELTA COMMITMENTS					-406.0	
	EQUIPMENT COSTS					1799.5	4587.0
	EQUIPMENT OPEN COMMITMENTS					1757.7	

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	85.5
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	16103.5	3741.0	18392.6	2289.1	-237.3
JUL	3177.7	19174.2						
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						
AUG	1216.7	13383.3						
SEP	1216.7	14600.0						

3.0 FERMI NAT'L ACCEL LAB - SUPERCOLLIDER

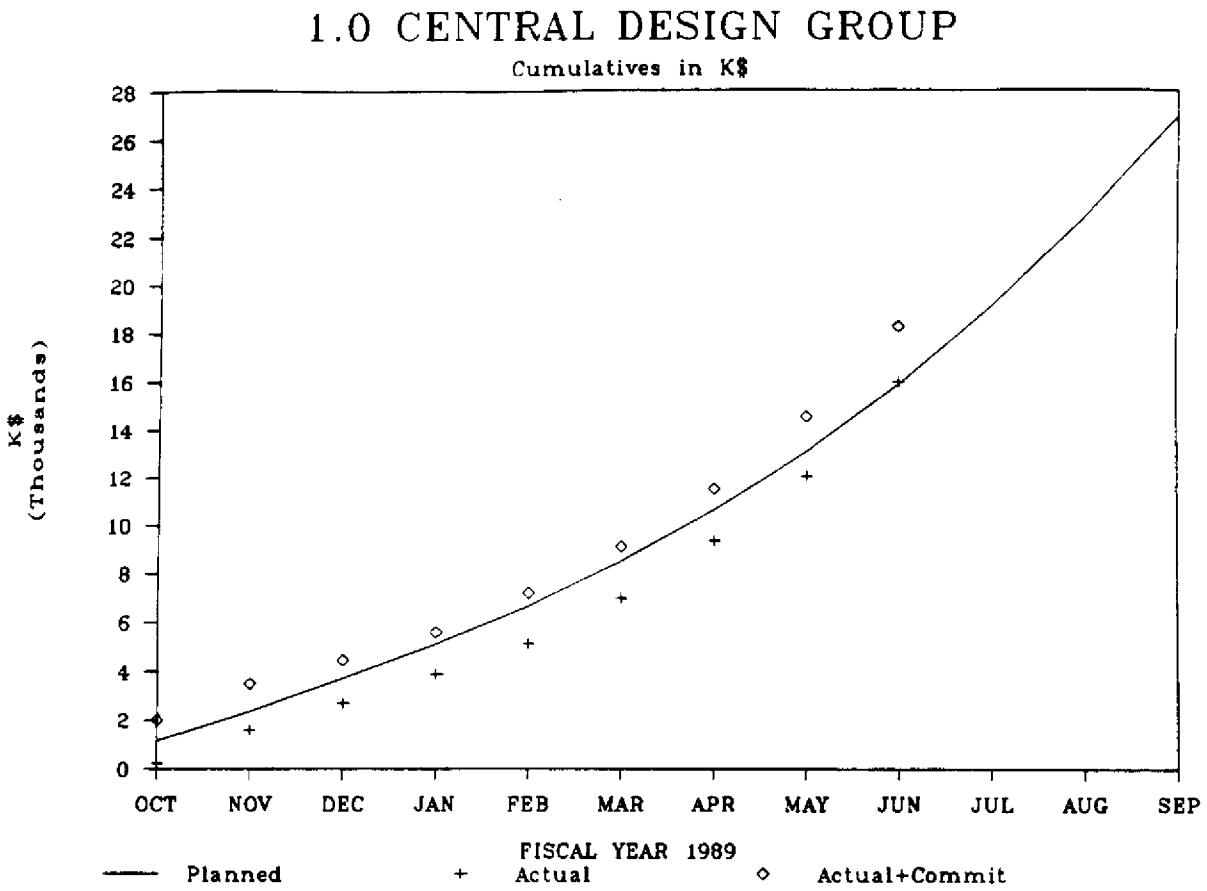
MONTH	MONTHLY PLANNED COSTS	FY PLANNED CUMULAT	MONTHLY ACTUAL COSTS	FY ACTUALS CUMULAT	MO ACT+ DELTA COMMITS	CUM ACT + COMMITS	CURRENT COMMITS	DELTA COMMITS
OCT	1014.0	1014.0	366.1	366.1	1178.9	1178.9	812.8	812.8
NOV	1014.0	2028.0	670.2	1036.3	488.4	1667.3	631.0	-181.8
DEC	1014.0	3042.0	613.1	1649.4	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						
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						
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	5343.5	38637.4	6715.1	36611.6	6309.1	42057.9	5446.3	-406.0
JUL	5693.4	44330.8						
AUG	6124.3	50455.1						
SEP	6662.9	57118.0						


1.0 CENTRAL DESIGN GROUP
Cumulatives in K$
K$ (Thousands)
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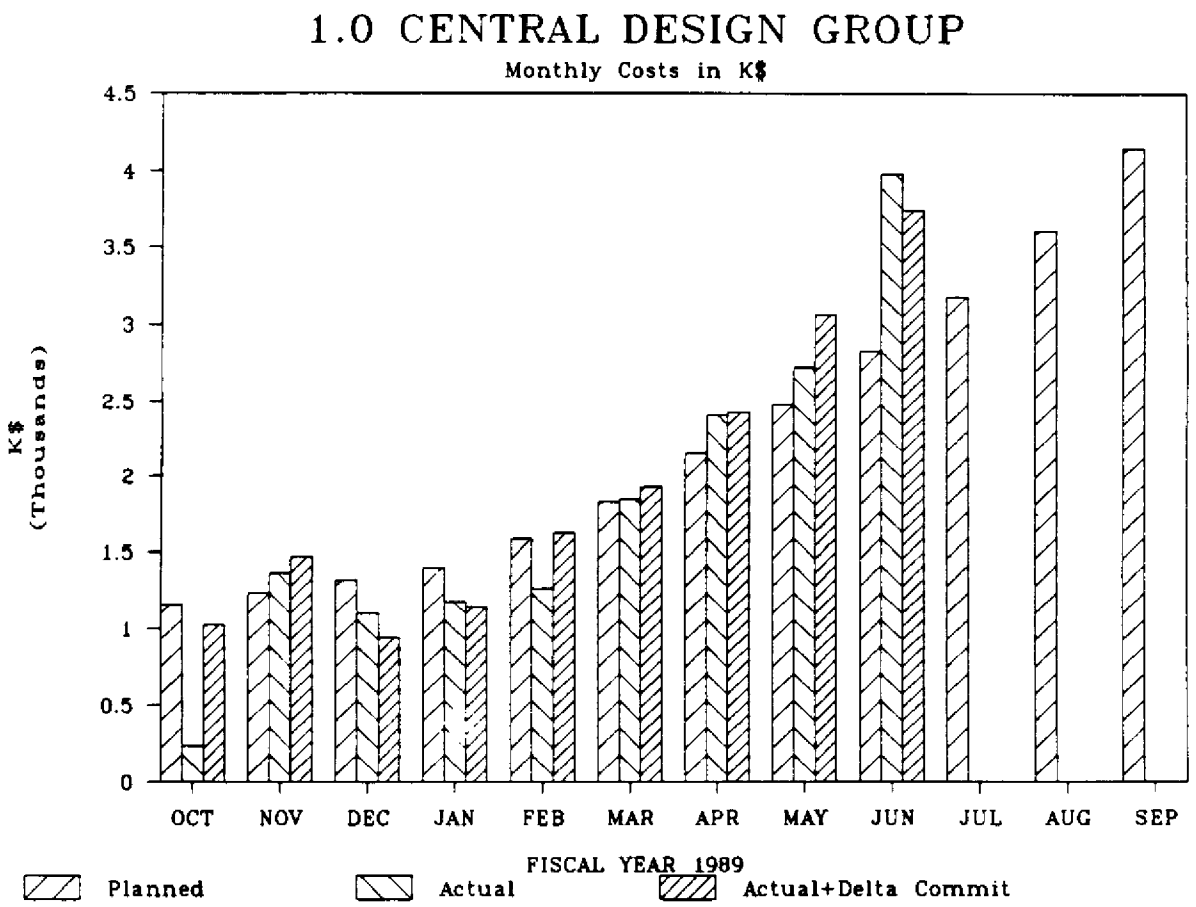
26
24
22
20
18
16
14
12
10
8
6
4
2
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Commit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Monthly Costs in K$
K$ (Thousands)
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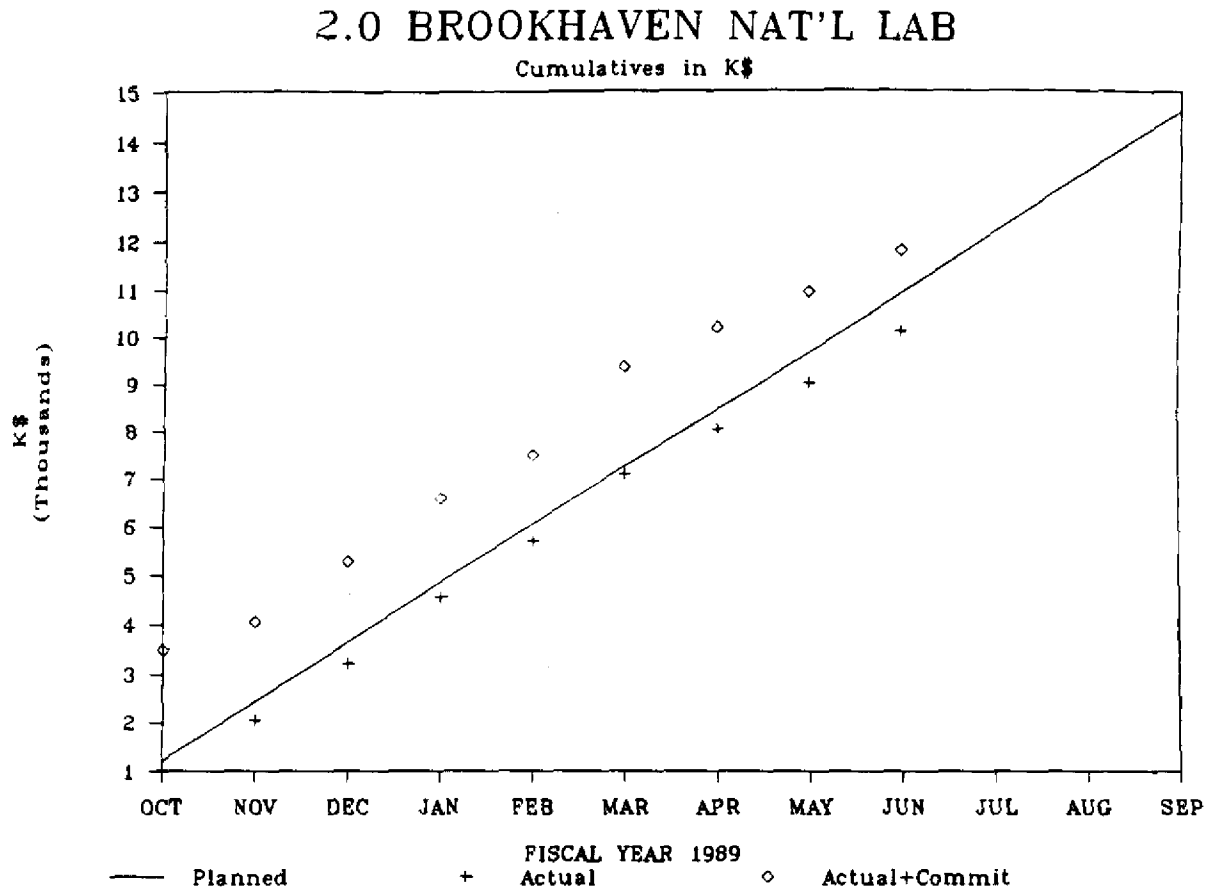
4
3.5
3
2.5
2
1.5
1
0.5
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 1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Cumulatives in K$
K$ (Thousands)
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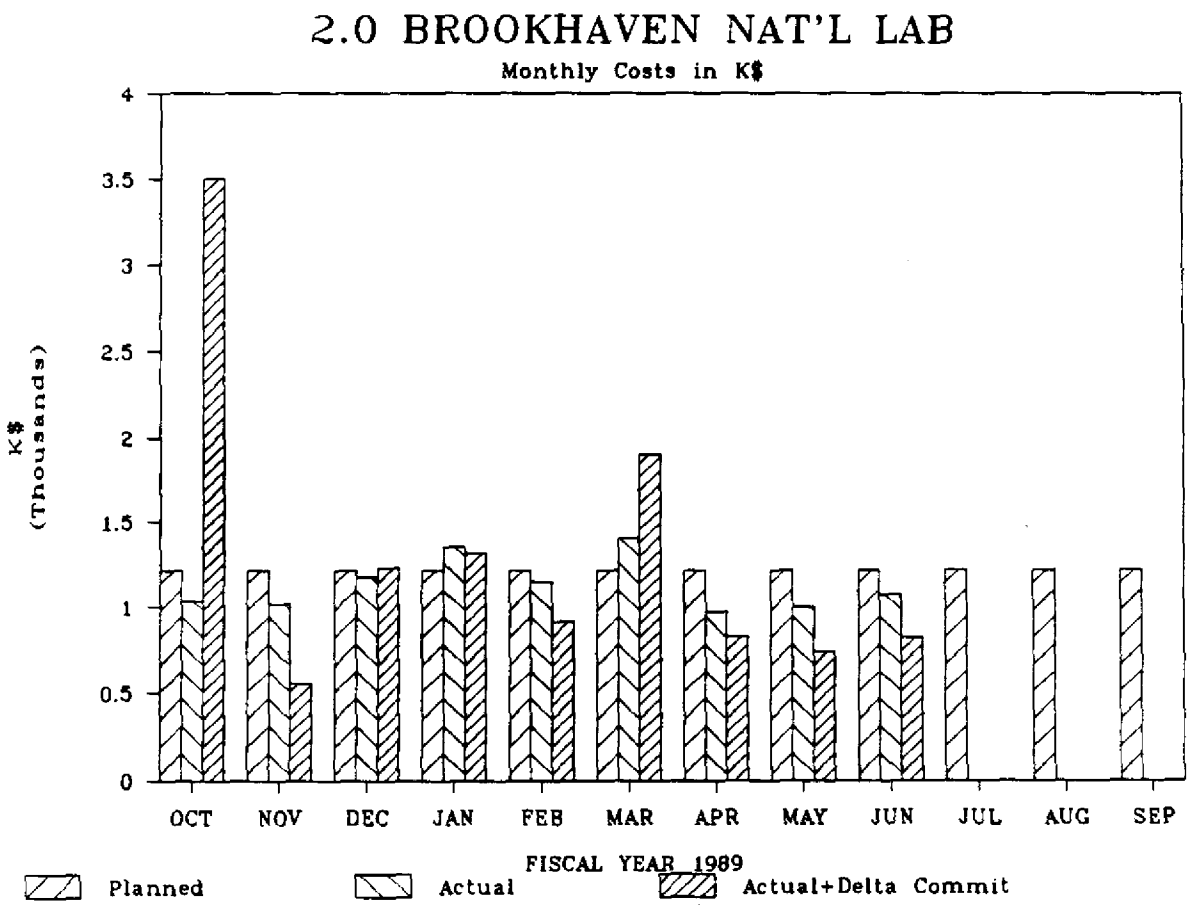
14
13
12
11
10
9
8
7
6
5
4
3
2
1
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Commit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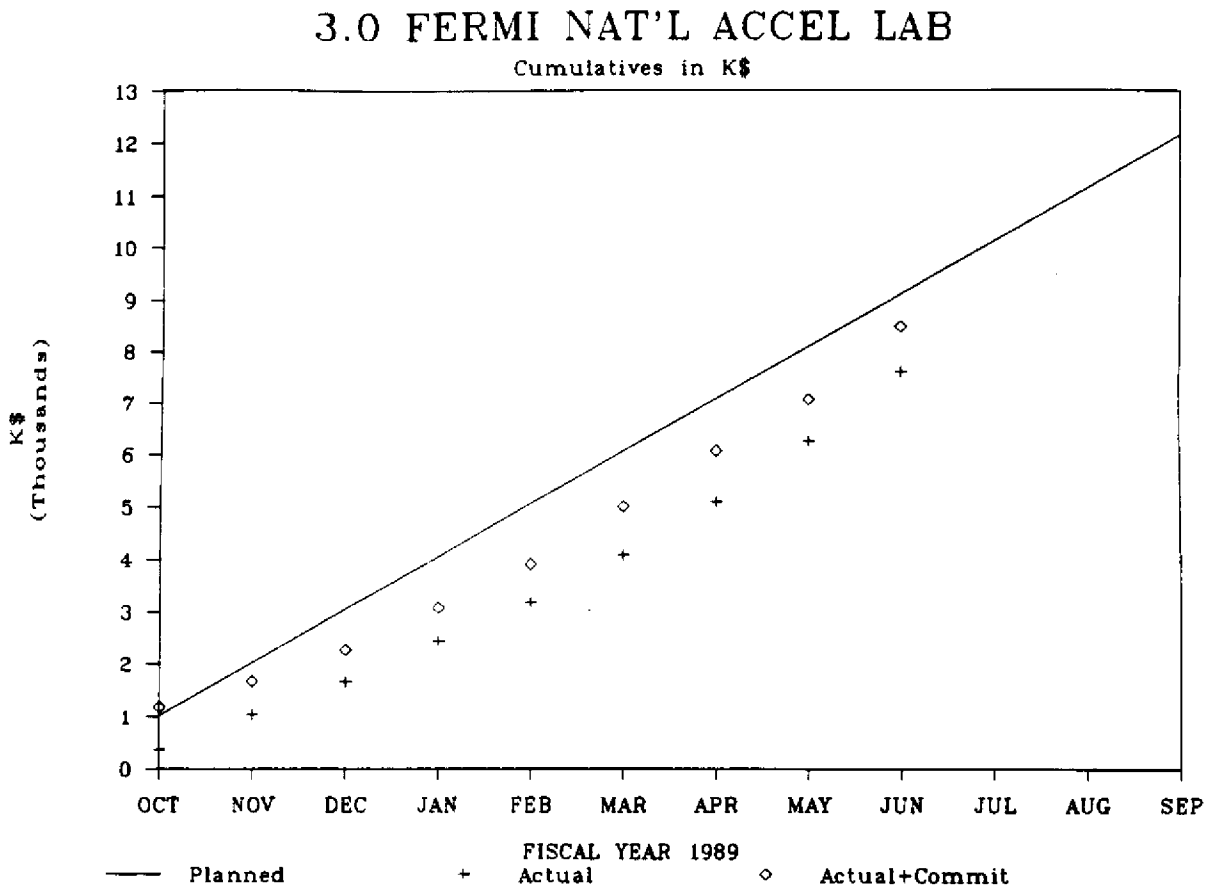
Monthly Costs in K$
K$ (Thousands)
4
3.5
3
2.5
2
1.5
1
0.5
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 2


3.0 FERMI NAT'L ACCEL LAB
Cumulatives in K$
K$ (Thousands)
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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

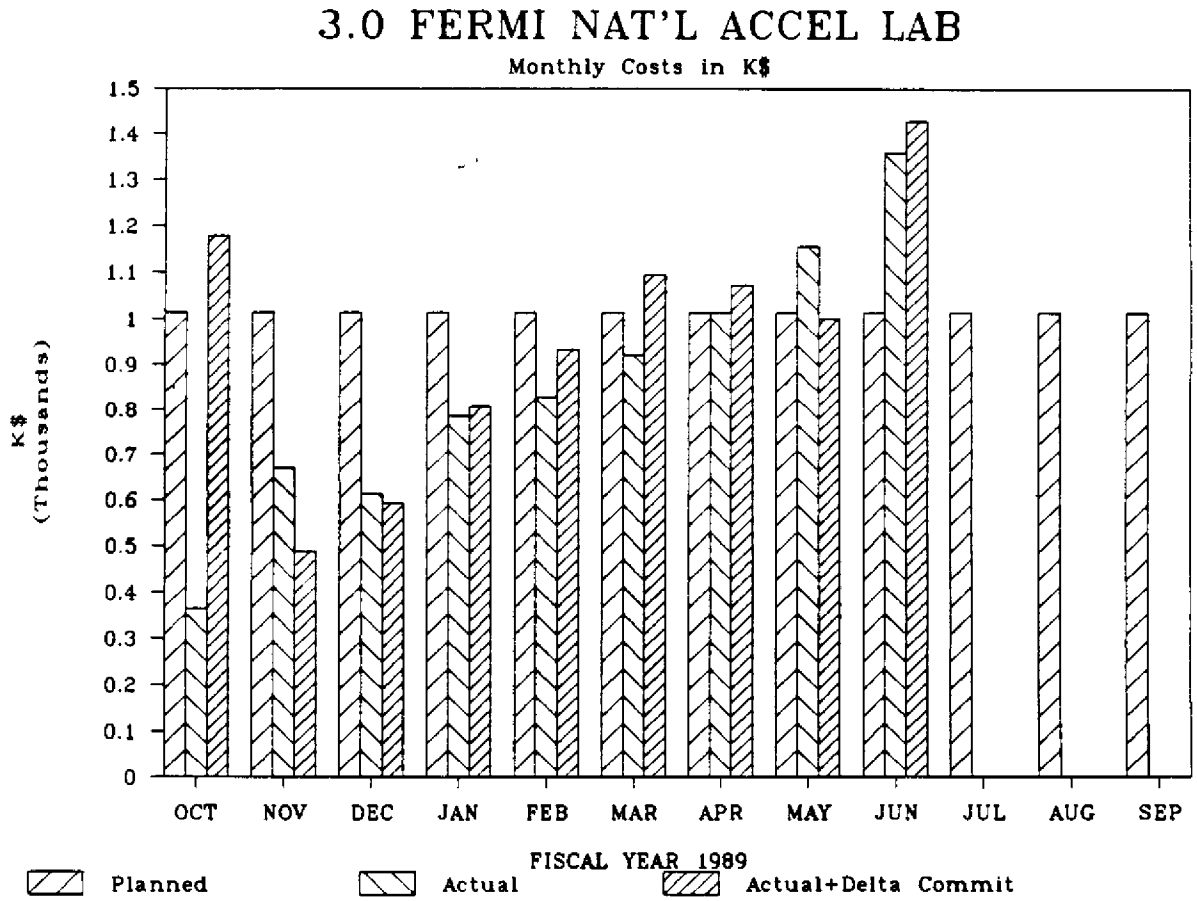
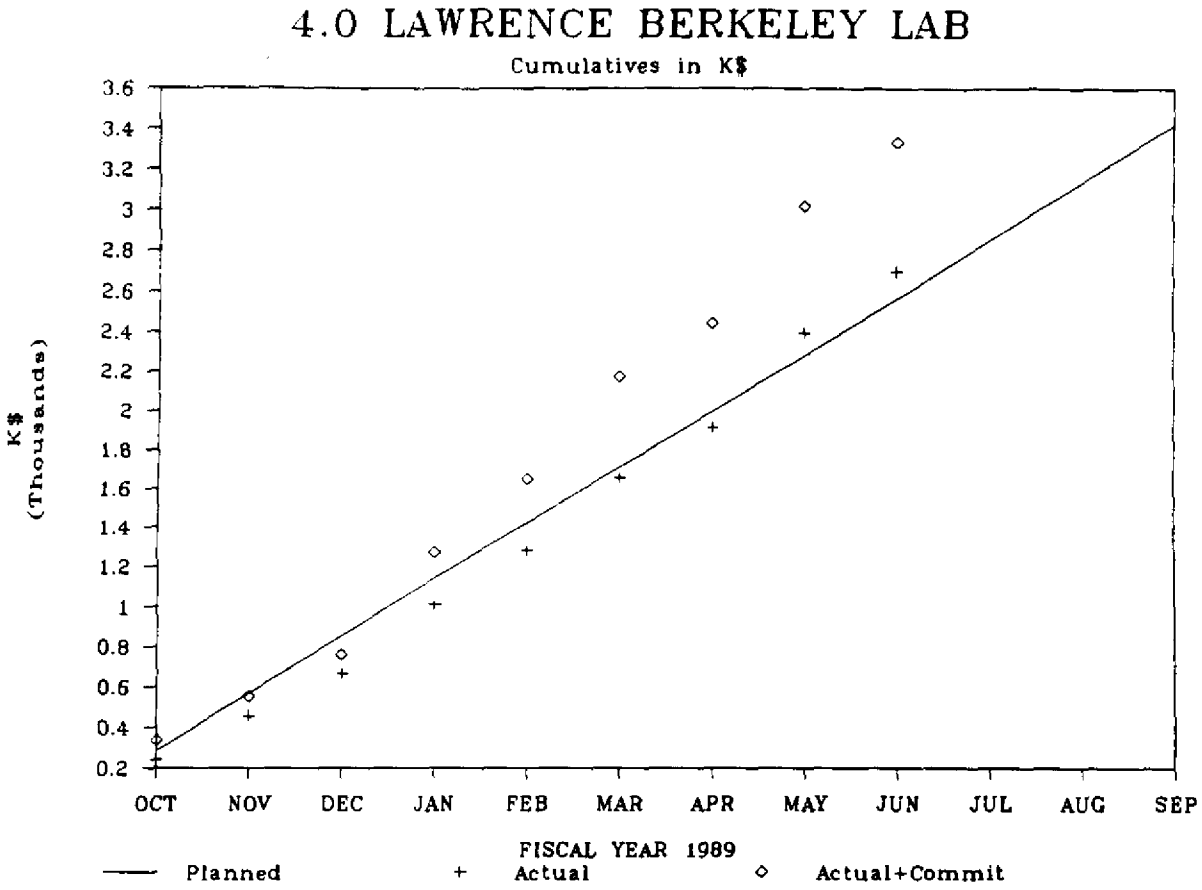

3.0 FERMI NAT'L ACCEL LAB
Monthly Costs in K$
K$ (Thousands)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 3


4.0 LAWRENCE BERKELEY LAB
Cumulatives in K$
K$ (Thousands)
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Commit

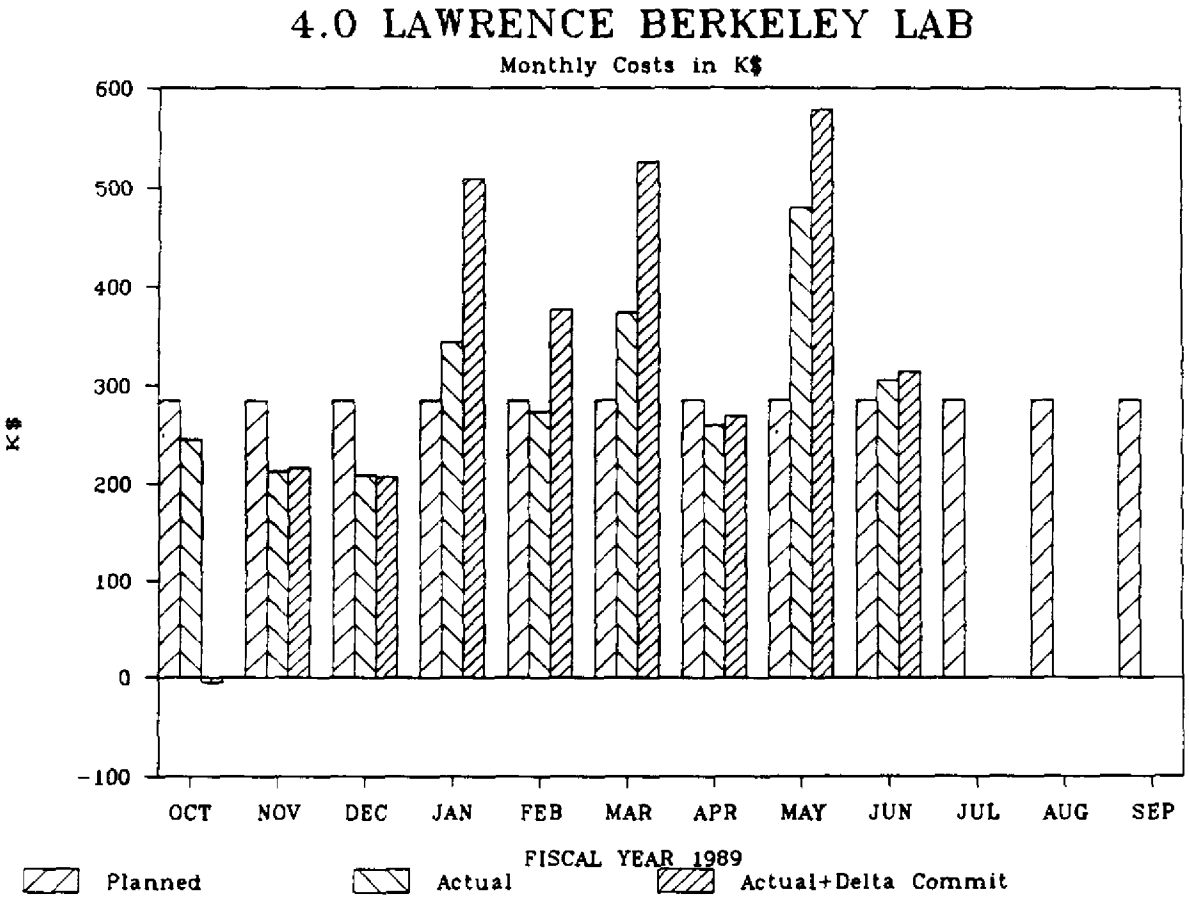
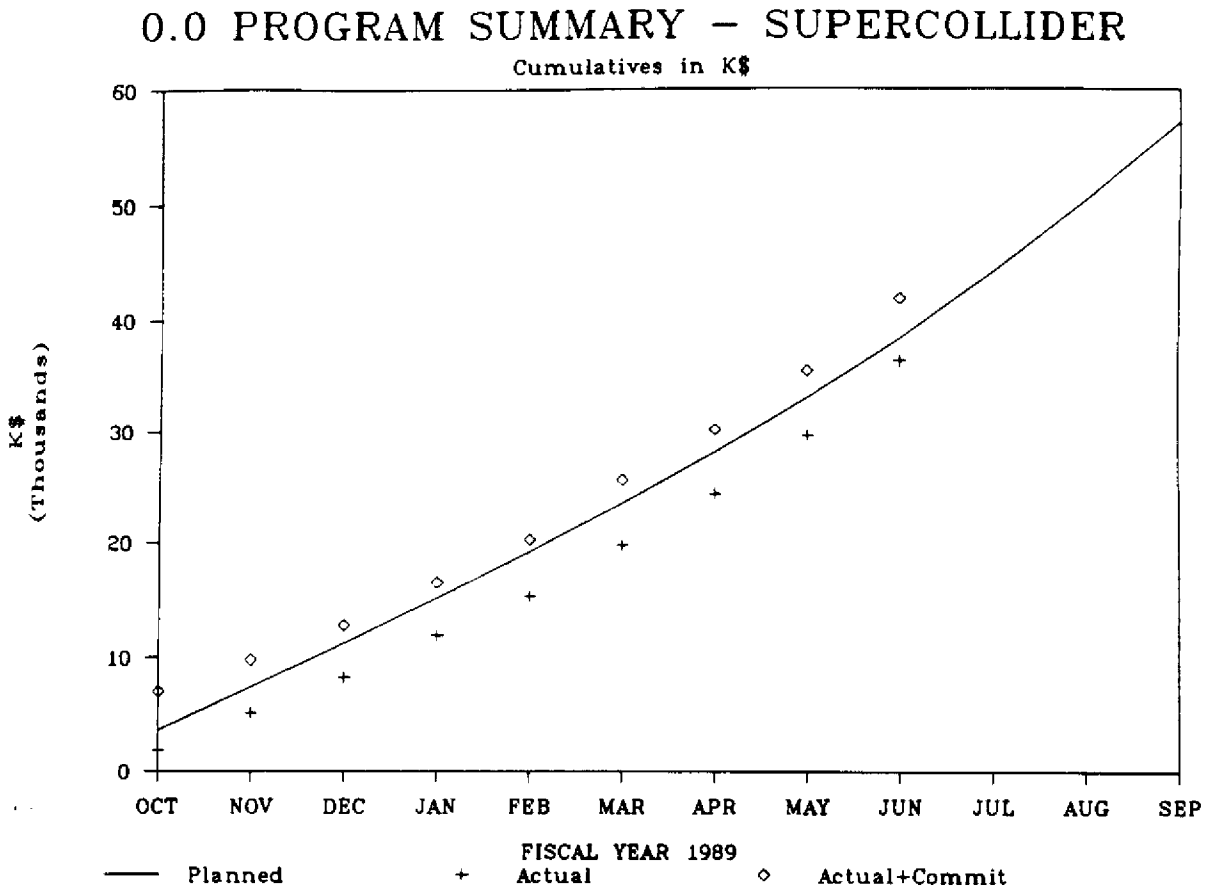

4.0 LAWRENCE BERKELEY LAB
Monthly Costs in K$
K$
600
500
400
300
200
100
0
-100
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

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

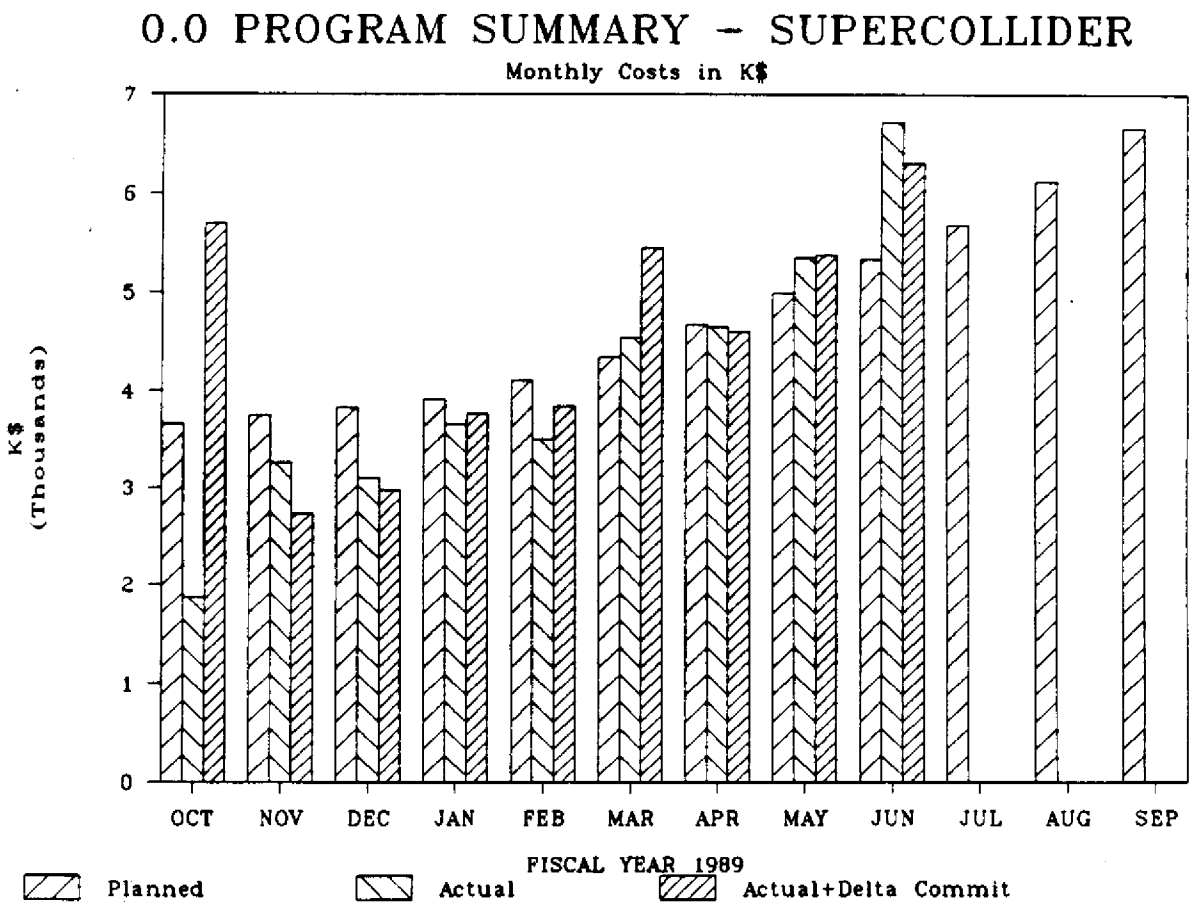

0.0 PROGRAM SUMMARY - SUPERCOLLIDER
Monthly Costs in K$
K$ (Thousands)
7
6
5
4
3
2
1
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
FISCAL YEAR 1989
Planned
Actual
Actual+Delta Commit

Figure 5