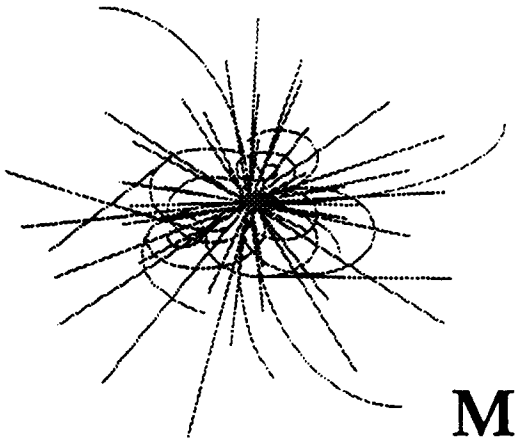
SDC 91-113



Monthly Report of the Solenoidal Detector Collaboration

September 1991

Contents

REPORT SUMMARY 3

A. TECHNICAL PROGRESS 5

1. OAK RIDGE NATIONAL LABORATORY (ORNL) 5
2. UNIVERSITY OF WISCONSIN 6
3. UNIVERSITY OF WISCONSIN 7
4. FERMILAB (FNAL) 11
5. ARGONNE NATIONAL LABORATORY (ANL) 14
6. WESTINGHOUSE SCIENCE AND TECHNOLOGY CENTER (WSTC) 20
7. UNIVERSITY OF MICHIGAN 21
8. LOS ALAMOS NATIONAL LABORATORY (LANL) 23
9. ICF – KAISER ENGINEERS (KE) 25
10. LAWRENCE BERKELEY LABORATORY (LBL) 63

B. PROGRAM COSTS 71

MONTHLY REPORT OF THE SOLENOIDAL DETECTOR COLLABORATION

SEPTEMBER 1991

REPORT SUMMARY

1. **OAK RIDGE NATIONAL LABORATORY (ORNL)**

   See text.

2. **PHYSICAL SCIENCES LABORATORY (PSL) - MUON**

   Work continued on descoping and staging plans. A short (4-cell) muon chamber and a 9.5m (2-cell) chamber were assembled and made ready for tests. The impact of floor deflections on the muon system alignment was studied.

3. **PHYSICAL SCIENCES LABORATORY (PSL) - TRIGGER**

   Revisions were made to the designs for the calorimeter electron lever-1 trigger, the overall SDC trigger system, and the trigger clock/control system.

4. **FERMI NATIONAL LABORATORY (FNAL)**

   Efforts continued on the design of the SC Solenoid cryo-system and on a new cold mass support system. The calorimetry group focussed on components for the up-coming beam tests. For the muon support system, efforts were directed on Truss subassembly and machining configurations.

5. **ARGONNE NATIONAL LABORATORY (ANL)**

   Refinements were incorporated into the designs of the barrel and end-cal calorimeter. A 3-dimensional analysis is proceeding.

6. **WESTINGHOUSE (WSTC)**

   Current contract efforts have been completed as of August 91.

7. **UNIVERSITY OF MICHIGAN**

   Investigations are continuing on triggering with superlayers of straw-tubes. The performance of various developmental digital chips is being evaluated. The cosmic ray test stand is mechanically complete.

8. LOS ALAMOS NATIONAL LABORATORY (LANL)

R&D and Fabrication plans have been up-dated for the silicon tracking system. Structural design and alignment studies of central region components are continuing.

9. ICF KAISER ENGINEERS (KE)

Construction planning continued for Detector assembly for months 18 through 40. Studies were made for I.R. Hall conditions when major repairs are needed.

10. LAWRENCE BERKELEY LABORATORY

An improved LAC piping design was developed. A summary of all currently identified services and their space requirements was prepared. Cost efforts were directed to support the Technical Board decision on calorimeter options. Thermal and stress analysis of several front-end electronics and detector configurations have been completed.

A. TECHNICAL PROGRESS

1. OAK RIDGE NATIONAL LABORATORY (ORNL)

Several reports were completed for the SDC Central Tracking Integration efforts. They are as follows: "HCTC Strawtube Electronics" by Gary Allen and Mike Emery; "Preliminary Engineering Studies for the Support Shell of the Outer Tracker of the SDC Detector" by David H. Vandergriff and John Mayhall; "Scintillating Fiber Tracker Baseline Costing, Schedule and Construction Concepts" by David Koltick and David Vandergriff; and "Radiation Length" by R.M. Leitch.

2. UNIVERSITY OF WISCONSIN PHYSICAL SCIENCES LABORATORY (PSL) - MUON SYSTEM

Muon System

Work continued in September on the muon system descoping/staging issues. A new system baseline has been derived and was used to verify costs. This baseline was also used to answer a set of questions that will be discussed in early October at SSCL during a chamber concept comparison meeting. The alignment requirements of the Wisconsin muon chamber design were investigated this month. Overall muon system alignment including the truss, tracks, and steel were also studied.

Muon Chamber Prototype

All 9.5 meter aluminum extrusions for long prototypes were received. The dimensions and finish are according to specifications. A short four-cell prototype was assembled and wire locations were measured. Effects of part tolerances on wire location were studied. A 9.5 meter two-cell chamber was assembled and is ready for testing. A 32-cell endplate was machined to verify the program for the CNC mill. This plate and 16 double cell 9.5 tubes were assembled to check assembly procedures. Fabrication of parts for two 1 meter 16-cell prototypes was started. These chambers, as well as a magnet will be used to do resolution studies. The cosmic ray testing of the two cell prototype showed that soft muons were multipl scattered in the aluminum walls of the cell. This multiple scattering is very difficult to separate from the intrinsic resolution error in the cell. The magnet will be used to help resolve this problem. This month, an out of service magnet was located, repaired, and tested. The magnet has a bending power of about 0.1 Tesla-meter in air and an acceptance of 0.3 square meter.

Preliminary Design (Coils)

Work has been done to determine the allowable deflection of the hall floor from the stand point of muon system alignment, forces and deflection in the muon system rails, and stresses and deflections in the MBT. Reasonable numbers for the floor deflection will cause problems with the current steel/support design during the installation of the calorimeter and the end caps. Work has begun to explore stiffening the MBT by the addition of side plates, splitting the MBT into three parts that can move independently, and alternative support ideas that allow the support system to be completely active when the calorimeter is moved in. A simple model is being developed at the SSC to study the effects of changing the stiffness of the MBT, the support, and the floor.

3. UNIVERSITY OF WISCONSIN PHYSICAL SCIENCES LABORATORY (PSL) - TRIGGER SYSTEMS

Calorimeter Level 1 Trigger

We have refined a preliminary design for a calorimeter isolated electron Level 1 trigger[1]. The proposed design uses tables to make local tests on the amount of energy in an individual trigger tower. The ratio of HAC to EMC energy is also tested. The results of these tests are encoded and passed forward with the energy sums to a search table that looks for matches with desired patterns. The definitions of the tower tests and their implementation have been made more flexible.

Photornultiplier Tube (PMT) currents for the EMC and HAC sections of each trigger tower are fed through a preamp and digitized in a FADC to produce a value for the current. We have designed and tested such a preamp[2] and have ordered 20 production surfacemount technology printed circuit boards to be manufactured for use in a beam test. The digitized FADC values are supplied as address to Memory Lookup Tables (MLUs) which both convert the energy to a 12-bit linear scale for the production of jet and total/missing energy sums, and also determine a state for the trigger tower, known as an Encode Tower Type (ETT) code. This code classifies a tower as electromagnetic, quiet or hadronic. This tower classification has been changed to allow triggering on high energy isolated hadrons, allow less strict isolation criteria for higher energy towers (by relaxing the quiet definition in these cases), and by allowing a different energy dependence of the ratio of hadronic to electromagnetic energy. The FADC and MLUs are organized in a pipeline architecture, so as to be able to sample new PMT currents and produce a new ETT code for each 16ns bunch crossing. The pipeline length will be approximately 3 crossing clocks.

The ETT codes are used to reflect the state of the trigger tower as it pertains to isolated electron triggering. The code is 3-bits wide, and thus can reflect 8 different states for the trigger tower. All of the states are programmable through the VME downloadable memory lookup tables. An ETT code exists for each trigger tower.

Each 8x8 region, hereafter. referred to as a "grid", has a 3-bit ETT code for each of its 64 trigger towers, for a total of 192 bits of ETT data. This data is applied via a common bus to 6 instances of a Pattern Recognition ASIC (PRA). All PRAs operate on the same ETT data simultaneously; each at a different electron threshold level. For each PRA, the electron threshold is determined by a select mask, which is under computer control. The select mask identifies the threshold level at which the PRA will identify a tower as containing an electron.

Trigger System Engineering

We have refined the preliminary conceptual design of the SDC trigger system[3]. This includes a summary of the trigger requirements, overall architecture and dataflow, design of the level 1 and 2 trigger systems, technology of data transmission, design of clock and control systems, timing of trigger decisions, and cost information. Considerable design effort has been expended on the clock and control. There is a new design of the clock and control distribution and generation. This new design results in a trigger system that is "partitionable" in a similar manner to the DAQ system. Generally, clock and control distribution parallels the DAQ processor control distribution and is closely linked to it.

The Front End Crates on the detector transmit their trigger information to the Level 1 Trigger off the detector on 1 Gbit/sec optical fibers[4]. Every 16 nsec, each fiber carries 16 bits of data to the trigger system. The same type of optical fibers carry the clock and control communication from the trigger clock and control systems to the front end electronics systems. The Level 1 Trigger Crates transmit data between themselves on short runs of twist-and-flat pair cable. Each Level 1 Trigger Crate contains a Level 2 Trigger Interface card that gathers Level 1 information buffered in the Level 1 Trigger Input Cards and transmits this information to the Level 2 after a Level 1 Accept. Each Level 1 Trigger Crate also contains a processor board, of the standard variety provided by the DAQ. Its function is to download trigger tables, monitor trigger data and provide a data path to the event builder for trigger information to be supplied with the event record to be written to tape. Each Level 1 Trigger Crate also contains a Level 1 Clock/Control board that provides the 16 nsec clock and the other control functions.

The calorimeter front end electronics crates transmit hadronic and electromagnetic compartment energies for each .1 x .1 trigger tower. The shower max detector transmits hits over threshold for 6.25 mrad ϕ by .2 η bins. The tracking detector transmits p_t bits for tracks in 6.25 mrad ϕ bins. The muon system transmits p_t bits for tracks in .2 ϕ by .25 η bins. The calorimeter isolation/summation crates find isolated electrons by searching for towers with a small ratio of hadronic to electromagnetic compartment energy surrounded by quiet towers. They also sum up energy in .4 x .4 regions. These crates test the energy in the .4 x .4 towers against a series of 8 thresholds, as well as summing up the total E_t, E_x and E_y energy found in the sum of .4 x .4 towers. The E_t, E_x and E_y sums, as well as the number of .4 x .4 towers over each threshold are sent to the calorimeter energy sum jet/threshold crates. The isolated electron information is transmitted to the calorimeter isolated electron matching crates. These crates combine information on the boundaries of regions covered by the calorimeter isolation/summation crates to find isolated electrons on region edges. They also check the electron energy against 6 thresholds. The isolated

electron logic has been revised as mentioned above to provide additional flexibility and higher efficiency.

The revisions are being incorporated into the design document for the Level 1 Decision Logic[5] .

Trigger Clock Control

We revised the conceptual design for the Trigger Clock and Control[6]. We have completed a second picture of clock and control distribution that is consistent with the DAQ partitioning in certain subsystems. In both systems, there is one Global Clock/Control Crate. It contains a Machine Clock Interface Board to communicate with the interface with the accelerator RF clock. It has a Beam Pickup Interface to communicate with the beam pickup electronics. It contains a Deadtime Monitor Board that tracks the disposition of each crossing, i.e. whether accepted, rejected, or lost due to downtime of trigger and/or DAQ. There is a Final Decision Interface that connects to the FDL card in the Final Decision Crate to provide the Level 1 Accept if the DAQ is able to read out the event and there are no outstanding error conditions that prevent accepting the event (i.e. clock phase confusion, etc.) There is a Global Clock Master that provides the phase lock of the 16 nsec clock and distributes the clock to Clock/Control Interface modules. There is a Global Control Master that distributes the Control signals to the Clock/Control Interface Modules. There are 2 Clock/Control Interface Modules that each communicate with 2 Local Clock/Control Crates. This crate also contains a DAQ Interface/Processor Board.

In the earlier design for systems that are not partitioned with the DAQ system, there are 4 Local Clock/Control Crates. Each contains 16 Local Clock/Control Boards that are connected with 4 optical fibers apiece to 4 Front End or Trigger Crates. The 4 fibers carry the Level 1 System Control, Level 1 Clock, Level 1 Control, and Level 1 Number. The Crate also contains a Global Clock/Control Interface Board that communicates with the Global Clock/Control Crate, as well as a DAQ Interface/Processor Board. In the new design of the "partitionable" system, the Local Clock/Control Boards are paired with the DAQ processor boards so the systems can have their DAQ and trigger systems partitioned in the same manner.

Every front end electronics crate, as well as every trigger system crate has a Level 1 Clock/Control Board (L1CCB). This board accepts the Level 1 Clock and Control Signals from the Global Level 1 System and puts these signals out on the crate backplane for use by the other modules in the crate. These signals are the Level 1 System Control, Level 1 Clock, Level 1 Control,and Level 1 Number. The L1CCB also receives fast error and busy signals from the other modules in the crate. The board also communicates with the crate processor, which is the DAQ Interface Card, from which is receives other status information about busy and error states. The L1CCB is programmable by the DAQ Interface Card to return busy and error states to the Global Level 1 System

depending on the local busy and error information it receives in the crate. The LlCCB is also programmed to return the correct crossing number that accompanies data from the crate that is provided for the level 1 System. We have begun design work on a module that simulates the functions of the LlCCB, for use in testing of front end electronics and DAQ systems.

References

[1]T. Gorski, J. Lackey, W.H. Smith, W. Temple. *Isolatfd Electron Pattern Logic Design and Performance at the SSC, U.* Wisconsin SDC Note SDC-91-00087, 1991.

[2] [2] D. Panescu, J. Lackey, P. Robl, W.H. Smith, *An SSC.P~T Preampli~er Circ7lit, U.* Wisconsin SDC Note SDC-91-00086, 1991.

[3]W. H. Smith, T. Gorski, J. Lackey SDC *T7igger Prelirr7.i77~7rlJ Co7lcept7lal Design.* Wisconsin SDC Note SDC-91-00090, 1991.

[4]M Thornpson, *Fiber Optic Data Transmission for the SDC Detector, U.* Wisconsin

[5]T. Gorski, J. Lackey, W.H. Smith, *Level 1 Trigger Decision Design for the SDC, U. Wisconsin* SDC Note SDC-91-00088, 1991.

[6]W. H. Smith, T. Gorski, J. Lackey, *SDC Glob~al Level 1 Processor- Clock &1 Cont* U. Wisconsin SDC Note SDC-91-00090, 1991.

4. FERMILAB (FNAL)

Superconducting Solenoid

Cryogenics

Calculations were initiated to determine the helium relieving rate from the cooling tube on the support cylinder and the peak pressure generated in the cooling tube during a quench of the full size solenoid. The relieving rate is needed to size the safety relief valves for the tube and the peak pressure determines the pressure rating (wall thickness) of the cooling tube. Both these quantities depend on the heating rate of the helium in the cooling tube. This rate varies with time and is a function of the heat generated in the support cylinder by the current induced in it as the current in the superconducting coil decays during the quench. We are considering two cases: In the first case, the dump switch fails to open and the solenoid decays through the small resistance of the power supply. In the second case, the dump switch operates correctly and the solenoid discharges through the fast dump resistor. Preliminary results show a peak pressure of 10.7 MPa (1551 psia) for the first case and 5.2MPa (756 psia) for the second. The peak relieving rate is 8 kg/s.

Design work continued on the isogrid outer vacuum shell for the prototype magnet. Our consultant has now completed all the tasks associated with the engineering of the isogrid shell, the annular bulkheads and the chimney penetration.

Cold-mass Support System

Efforts started on a new cold-mass support. It is a triangular shaped structure, similar in appearance to a billiard ball rack, made of carbon-fiber epoxy composite. It allows the coil to center itself during cooldown by providing axial motion on one end. The support will support both tensile and compressive decentering forces. The load path is through the support to the annular bulkhead and thence through the cryostat supports to the calorimeter.

Magnetostatics and other Finite-Element Calculations

We began a new series of magnetostatic calculations to study the magnetic effects of the slot pattern in the calorimeter endwall region. We also investigated the bolted joint between the outer vacuum shell and the annular bulkhead. The vacuum seal is provided by a small fillet weld. The bolt-weld geometry dictates that the vacuum load be carried by both the bolt and the weld. We created ANSYS models with both 1/2-inch and 5/8-inch bolts, preloaded to about 75% of the yield strength of the bolt material.

We continued to develop a quench analysis scheme using ANSYS. We noted that the diffusion of the current from the superconducting strands into the high-purity aluminum stabilizer is not instantaneous and that assuming that it might result in our underestimating the hot spot temperature during a quench. We have made good progress in solving the space-time current diffusion equation with appropriate boundary conditions.

Calorimetry

Test Beam Work

The work of the calorimeter mechanical group is now focused entirely on beam test activity to be able to produce a partial prototype hadron block for the beam test. After some serious soul-searching, we have become convinced that our original plan of building 4 partial half-wedges (two towers by six towers each) and a stacked lead test EM section were too ambitious. Also, the effort to write the CDR and do the conceptual design prevented us from working on the beam test until that was finished,.

The current plan is to build at least one half wedge, two towers by four towers,. We are currently designing the absorber steel and hadron tiles.

We have learned is that the technique of building the absorber out of thick plates and individual spacers and plug welding them together is probably not the way to go. The number of different parts is very large and the assembly time and labor is substantial. As a result the thick plate construction that mills the slots for the tiles is favored. The number of pieces is much smaller.

We have specified the PMTs and ordered them. We have also ordered extra fiber and scintillator. We are currently having trouble with the controller on the Thermwood cutting machine. The goal is to have the block in the beam-line by the middle of December.

Fiber Tracking

The notice to proceed was sent to Rockwell Electro Optics Center.

Data Acquisition System

Studies were directed to descoping in order to reduce costs. Some time was spent artworking the tracking module and loading parts on the test transmitter and adder modules. After a review by the SDC DAQ Working Group, the conceptual DAQ document was revised.

Muon Support Alignment Systems

Work was done on Truss subassembly and machining configurations to provide manageable piece size transport to the SSCL and simple re-assembly ideas. In addition, we are pursuing the idea of transforming the BW2 supermodule structure into a base for a spacer truss and BW3 assembly with all the prototype muon chamber groups.

In September, systematic comparative testing of Microswitch, Turck, and Rechner proximity sensors was completed. Long term tests of the stretched wire-target-proximity sensor continued. We are now trying to analyze the data over a nine week period. This has been delayed by the alignment workshop and Collaboration activities.

Long term tests on the prototype BW3-BW1 and BW3-BW2 optical systems have been underway for five weeks. Readout fluctuations with temperature include the detector sum outputs as well as differences. There are light source and/or electronics effects. In addition, there may be a slow variation of the systems corresponding to a small physical movement of the optics. We are trying to identify and understand this. Relative chamber superlayer displacement monitoring is critically sensitive to such effects.

The Hutchison Center in Fairbanks, Alaska, has begun to setup a prototype of a wire current/differential flux transformer position sensor system we sent from Fermilab. They will study and develop the system with test results in the next few months.

In mid-September, we took delivery of the prototype MIGATRON RPS 8800 Ultrasonic distance measuring system. We hope to use such systems to link the Barrel/Intermediate/Forward muon system positions and to link the Barrel muon/calorimeter/tracking systems. Proximity sensing does not work at large separations. We are presently studying range limits, air current and temperature effects, etc. While it is set up for RS485 readout levels and protocol, we are modifying it for RS232 readout and will modify software to read out this system with the other sensors so we can correlate temperature and other effects.

5. ARGONNE NATIONAL LABORATORY (ANL)

Lead Scintillator Plate Calorimeter

The mechanical support effort for the month of September was as follows:

Barrel Calorimeter Design

The cross sections of the barrel calorimeter were updated to reflect the final dimensions and geometry dictated by the last round of cost reductions. These changes now coincide with T. Kirk's spreadsheet described as Model B dated September 4, 1991.

Barrel Calorimeter Analysis

The models of the barrel calorimeter modules were remeshed to correct for an inherent "Cosmos" problem. The newly constructed model is now being iterated as individual super elements back into the full barrel 3D model. This is a repeat of the process started earlier. "Cosmos" has difficulty with element aspect ratios of more than 3:1.

End Cap Calorimeter Design

The end cap geometries and dimensions reflected in T. Kirk's Model B spreadsheet dated September 4, 1991 were incorporated into the conceptual drawings of the end cap.

End Cap Calorimeter Analysis

The same process of analysis that was used in the barrel is being applied to the end cap geometry. Due to the smaller number of modules, this analysis is proceeding more rapidly and some data has been obtained. After a very cursory look at the data it appears there are no unanticipated problems in the end cap design.

Test Beam Apparatus Installed

The test beam apparatus was installed in the MP beam at Fermilab. The function of the X,Y table has been checked and found operable. Work has proceeded on the necessary fixturing to add the second module to this array during the month of October. This fixturing is being fabricated in the Argonne Central Shops.

Prototype Casting

The second EM prototype casting was completed at the end of the last reporting period and is now being prepared for instrumentation. The quality of this cast

is much better than the first one. The tolerances are improved and the porosity experienced on the top edge of the casting has been eliminated. The bulkhead distortions that were experienced in welding test module #1 were reduced to acceptable limits on module #2.

Westinghouse Subcontract

Barrel Design

A minimal effort was expended in documenting previous work on casting EMC test module 2.

The log book notes from the August 20-21 casting were reviewed and documented. An evaluation of this work is as follows:

1) The mold extension was successful in eliminating porosity from the finished casting.

2) Bulkhead flashing seemed to be significantly reduced (need Argonne confirmation on this). One possible reason for this is that temperature gradients (in space and time) were reduced during the casting and cooling press. Room temperature clearances between inserts and frame should be checked and compared.

3) Most aluminum plates came out easily. However, a significant quantity (~ 10-20%) needed some mechanical assistance such as prying, or striking with a small rubber mallet. An impact pulling device should improve this operation.

4) The productivity of mold disassembly, overall, was greatly improved. The entire press took 5.5 elapsed hours and 11 man-hours of effort.

5) Surface finish and overall casting quality is as good or better than the first casting in all aspects.

6) Apparent frame flotation, as evidenced by excess lead on the bottom surface, is still an existing problem. The new clamping design may not have worked, because the Belville washers yielded due to the heat. This subject needs to be re-evaluated prior to the next casting.

7) A clamp is needed to align the aluminum inserts across bulkhead boundaries. In the first casting, this function was served by the 2-56 threaded insert locators. The removal of these locators allowed small misalignments to occur.

End Cap Design

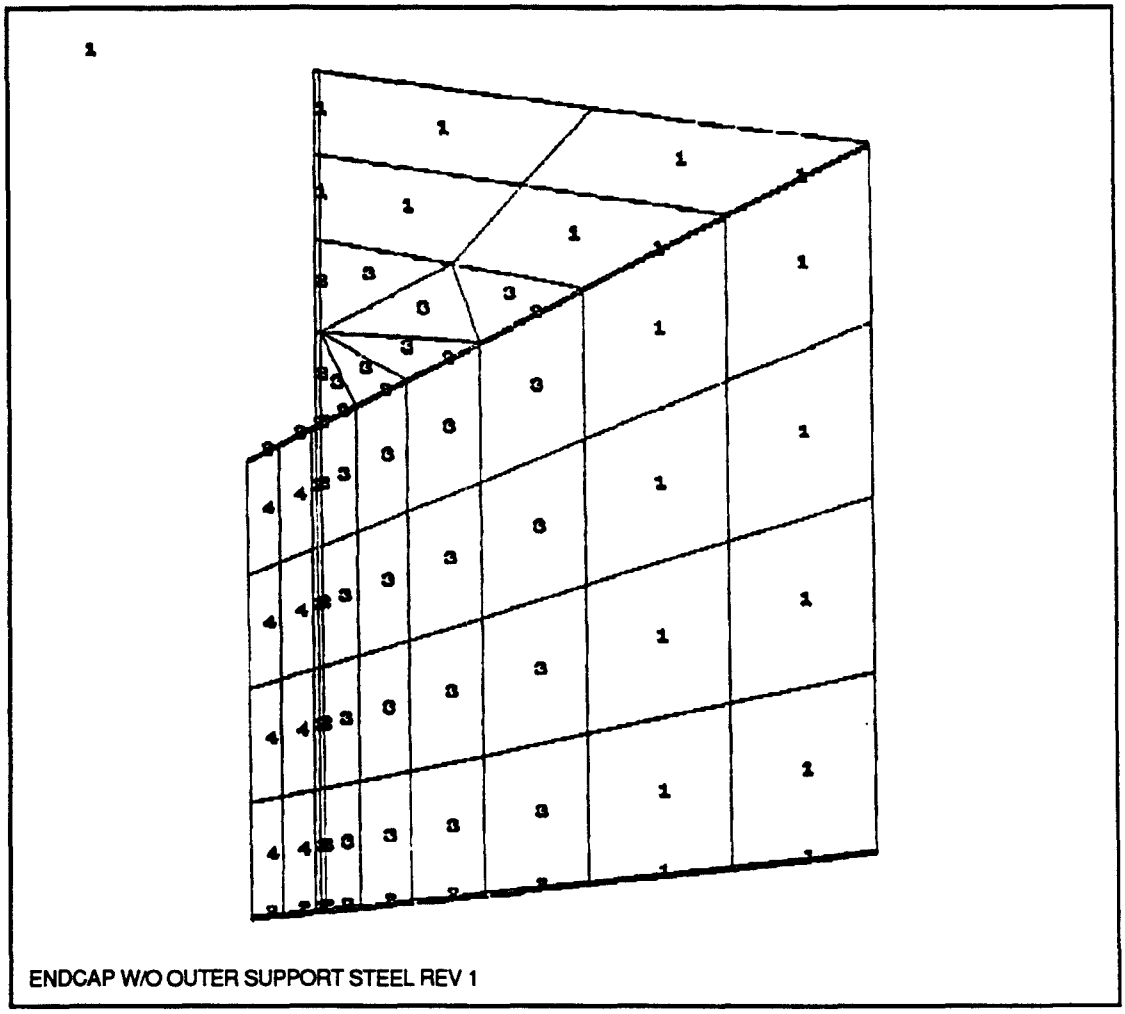
A 3-D finite element model of the entire end cap was constructed and executed. This was the baseline calorimeter design of August '91, with 12 l at h = 3, and no solid outer steel support and flux return shell. Documentation and further analysis of this case has been put on hold due to a design change.

A revised model was constructed with 11 λ and $\eta = 3$, and no solid outer steel. This model is described by three attached figures that show the material properties, end cap layers in the z direction, and overall deflections and stresses for Rev. 1. The maximum deflection is 1.4 mm, and the maximum stress is 2714 psi. These are preliminary results that are undergoing further review. Rev. 1 has a minimal number of attachment points between modules. Further revisions will add additional attachment points.

Management efforts have continued at a minimal level to insure progress and proper prioritization of efforts. The HAC1/HAC2 joint has been conceptually designed.

Two meetings were attended at SSCL on September 5 and September 12. A variety of calorimeter options were costed and presented.

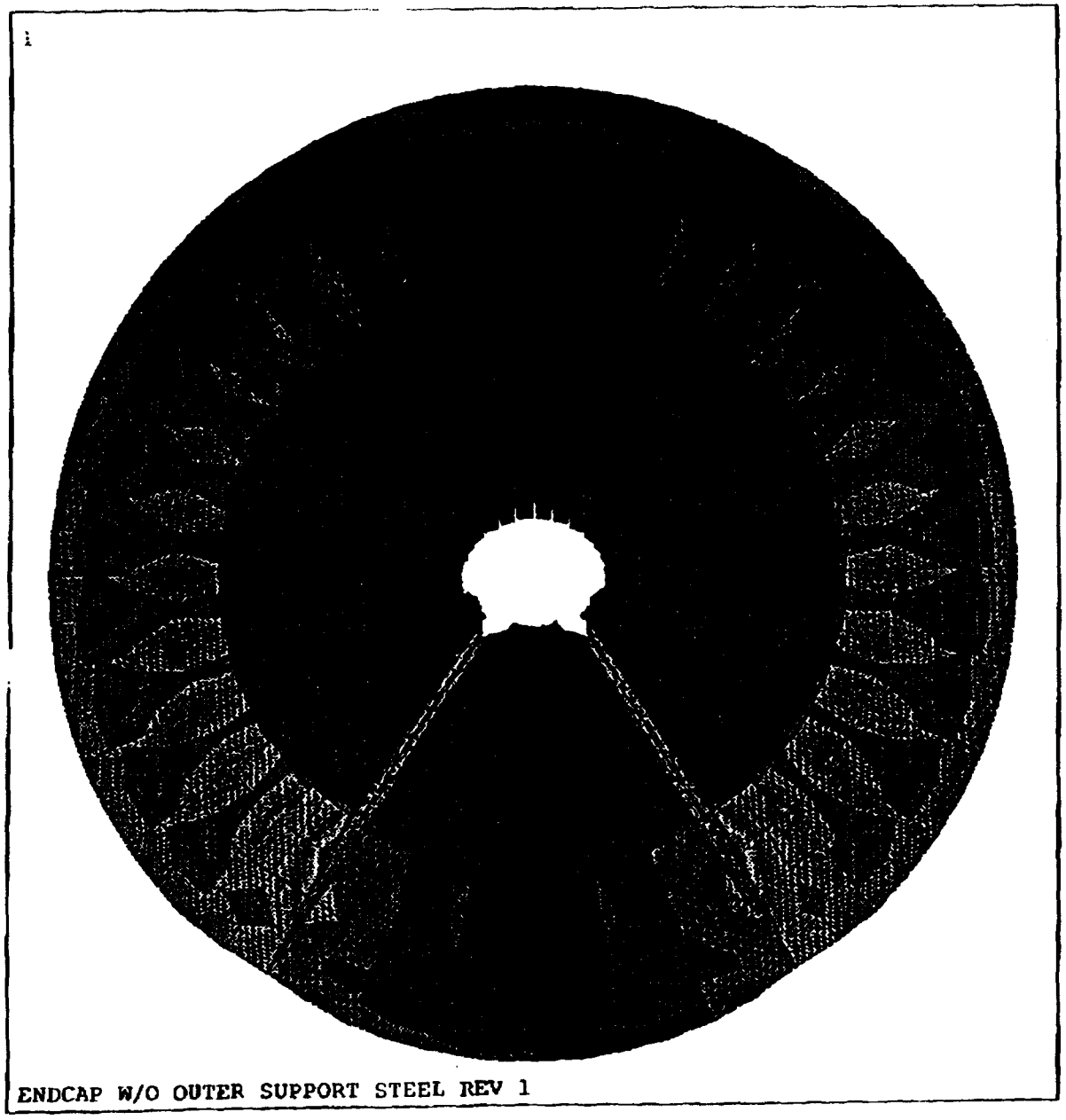
END CAP CALORIMETER 3-D ANALYSIS
11λ at η = 3, NO OUTER SUPPORT STEEL, REV 1
MATERIAL PROPERTIES



Matl. No.	Description	Density (kg/m^3)	E_R (Nt/m^2)	E_θ (Nt/m^2)	E_Z (Nt/m^2)
1	HAC2 Steel	7359	1.94×10^{11}	1.94×10^{11}	5.18×10^{10}
2	Solid Steel	7850	2.07×10^{11}	2.07×10^{11}	2.07×10^{11}
3	HAC1 Lead	9931	1.21×10^{10}	2.48×10^{9}	2.48×10^{9}
4	EMC Lead	7264	8.82×10^{9}	1.04×10^{9}	1.04×10^{9}

END CAP DEPTH COMPONENTS
11λ at η = 3, 9/24/91

Component	ΔZ (mm)	Z Coordinate (mm)
EM Front Face		4185.94
EM front plate	3.18	
15 Normal slots @ 4.5 ea.	67.50	
1 large slot	21.50	
15 Pb plates @ 8.0 ea.	120.00	
EM back plate	15.88	
Total EM	228.06	
EM/HAC1 Boundary		4414.00
HAC1 front plate	15.88	
25 slots @ 4.5 ea.	112.50	
24 Pb plates @ 31.5 ea.	756.00	
Total HAC1	884.38	
HAC1/HAC2 Boundary		5298.38
13 steel plates @ 67.5 ea.	877.50	
13 slots @ 4.5 ea.	58.50	
Total HAC2	936.00	
HAC2 Outer Boundary		6234.38


ANSYS 4.4A
SEP 27 1991
27:21:26
PLOT NO. 1
POST1 STRESS
STEP=1
ITER=1
SIGE (AVG)
DMX =0.001423
SMN =4023
SMX =0.187E+08
SMXB=0.631E+08
ZV =-1
DIST=3.576
ZF =5.21
FACE HIDDEN
4023
0.208E+07
0.415E+07
0.622E+07
0.830E+07
0.104E+08
0.124E+08
0.145E+08
0.166E+08
0.187E+08
ENDCAP W/O OUTER SUPPORT STEEL REV 1

6. WESTINGHOUSE SCIENCE AND TECHNOLOGY CENTER (WSTC)

Current contractural efforts have been completed.

7. UNIVERSITY OF MICHIGAN

SDC Trigger Design Report

Work has continued on triggering with superlayers of straw tubes. The work is proceeding in both simulation and the development of Application Specific Integrated Circuits (ASICs). The first digital chip has been fully tested. Its performance has been evaluated and presented as part of the SDC Trigger Subsystem Report. With respect to the work on muon trigger designs, a preliminary conceptual design report is in preparation. The ideas contained within the report have been presented at the SDC muon electronics design review held at the SSC Laboratory in early September. Further discussions of the preliminary conceptual design will be held at the SSC Laboratory on October 26th when the conceptual design will be extended to include the forward direction.

Chip development

Test of the first version of the digital mean timer chip have revealed variations in the timing characteristics that are unacceptable unless corrected. These variations have been traced to differences in the loading of the individual stages of the mean timer. These can be corrected and new designs will eliminate this differential loading. A second area where improvements are needed is in the unwanted interaction of the rising and falling edge timing. This coupling is automatically removed by the independent feedback control of the two edges but results in a limited range of individual stage delay. To extend the timing range and decouple the timing of the leading and falling edges, a change in the location of the current control elements of the delay stage will be incorporated into the next version of the chip.

The next chip will contain several test structures to permit a broader range of triggering options to be evaluated. The circuit will contain both 8 and 16 cell mean timers, delay cells with individual outputs, and two delay timing control circuits. It will contain cells tuned for 2ns delays (as does the first chip) and cells optimized for 4ns delay times as required for muon trigger designs.

Trigger Algorithm Simulation

Work has continued on trigger simulation in the framework of GEANT and a fast emulation of a stiff track trigger. We continue to pursue a trigger based on 8 straw tubes per superlayer. A trigger based on 3 superlayers of 8 straws and mean timers is clearly viable for triggering on straw tubes. An arrangement that uses 3 trigger layers in a 2 out of 3 coincidence for the level 1 trigger and the actual stiff track segments in a level 2 trigger is clearly robust and very attractive. Simulations are continuing to evaluate the options.

Cosmic-ray Test Stand

The cosmic-ray test stand is mechanically complete with scintillator trigger counters, straw tube layer, amplifier-discriminators, and cabling. Test of the cosmic ray stand have been troubled by the inclination of the very fast amplifiers and discriminators to oscillate. Since the new boards (fabricated in Colorado) are to be available in October, we have discontinued work on the straw readout based on the old Brookhaven amplifiers and borrowed CDF ASD cards in favor of the new cards when they become available. We plan to connect the new cards to a LeCroy 1879 Fastbus TDC in the near future and begin testing the straw tube pattern. Our plan for testing trigger chips is the same as before and will use the auxiliary card connection of the LeCroy TDC for pickoff of the straw outputs.

Muon Trigger

The efforts in the area of muon trigger have concentrated in the development of a preliminary conceptual design report and in the design and simulation of delay cells with 4ns times. The design report is complete through the specification of the design logic, component modularity, and component connectivity. Component counts are specified for the central system. The intermediate and forward regions will now receive attention. The meeting on the forward system planned for October 26th will aid in pinning down the detector specifications so that the trigger design modularity and connectivity can be specified.

8. LOS ALAMOS NATIONAL LABORATORY (LANL)

Cost and Schedule Activities

The silicon tracking system program revisions have been initiated. The revisions are being undertaken to bring the overall plan up to date with the detailed WBS architecture for the silicon system. The plan includes all R&D activities and construction tasks. The next step will be to modify the task efforts for the descoped version of the silicon tracking system.

The R&D plan for FY92 was prepared for integration into the overall silicon tracking system effort. LANL was in attendance at the ORNL SDC collaboration meeting in which this topic was discussed in addition to other topics relating to the general design status.

Silicon Tracking Configuration Studies

System integration activities relating to this topic confined largely to the central region silicon area.

We have reviewed various options for constructing the graphite/matrix composite cooling rings. Topics studied were matrix composition, construction techniques, and potential manufacturing sources. Matrix additives are being considered for improving the thermal conductivity of the composite. Also, the choice of matrix material is being reconsidered. Currently a hydrophobic resin is a prime candidate for replacing the standard aromatic amine resin used in previous sandwich panel development tests at LANL.

Thermal analyses are being performed to study the sensitivity of the overall temperature drop across the central region cooling ring to the composite ring thermal conductivity. On the basis of these results, we will be in a better position to define the required improvement in the ring's thermal conductivity during future materials investigations.

We are considering design modifications to the cooling ring wick structure that will enhance its fabricability by using molding techniques. We hope to eliminate all machining operations and to simplify the assembly concept. The design concept, however, will likely introduce the prospect for additional temperature drop in the overall structure. We are analytically studying this aspect. The goal is to better define the construction technique in order to enhance our ability to generate more definitive construction costs.

Opto-Mechanical Fixture Design

Progress on the design layout for producing silicon shells has been made. This fixture will be instrumental to our cost-effective production of silicon shell assemblies. Information obtained from this study will be used to guide the cost analysis for the upcoming cost proposal.

Alignment Studies

Concept consolidation efforts regarding central region alignment continue. Optical tooling from prior LANL programs is being assembled for alignment studies during FY92. A demonstration of the central region's critical alignment is planned for midyear.

9. ICF – KAISER ENGINEERS (KE)

Construction planning was continued in detail for the months 18 through 40. In addition studies were made on the hall arrangement when a major repair has to be made to the detector.

Additionally, closeup views of the construction of the muon steel barrel were made for months 5, 7, 8 and 9.

Months 18, 21 and 30 were selected for simulation of the congestion that may occur in the hall floor by including mobile equipment, scaffolding, cable storage pallets and test equipment in the construction progress drawings.

An alternate schedule was developed whereby the arrival of the equipment which is not in the critical path was delayed as much as possible, allowing for a better cash flow and less congestion in the hall and in the surface facilities during the early stages of construction. Both schedules, are attached.

In the Figure 5 for this section, the two schedules are given first followed by the close-up views of the muon steel barrel for months 5,7,8, and 9. These are followed by the sequence of construction drawings from months 18 through 40 as described below.

Construction Progress Drawings

Month 18 shows scaffolding attached to the faces of the forward toroids. This scaffolding will be used for mounting electronics, cables and gas piping for the forward muon chambers.

A desk is shown with an operator, a computer and several electronic racks to test the equipment installed on each of the forward toroids.

Several cherry pickers are shown, serving several installation and testing functions. Storage pallets for cable harnesses and reels are also shown, as well as fork lift trucks in charge of transporting heavy loads from one place to another.

An accurate survey of all equipment and laydown area requirements has not been made, however the picture illustrates the importance of performing this task in detail, as the floor appears highly occupied. Laydown areas for fixtures and tools need to be allocated and vehicles need room to park and maneuver for an efficient construction operation.

Months 19 and 20 are self explanatory.

There are two drawings shown for month 21 from different perspective angles. The first drawing was done in more detail for the same reasons as month 18.

Month 22 shows the muon chamber/Cerenkov counter system being lowered to the hall floor by the surface crane. It is not certain at this time that this system will be assembled on the surface and lowered as a unit. On the July monthly report, we had shown a system by which the forward muon chambers and the Cerenkov counter would be brought down in pieces and assembled on the hall floor.

Month 23 is self explanatory.

Month 24 shows the south endcap calorimeter being lowered by the same system used for the barrel calorimeter. The operation would be similar in that the frame would be disengaged from the hoisting wire ropes and travel to match the calorimeter supports so that the endcap can be rolled into place.

Month 25 shows the north forward calorimeter being lowered to the hall floor. The calorimeter is being lowered right after the north endcap calorimeter has been lowered, so the same rig can be used for that purpose.

Month 26 shows the south forward calorimeter being lowered to the hall floor by a jacking system similar to the one used for lowering the barrel calorimeter. The same frame could be used but the hydraulic jacks could be replaced with lighter ones and fewer ropes could be used thus saving time in the rigging operation. Another option would be to change the schedule and lower the forward calorimeter right after the endcap calorimeter thus saving the setup time.

Month 27 is self explanatory.

Month 28 shows intermediate muon chambers stored on the floor waiting to be picked up by the bridge cranes. Once the detail design of the chambers is available, a fixture or fixtures for supporting the chambers while exchanging from the surface crane to the hall cranes will have to be developed. These fixtures will take space when not in use and should be taken into consideration in the overall process.

Month 29 is self explanatory.

Month 30 was developed in greater detail, the same as months 18 and 21. Scaffolding is shown on the periphery of the endcap calorimeters. This will be used to complete the wiring and testing of the different components, as some of the electronics or other systems could have suffered with the lowering operation.

Months 31 and 32 are self explanatory.

No drawings were made for months 33 and 34 because little physical change is observed in those months.

Month 35 shows the silicon tracker being installed. The system for this installation was described in the August monthly report. During the preceding period, the muon chambers and absorbers were installed on the endcap calorimeters.

Months 36 and 37 are self explanatory.

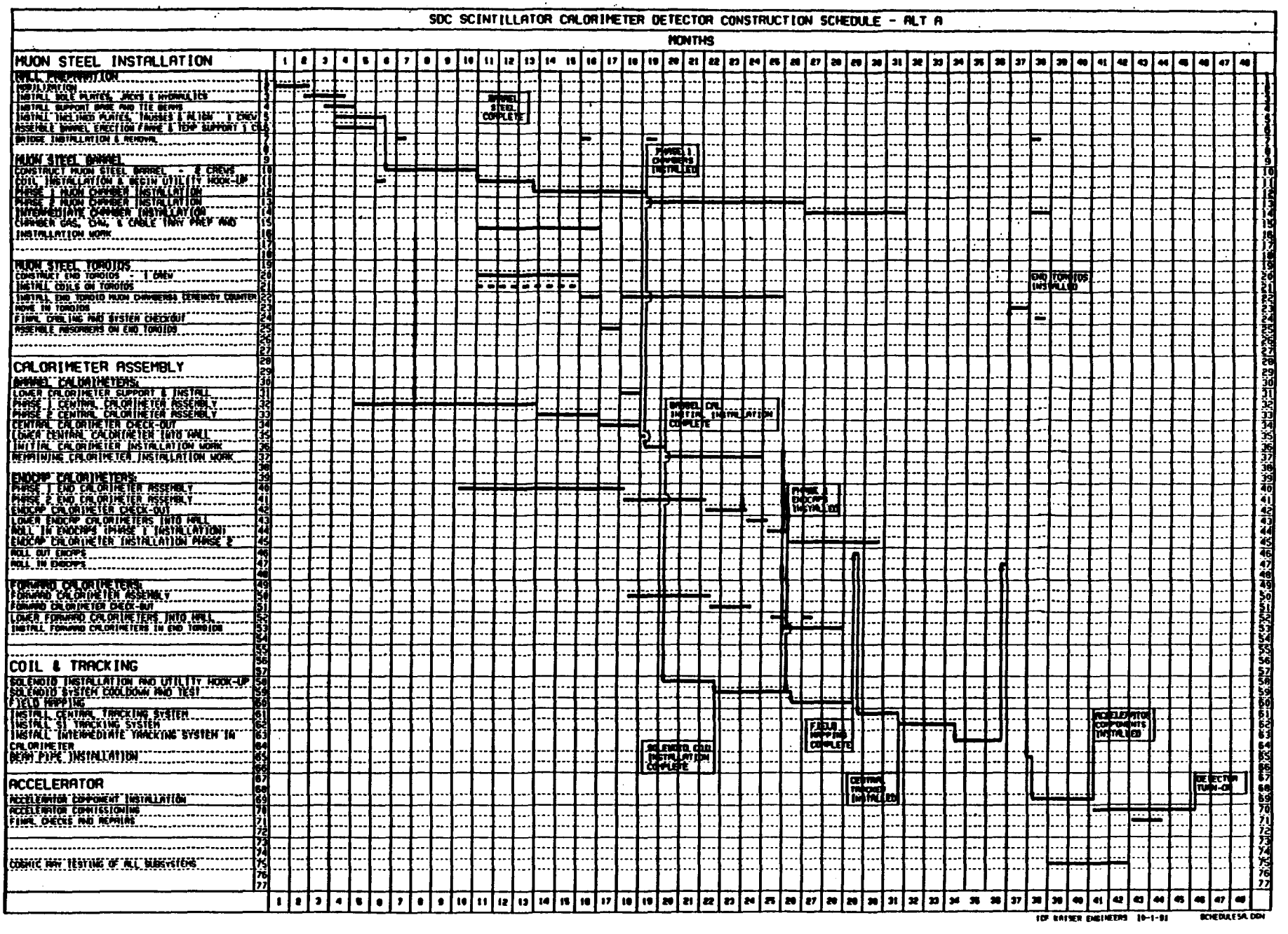
On month 38, the last intermediate muon chambers were installed. In order to do this, the bridges had to be removed. In future designs, the posssibility of moving the bridges sideways on some kind of tracks and storing them inside the pit area should be studied. With the present design, the bridges cannot move sideways far enough to allow for the bottom intermediate chambers to be installed.

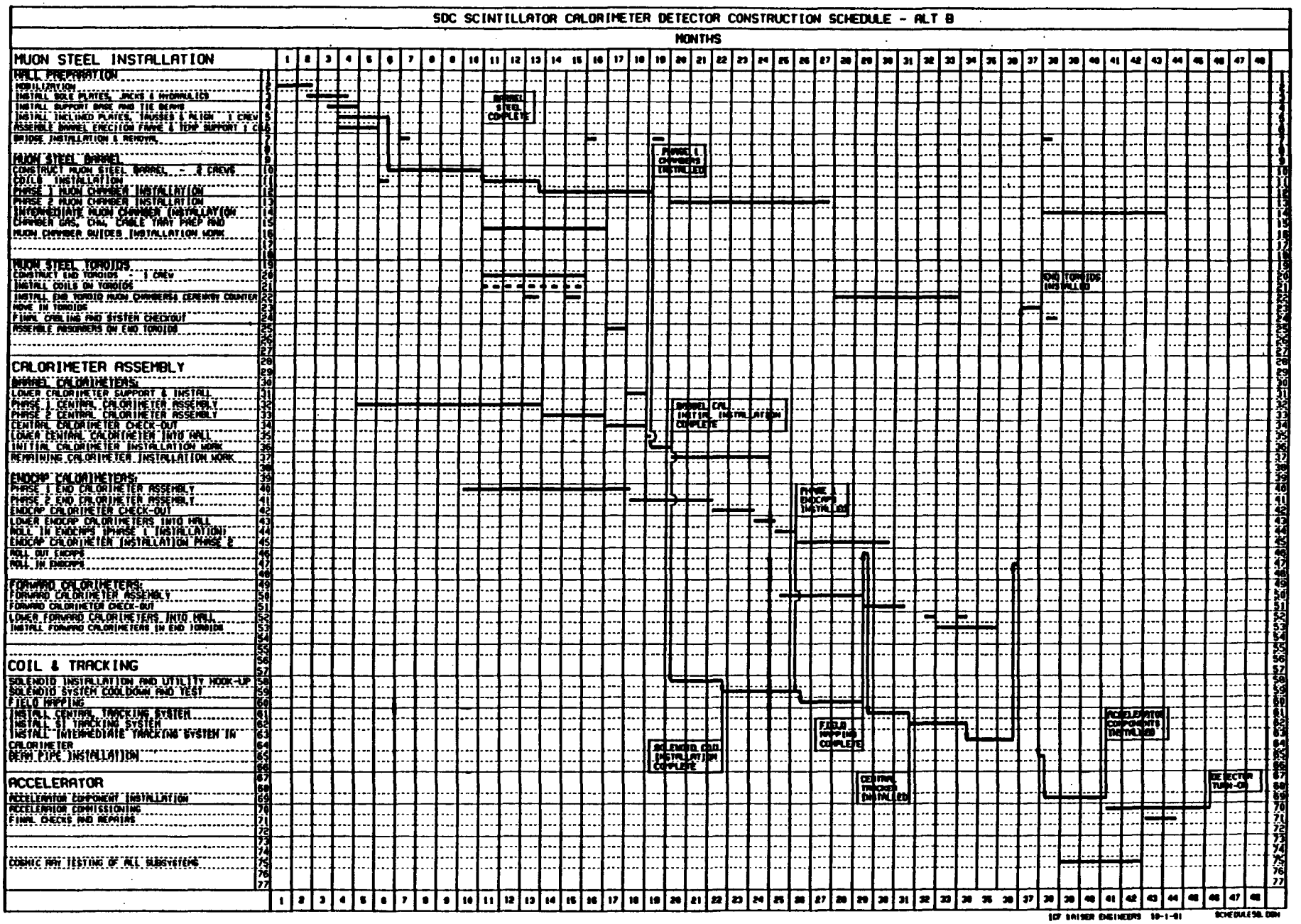
Month 39 shows the installation of the accelerator components structural steel almost complete.

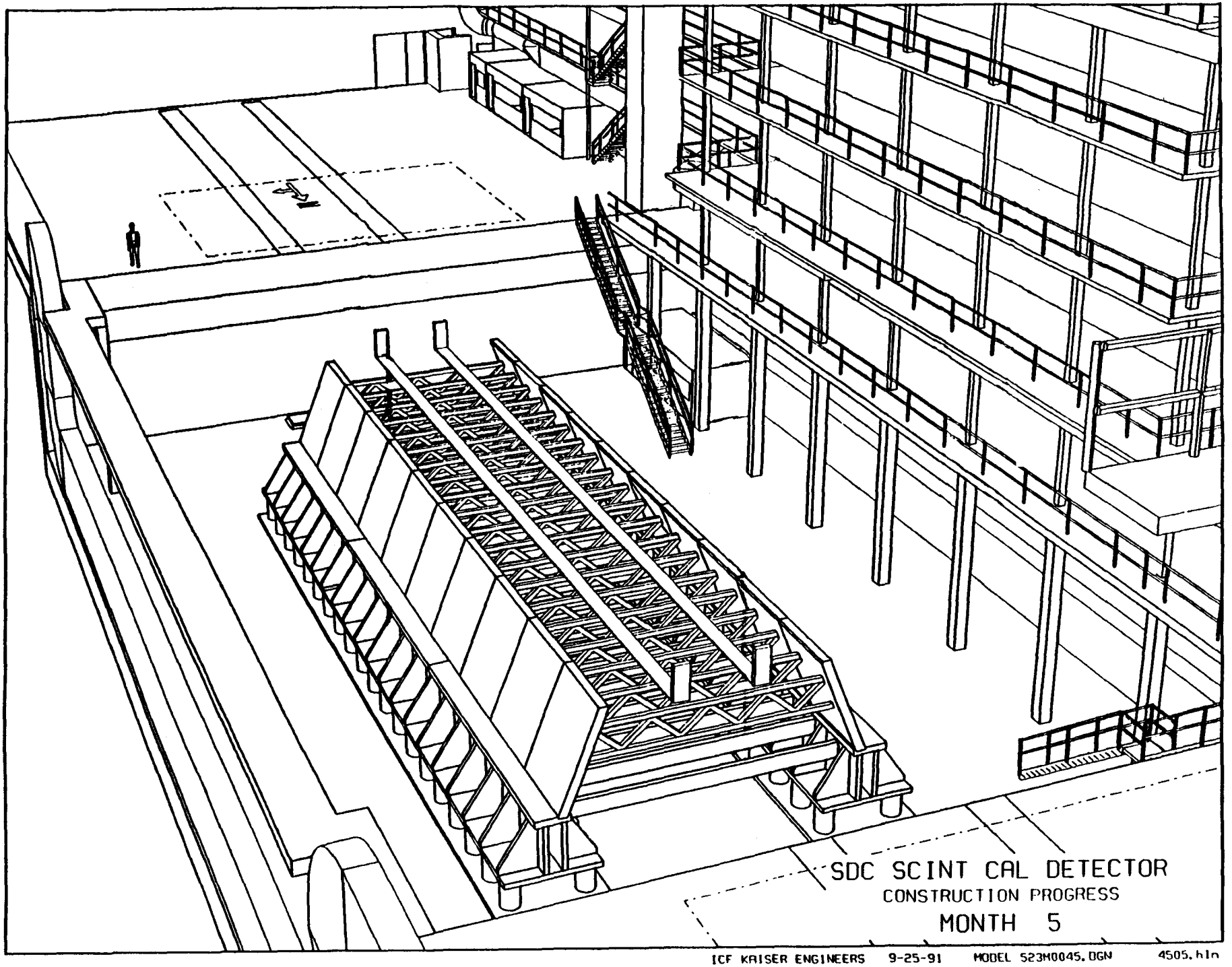
Month 40 shows the quadrupoles installed. No further drawings were made beyond this month as no significant physical changes would take place. Two months may not be enough to install the accelerator components. At the time of this effort the design of the accelerator in this area was not far enough along to make a good judgement.

Major Repairs of the Detector

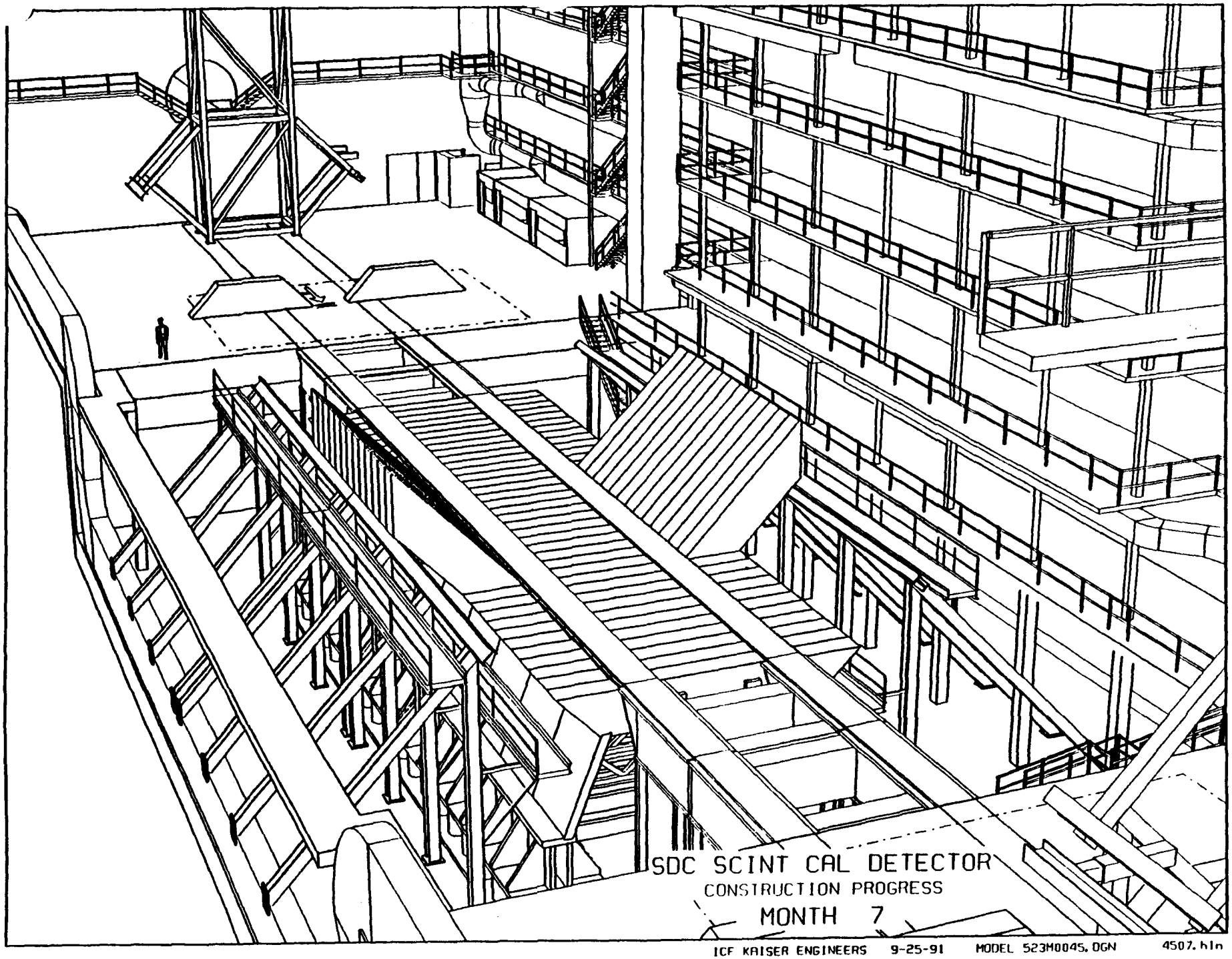
The last drawing (following month 40) shows the detector open for major repairs. The drawing shows the number of components that have to be removed for major repairs of an endcap calorimeter without opening the construction shaft. If the barrel calorimeter needs to be removed, some of the detector components will have to be raised to the surface for lack of space on the hall floor.

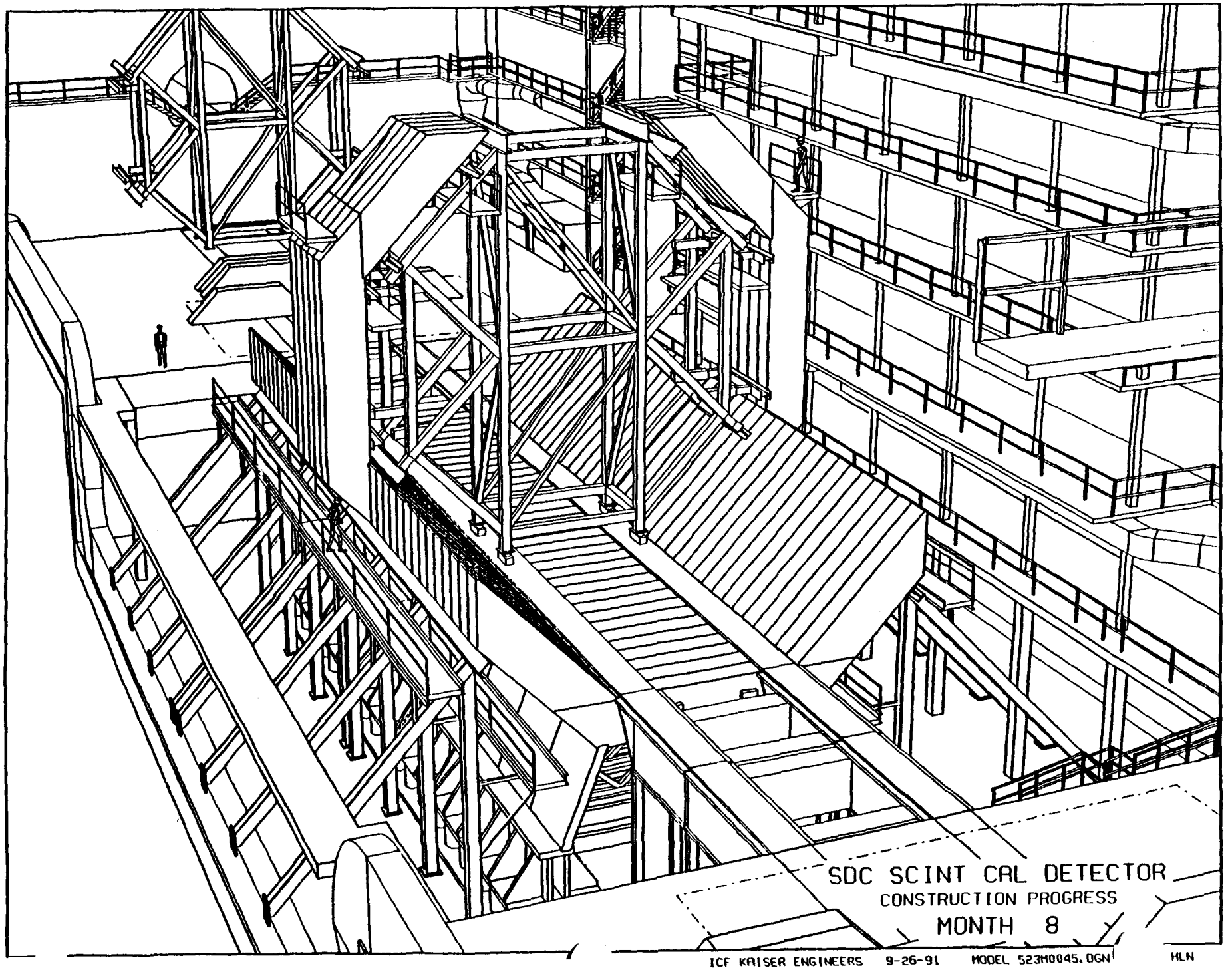

SDC SCINTILLATOR CALORIMETER DETECTOR CONSTRUCTION SCHEDULE - ALT A
MONTHS
MUON STEEL INSTALLATION
HALL PREPARATION
MUON STEEL BARREL
MUON STEEL TOROIDS
CALORIMETER ASSEMBLY
BARREL CALORIMETERS:
ENDCAP CALORIMETERS:
FORWARD CALORIMETERS:
COIL & TRACKING
ACCELERATOR
BARREL STEEL COMPLETE
PHASE 1 CHAMBERS INSTALLED
END TOROIDS INSTALLED
BARREL CAL INITIAL INSTALLATION COMPLETE
PHASE 2 ENDCAP INSTALLED
SOLENOID COIL INSTALLATION COMPLETE
FIELD MAPPING COMPLETE
CENTRAL TRACKER INSTALLED
ACCELERATOR COMPONENTS INSTALLED
DETECTOR TURN-ON
TOP RAISER ENGINEERS 10-1-91
SCHEDULESA.DGN

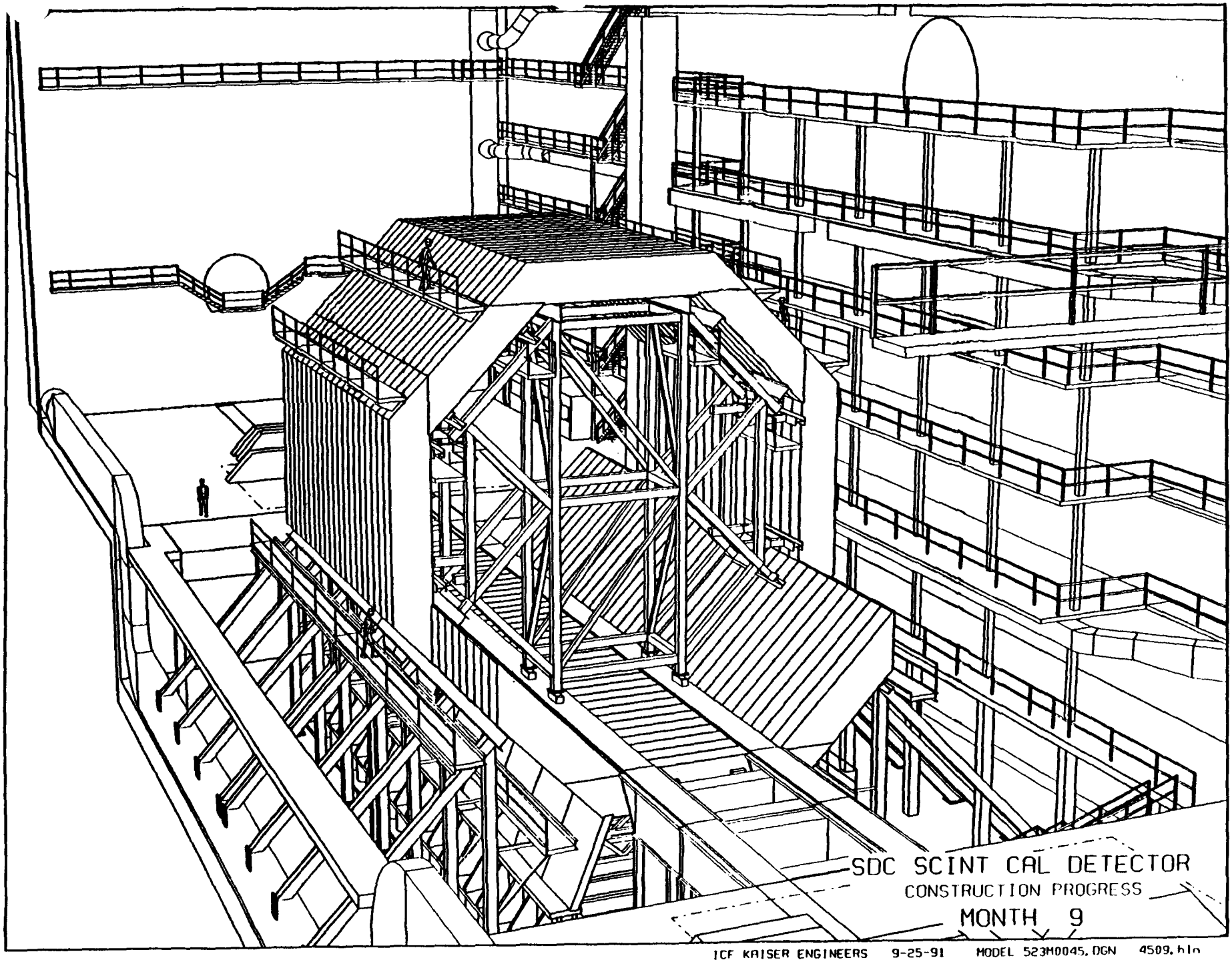

SDC SCINTILLATOR CALORIMETER DETECTOR CONSTRUCTION SCHEDULE - ALT B
MONTHS
MUON STEEL INSTALLATION
HALL PREPARATION
MOBILIZATION
INSTALL SOLE PLATES, JACKS & HYDRAULICS
INSTALL SUPPORT BASE AND TIE BEAMS
INSTALL INCLINED PLATES, TRUSSES & ALIGN 1 CREW
ASSEMBLE BARREL ERECTION FRAME & TEMP SUPPORT 1 CREW
BRIDGE INSTALLATION & REMOVAL
MUON STEEL BARREL
CONSTRUCT MUON STEEL BARREL - 2 CREWS
COILS INSTALLATION
PHASE 1 MUON CHAMBER INSTALLATION
PHASE 2 MUON CHAMBER INSTALLATION
INTERMEDIATE MUON CHAMBER INSTALLATION
CHAMBER GAS, CHW, CABLE TRAY PREP AND
MUON CHAMBER GUIDES INSTALLATION WORK
MUON STEEL TOROIDS
CONSTRUCT END TOROIDS - 1 CREW
INSTALL COILS ON TOROIDS
INSTALL END TOROID MUON CHAMBERS, CERENKOV COUNTER
MOVE IN TOROIDS
FINAL CABLING AND SYSTEM CHECKOUT
ASSEMBLE ABSORBERS ON END TOROIDS
CALORIMETER ASSEMBLY
BARREL CALORIMETERS:
LOWER CALORIMETER SUPPORT & INSTALL
PHASE 1 CENTRAL CALORIMETER ASSEMBLY
PHASE 2 CENTRAL CALORIMETER ASSEMBLY
CENTRAL CALORIMETER CHECK-OUT
LOWER CENTRAL CALORIMETER INTO HALL
INITIAL CALORIMETER INSTALLATION WORK
REMAINING CALORIMETER INSTALLATION WORK
ENDCAP CALORIMETERS:
PHASE 1 END CALORIMETER ASSEMBLY
PHASE 2 END CALORIMETER ASSEMBLY
ENDCAP CALORIMETER CHECK-OUT
LOWER ENDCAP CALORIMETERS INTO HALL
ROLL IN ENDCAPS (PHASE 1 INSTALLATION)
ENDCAP CALORIMETER INSTALLATION PHASE 2
ROLL OUT ENDCAPS
ROLL IN ENDCAPS
FORWARD CALORIMETERS:
FORWARD CALORIMETER ASSEMBLY
FORWARD CALORIMETER CHECK-OUT
LOWER FORWARD CALORIMETERS INTO HALL
INSTALL FORWARD CALORIMETERS IN END TOROIDS
COIL & TRACKING
SOLENOID INSTALLATION AND UTILITY HOOK-UP
SOLENOID SYSTEM COOLDOWN AND TEST
FIELD MAPPING
INSTALL CENTRAL TRACKING SYSTEM
INSTALL SI TRACKING SYSTEM
INSTALL INTERMEDIATE TRACKING SYSTEM IN
CALORIMETER
BEAM PIPE INSTALLATION
ACCELERATOR
ACCELERATOR COMPONENT INSTALLATION
ACCELERATOR COMMISSIONING
FINAL CHECKS AND REPAIRS
COSMIC RAY TESTING OF ALL SUBSYSTEMS
BARREL STEEL COMPLETE
PHASE 1 CHAMBERS INSTALLED
BARREL CAL INITIAL INSTALLATION COMPLETE
PHASE 1 ENDCAP INSTALLED
SOLENOID COIL INSTALLATION COMPLETE
FIELD MAPPING COMPLETE
CENTRAL TRACKER INSTALLED
END TOROIDS INSTALLED
ACCELERATOR COMPONENTS INSTALLED
DETECTOR TURN-ON
(C) KAISER ENGINEERS 10-1-81
SCHEDULE5B.DBN

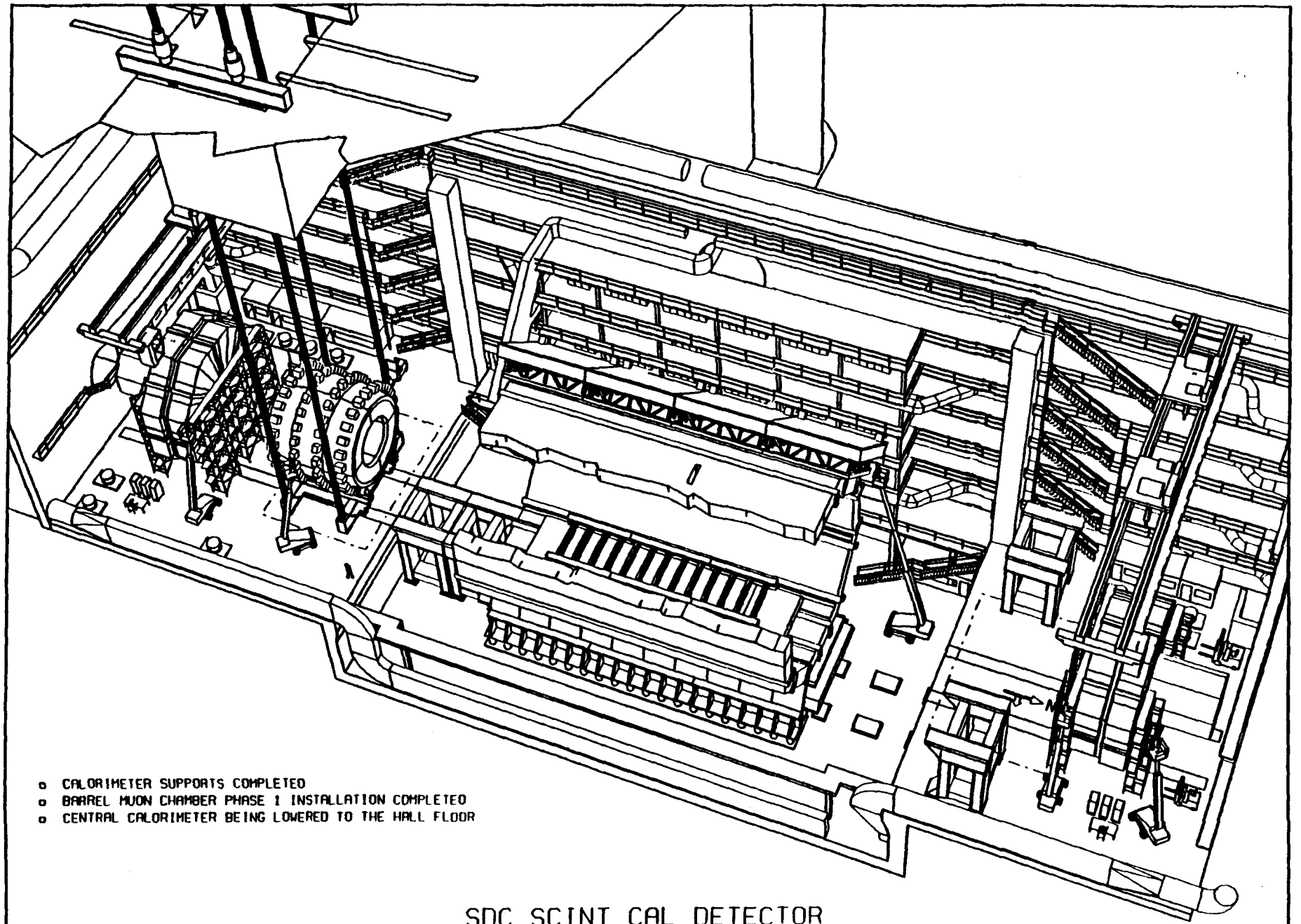


ICF KAISER ENGINEERS 9-25-91 MODEL 523M0045.DGN 4505.hln


SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 7
ICF KAISER ENGINEERS 9-25-91 MODEL 523M0045.DGN 4507.hln


SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 8
ICF KAISER ENGINEERS 9-26-91 MODEL 523M0045.DGN
HLN


SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 9
ICF KAISER ENGINEERS 9-25-91 MODEL 523M0045.DGN 4509.hln



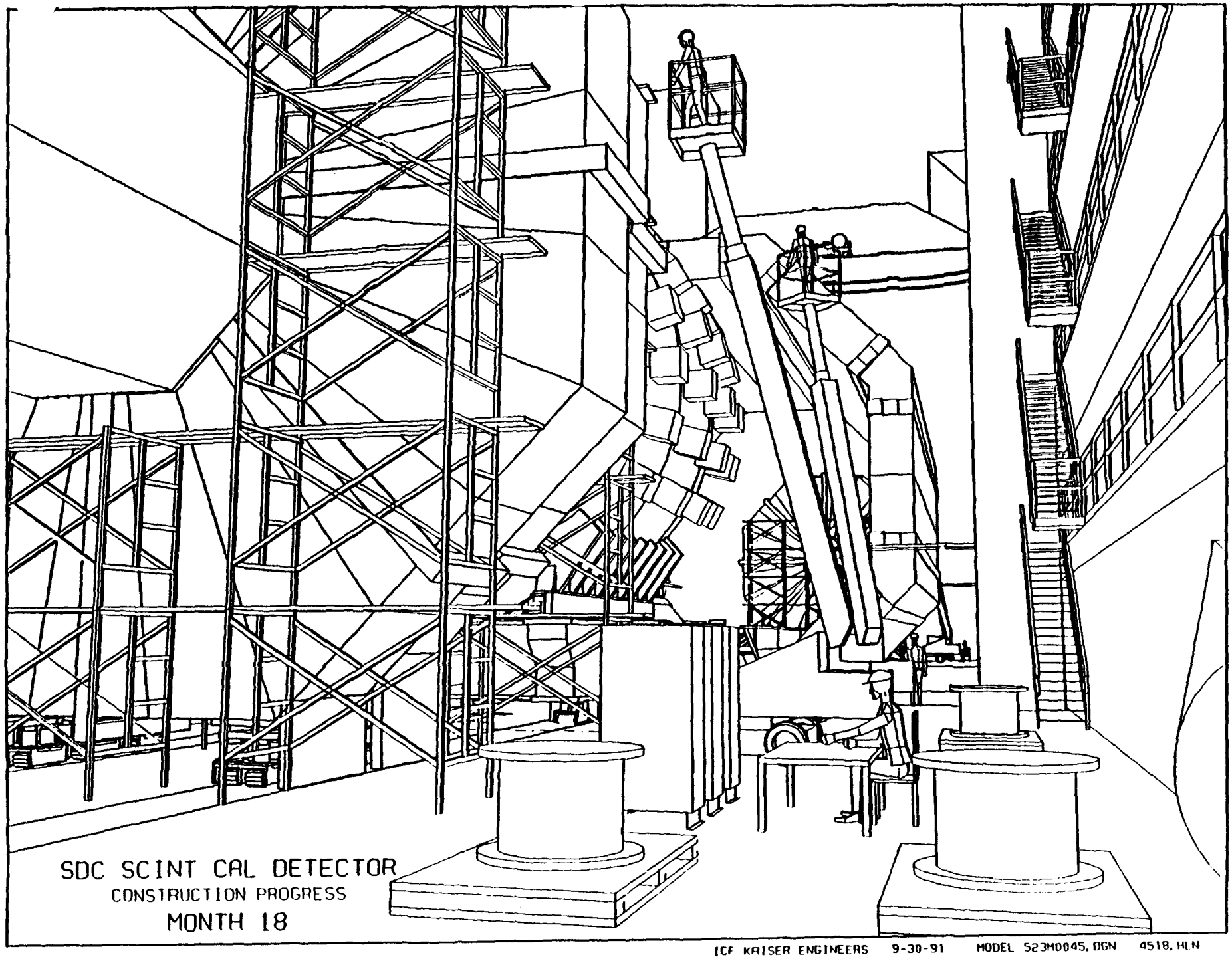
- CALORIMETER SUPPORTS COMPLETED
- BARREL MUON CHAMBER PHASE 1 INSTALLATION COMPLETED
- CENTRAL CALORIMETER BEING LOWERED TO THE HALL FLOOR

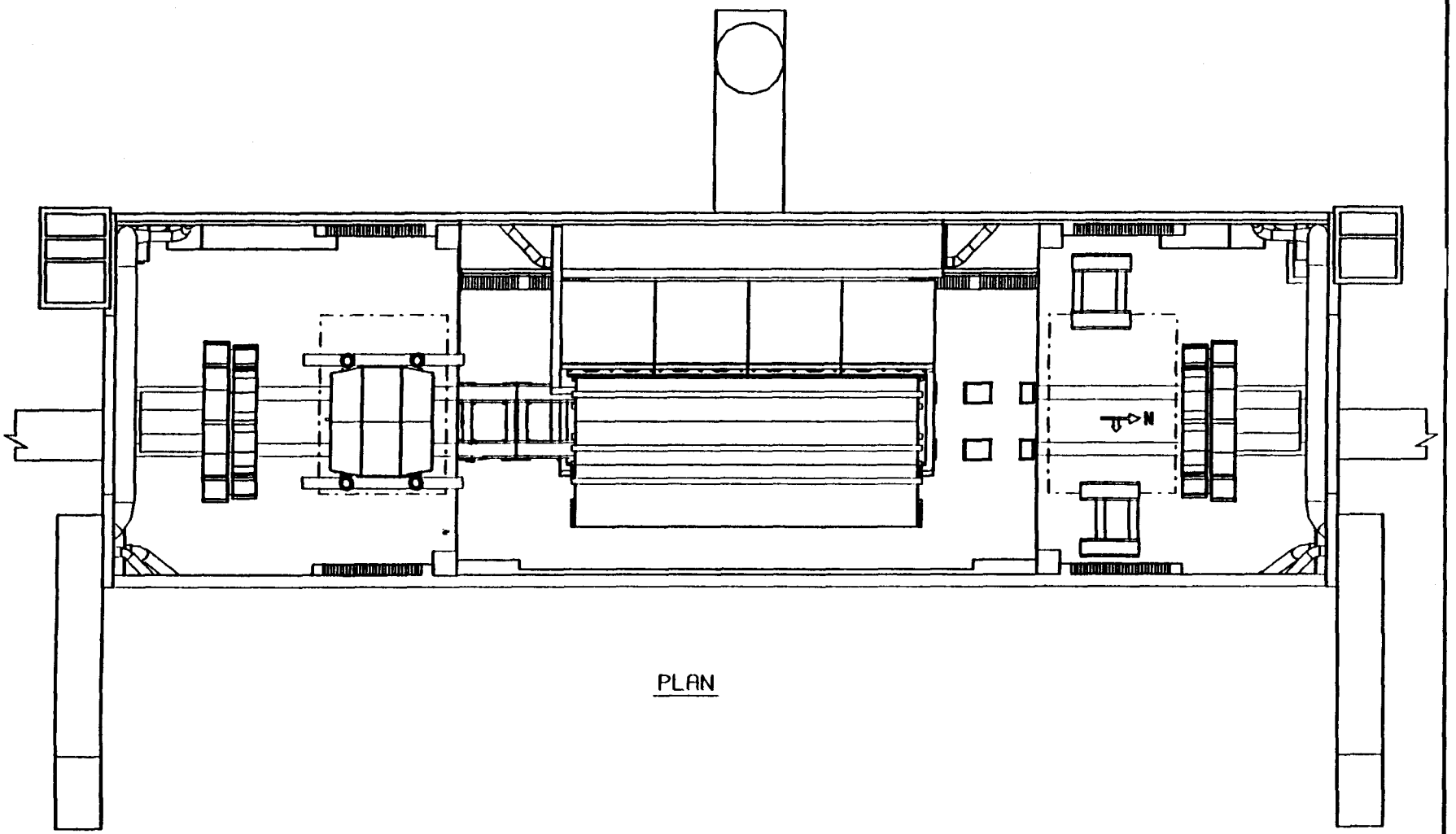
SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 18

ICF KAISER ENGINEERS 9-24-91 MODEL 523M0045.DGN

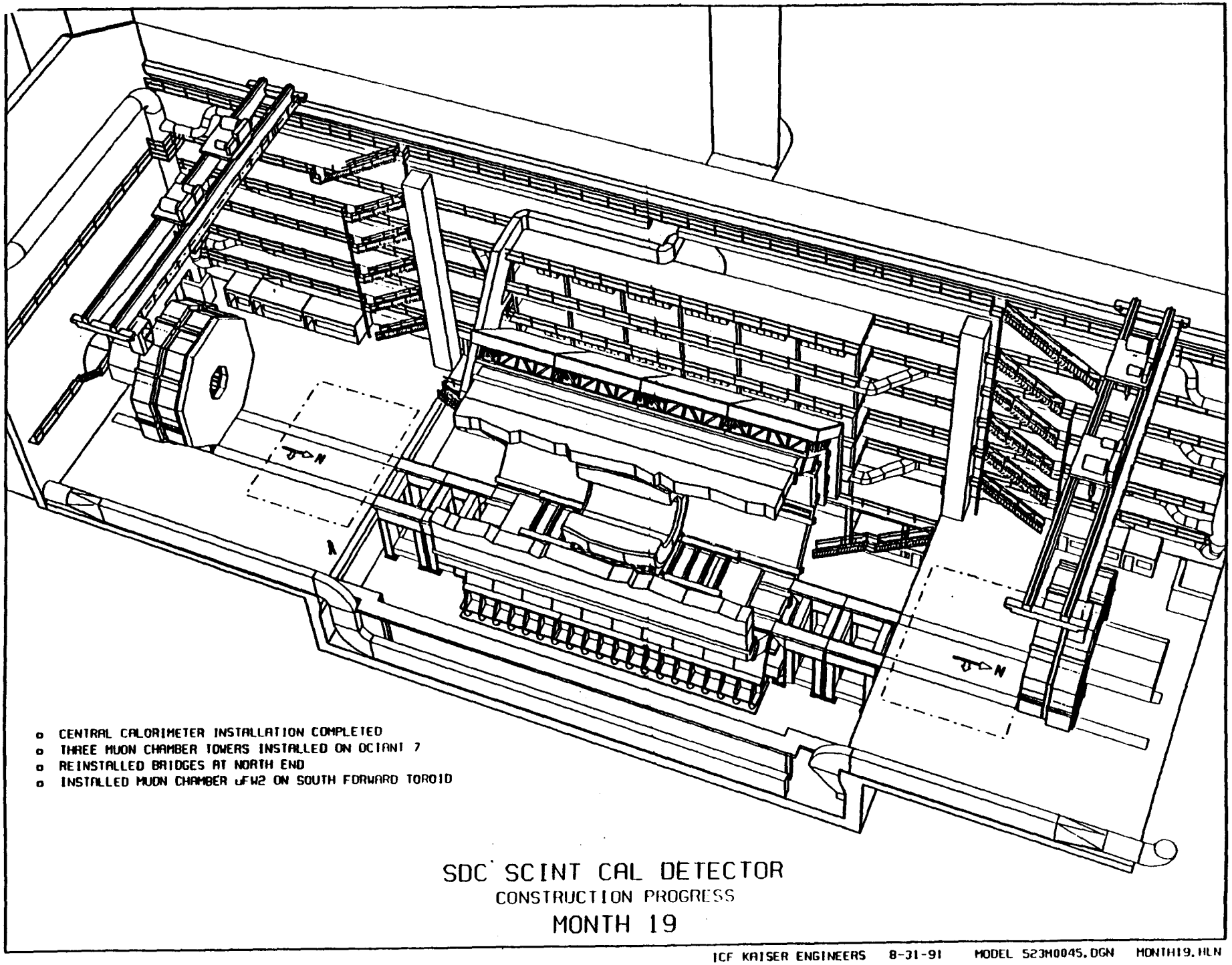

SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 18
ICF KAISER ENGINEERS 9-30-91 MODEL 523M0045.DGN 4518.HLN



PLAN

SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 18

ICF KAISER ENGINEERS 9-19-91 523 118



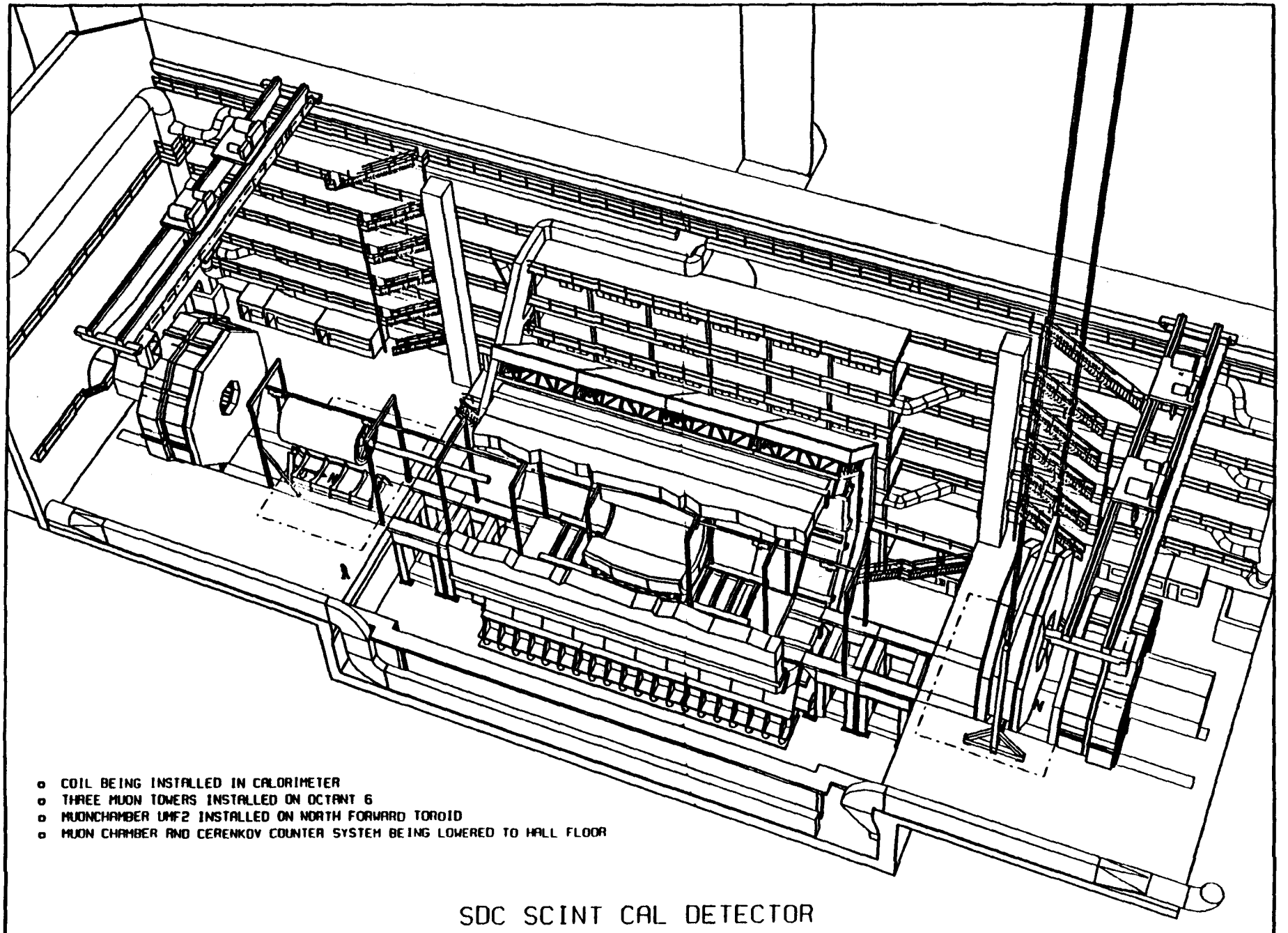
- CENTRAL CALORIMETER INSTALLATION COMPLETED
- THREE MUON CHAMBER TOWERS INSTALLED ON OCTANT 7
- REINSTALLED BRIDGES AT NORTH END
- INSTALLED MUON CHAMBER uFW2 ON SOUTH FORWARD TOROID

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 19

ICF KAISER ENGINEERS 8-31-91 MODEL 523M0045.DGN MONTH19.HLN



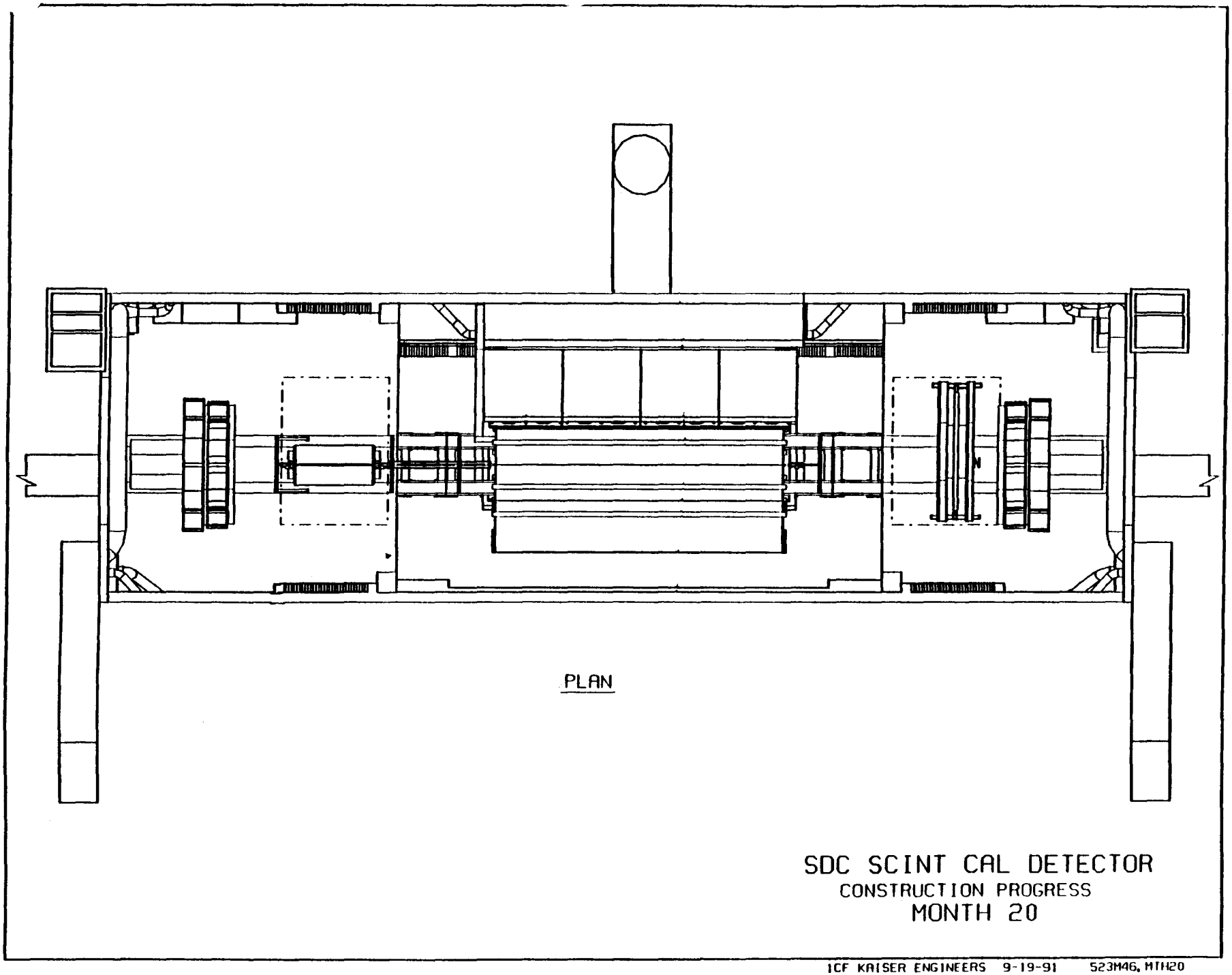
- COIL BEING INSTALLED IN CALORIMETER
- THREE MUON TOWERS INSTALLED ON OCTANT 6
- MUONCHAMBER UMF2 INSTALLED ON NORTH FORWARD TOROID
- MUON CHAMBER AND CERENKOV COUNTER SYSTEM BEING LOWERED TO HALL FLOOR

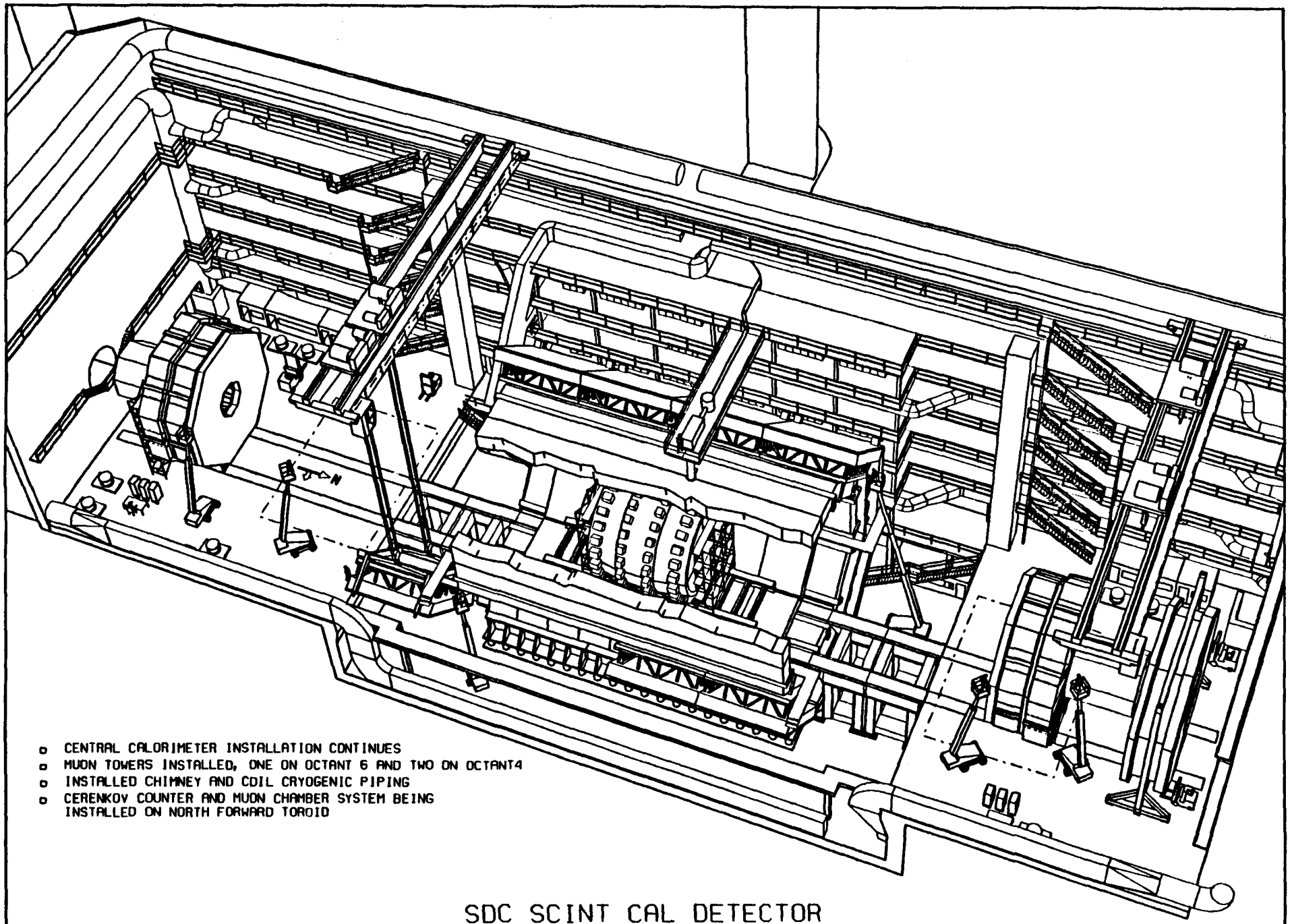
SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 20

ICF KAISER ENGINEERS 9-3-91 MODEL 523M0045.DGN ...TH20.HLN


PLAN
SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 20
ICF KAISER ENGINEERS 9-19-91 523M46, MTH20



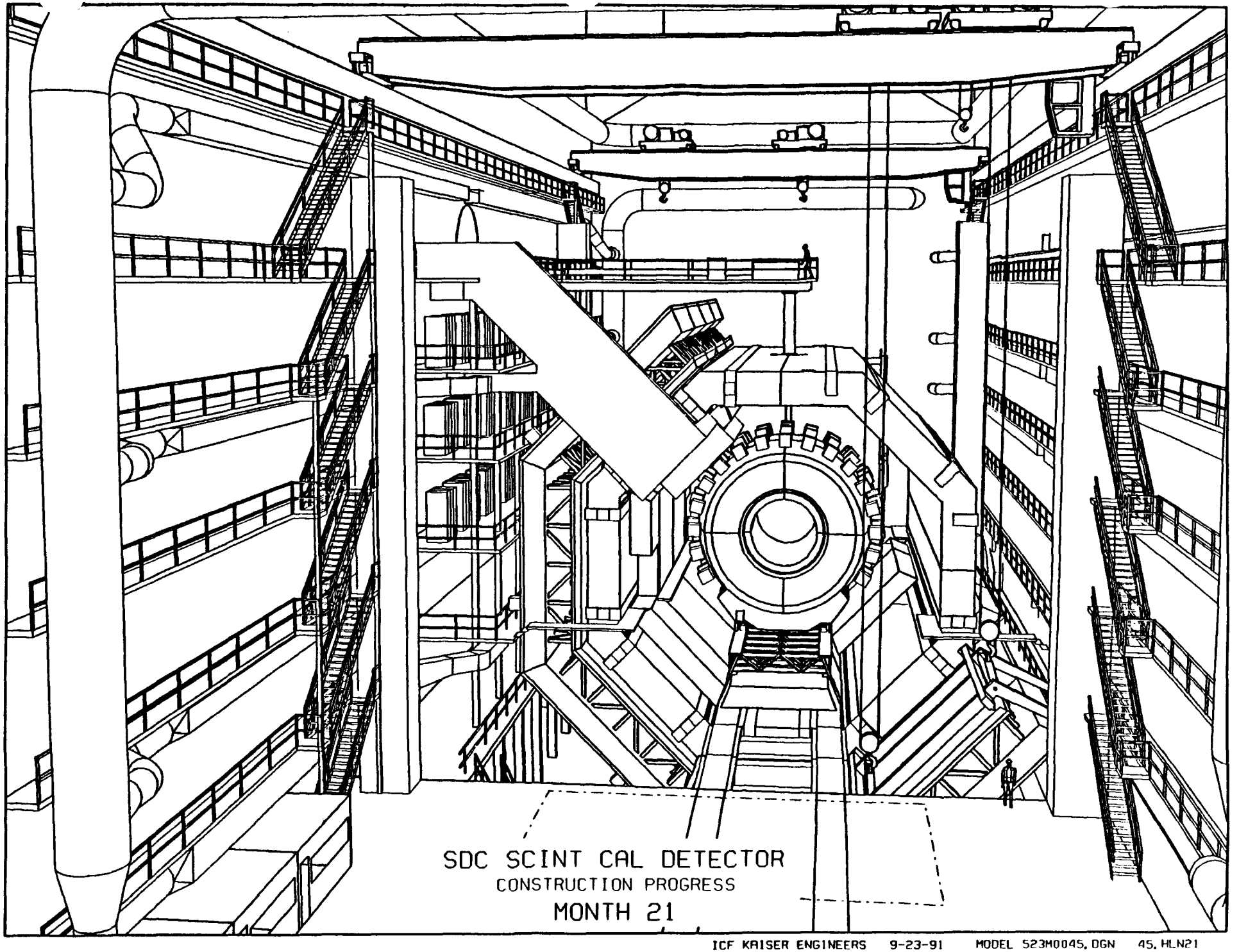
- CENTRAL CALORIMETER INSTALLATION CONTINUES
- MUON TOWERS INSTALLED, ONE ON OCTANT 6 AND TWO ON OCTANT4
- INSTALLED CHIMNEY AND COIL CRYOGENIC PIPING
- CERENKOV COUNTER AND MUON CHAMBER SYSTEM BEING INSTALLED ON NORTH FORWARD TOROID

SDC SCINT CAL DETECTOR

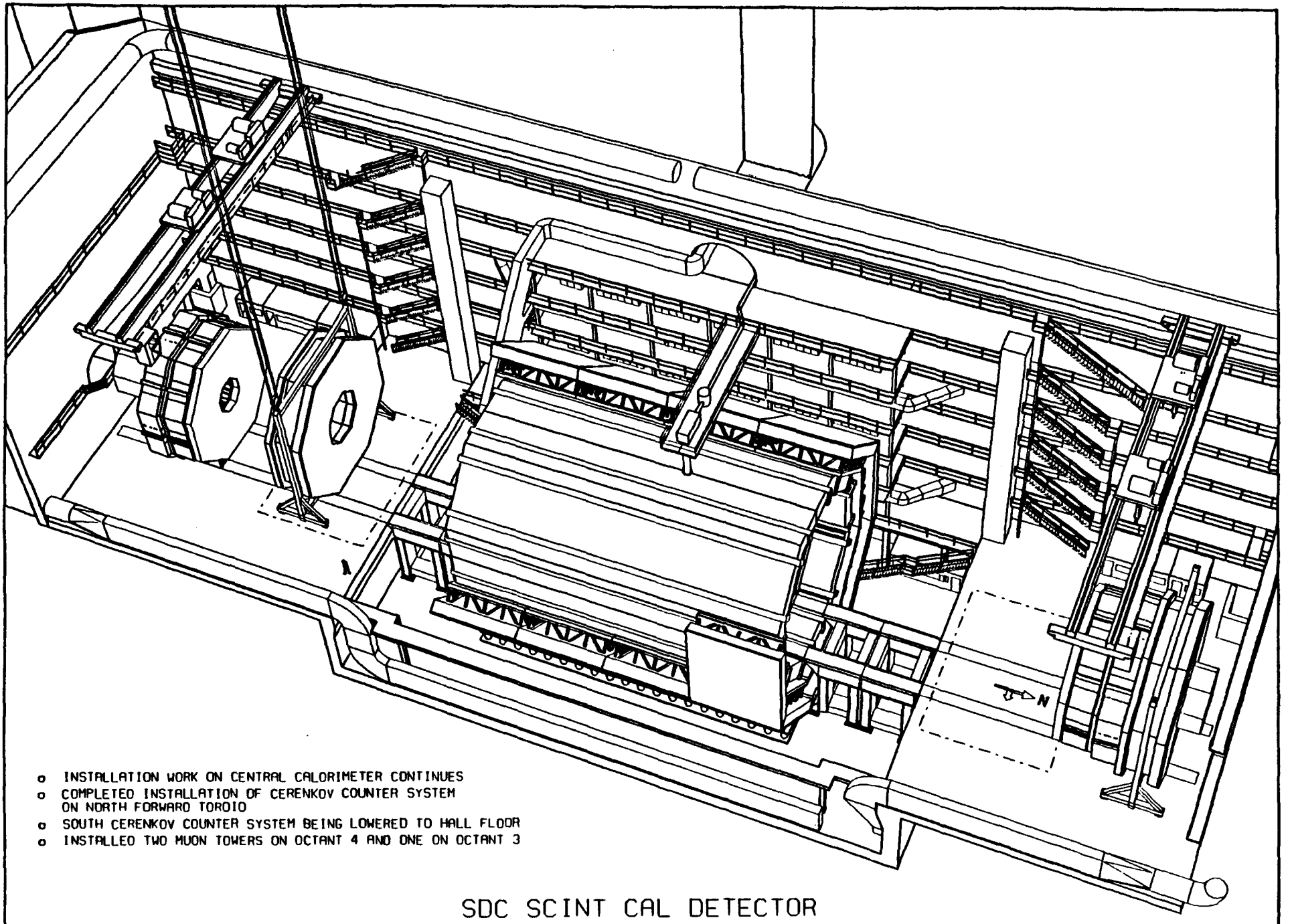
CONSTRUCTION PROGRESS

MO 21

ICF KAISER ENGINEERS 9-27-91 MODEL 523M0045.DGN 10NTH21.HLN



ICF KAISER ENGINEERS 9-23-91 MODEL 523M0045.DGN 45.HLN21



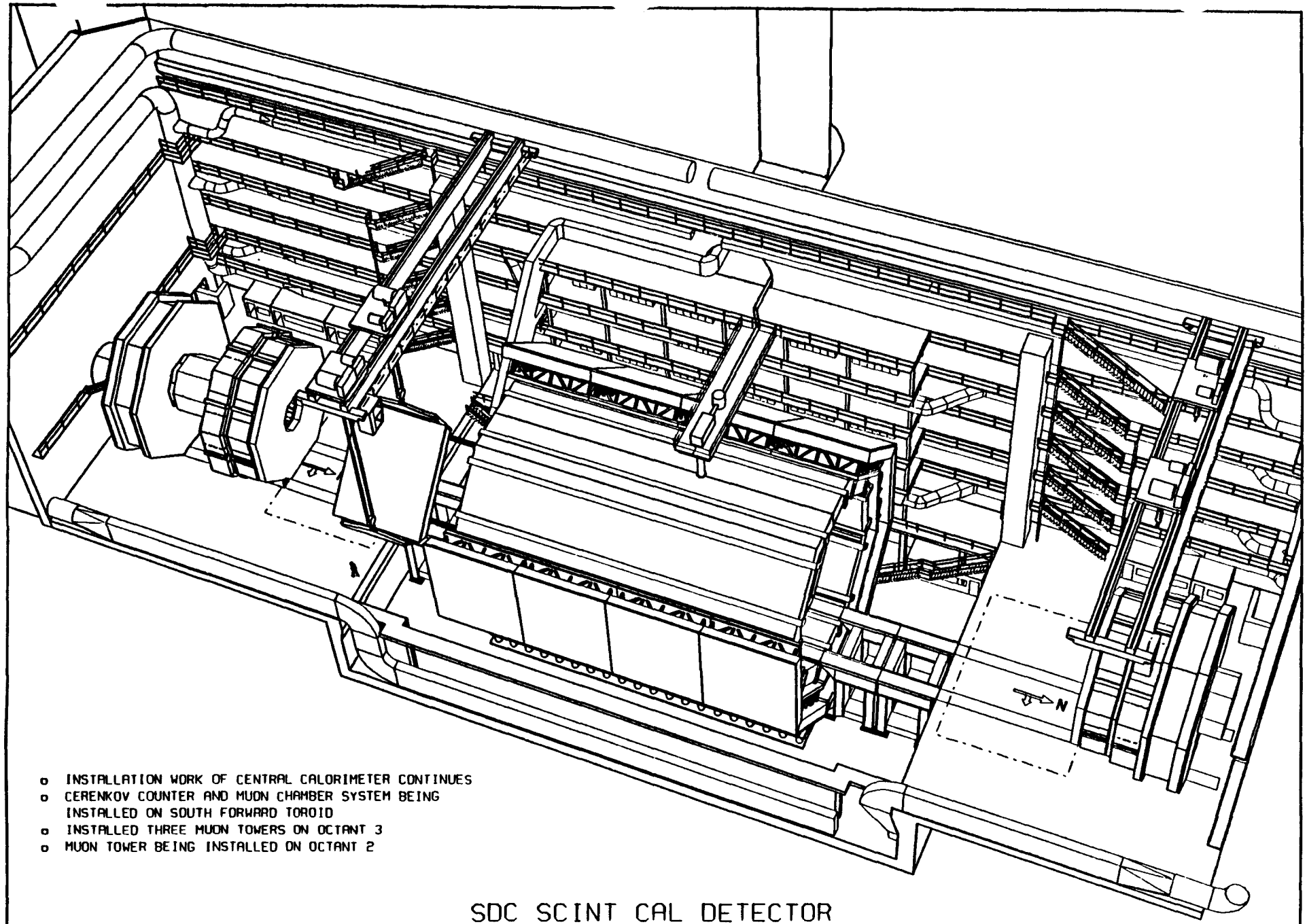
- INSTALLATION WORK ON CENTRAL CALORIMETER CONTINUES
- COMPLETED INSTALLATION OF CERENKOV COUNTER SYSTEM ON NORTH FORWARD TOROID
- SOUTH CERENKOV COUNTER SYSTEM BEING LOWERED TO HALL FLOOR
- INSTALLED TWO MUON TOWERS ON OCTANT 4 AND ONE ON OCTANT 3

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

M(1 22

ICF KAISER ENGINEERS 9-6-91 MODEL 523M0045.DC' ONTH22.HLN



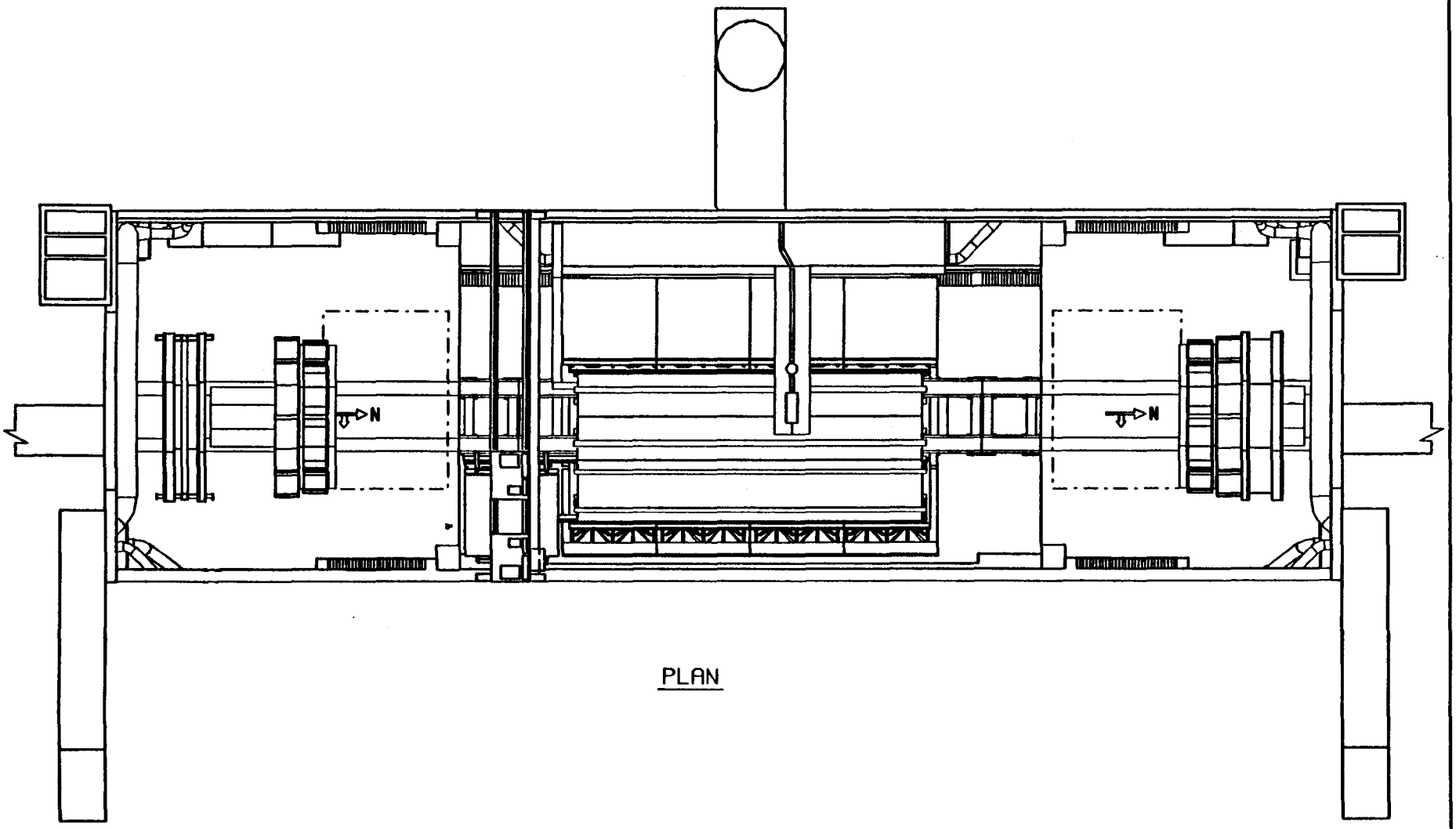
- INSTALLATION WORK OF CENTRAL CALORIMETER CONTINUES
- CERENKOV COUNTER AND MUON CHAMBER SYSTEM BEING INSTALLED ON SOUTH FORWARD TOROID
- INSTALLED THREE MUON TOWERS ON OCTANT 3
- MUON TOWER BEING INSTALLED ON OCTANT 2

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

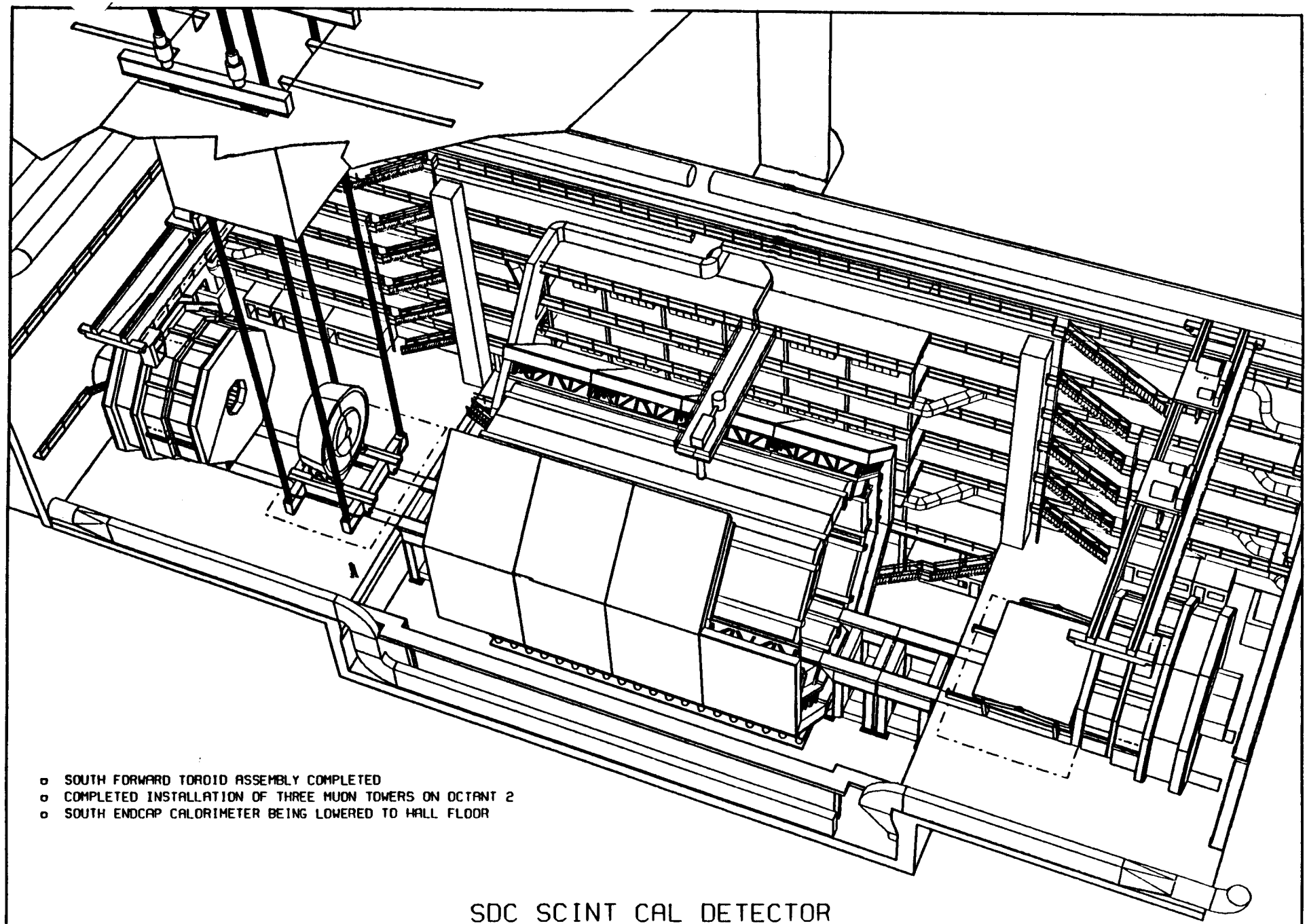
MONTH 23

ICF KAISER ENGINEERS 9-6-91 MODEL 523M0045.DGN MONTH23.HLN



PLAN

SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 23



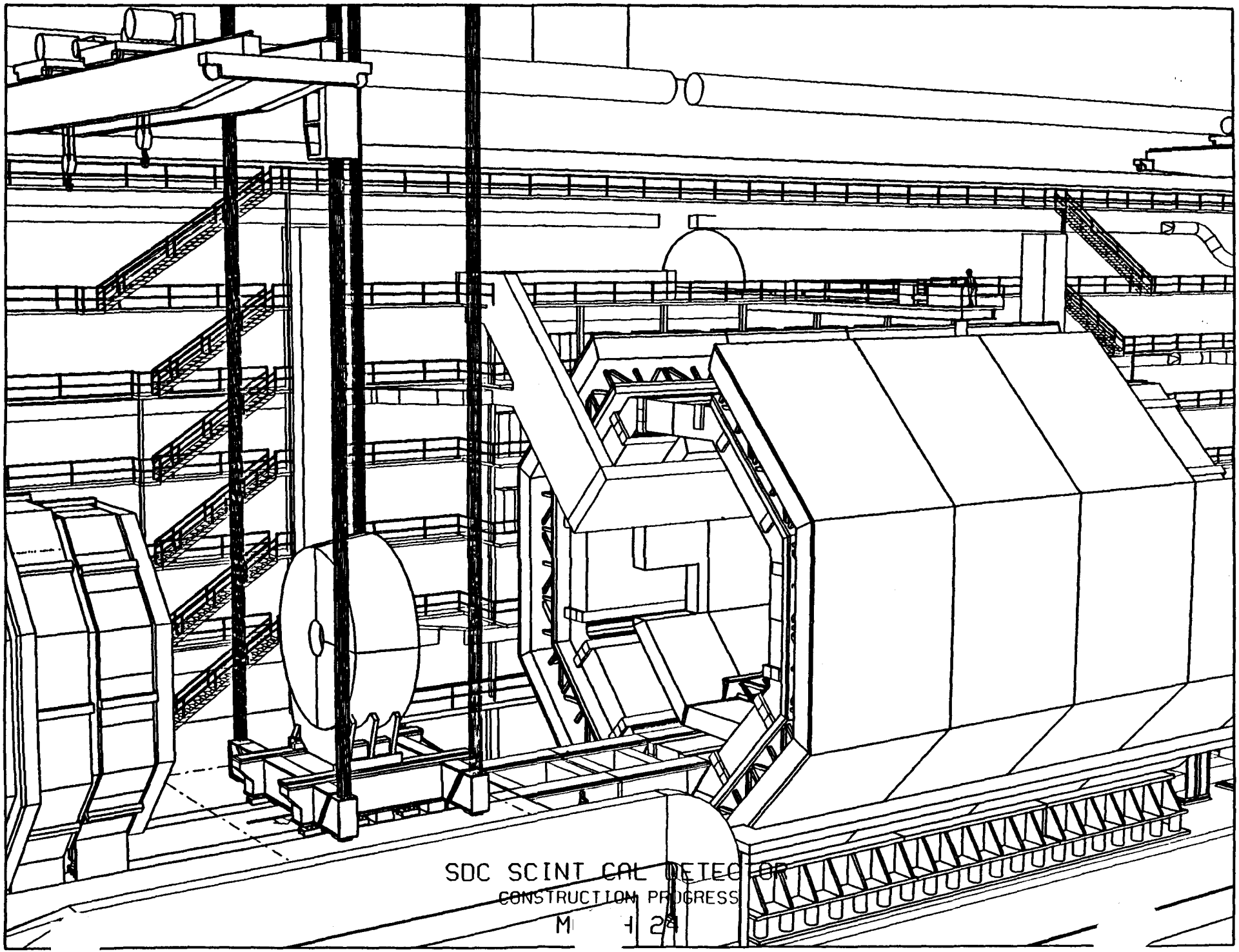
- SOUTH FORWARD TOROID ASSEMBLY COMPLETED
- COMPLETED INSTALLATION OF THREE MUON TOWERS ON OCTANT 2
- SOUTH ENDCAP CALORIMETER BEING LOWERED TO HALL FLOOR

SDC SCINT CAL DETECTOR

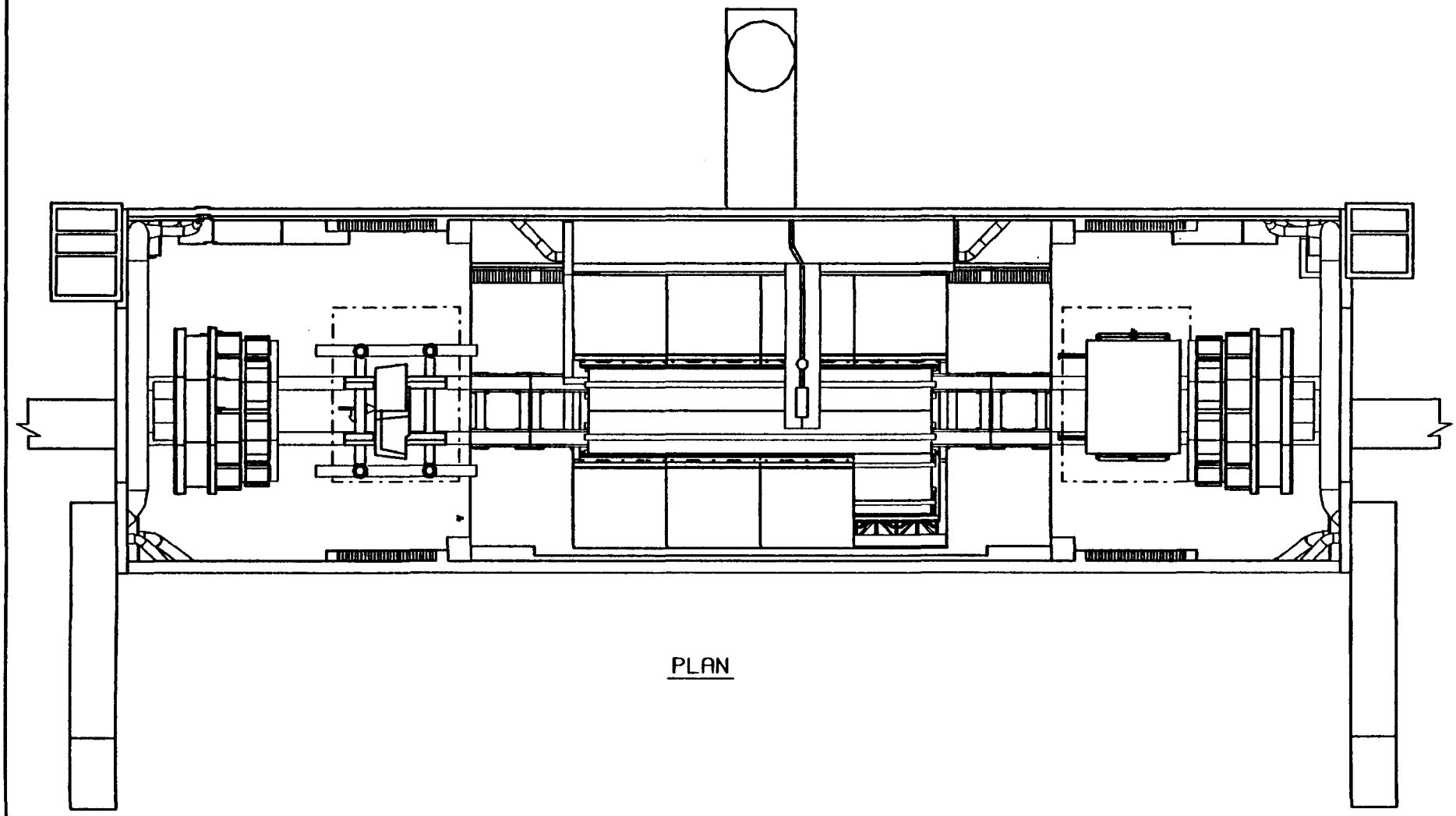
CONSTRUCTION PROGRESS

MONTH 24

ICF KAISER ENGINEERS 9-6-91 MODEL 523M0045.DGN MONTH24.HLN



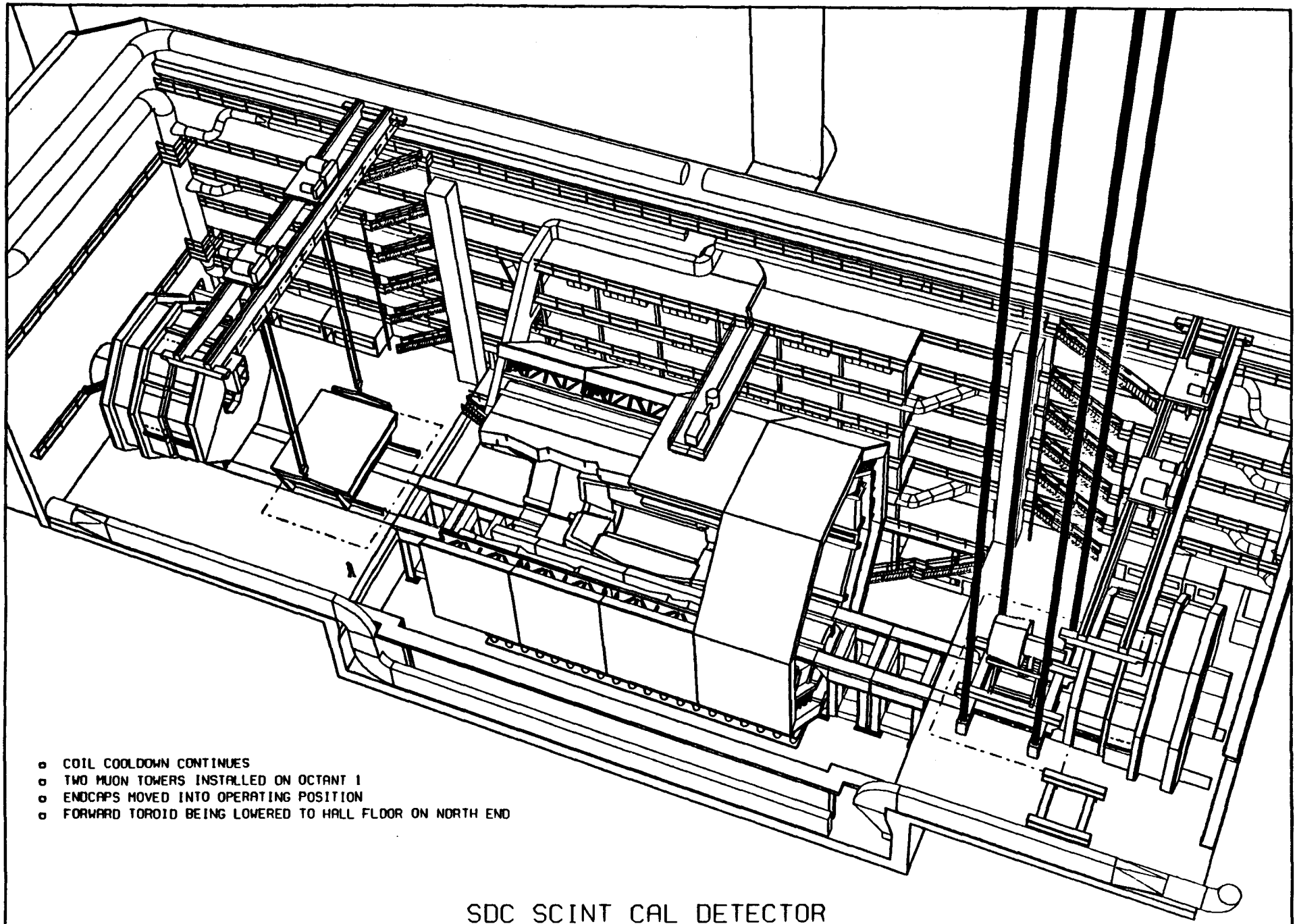
ICF KAISER ENGINEERS 9-19-91 MODEL 523M0045. 45.h124



PLAN

SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 24

ICF KAISER ENGINEERS 9-19-91 523M46.MTH24



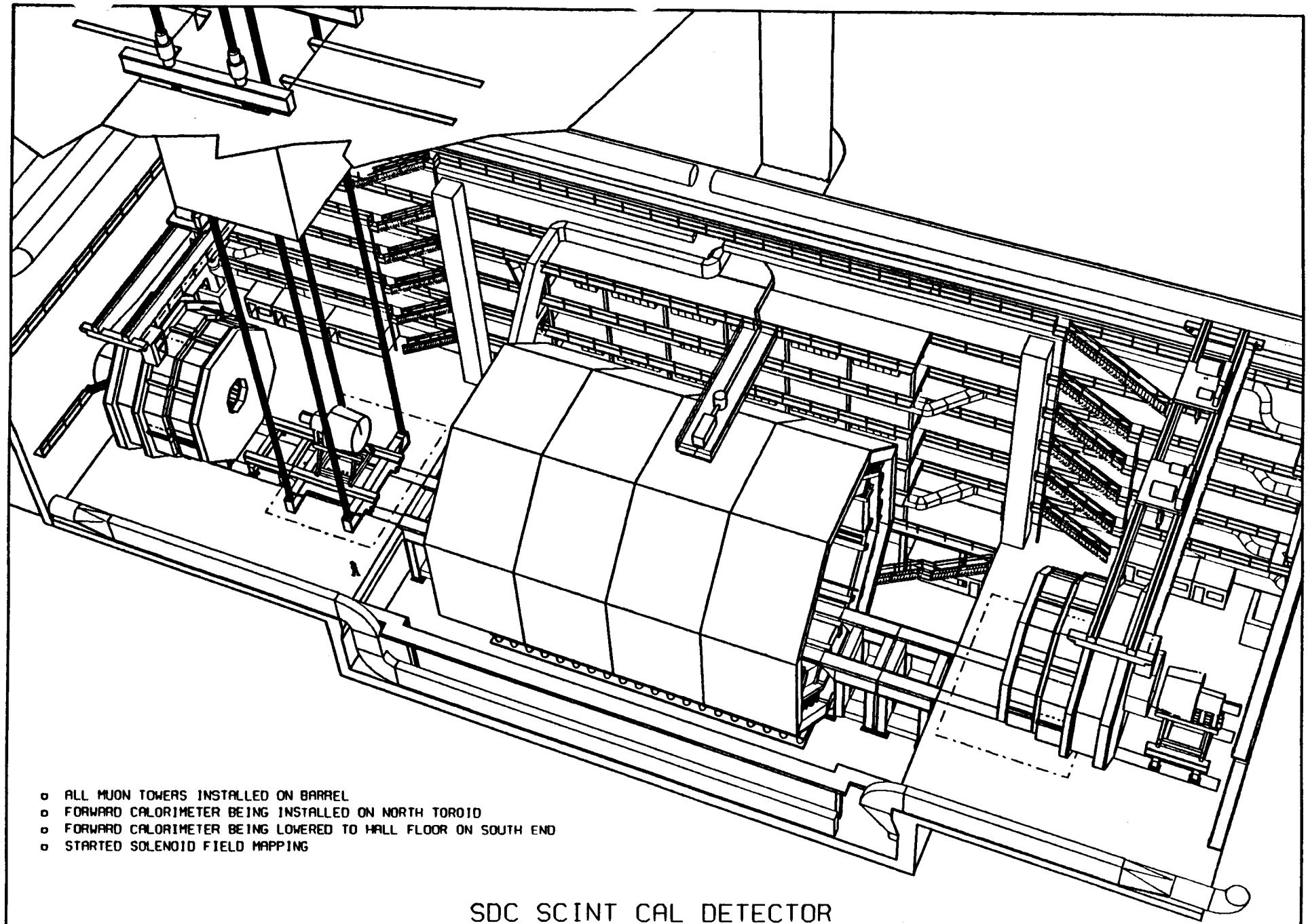
- COIL COOLDOWN CONTINUES
- TWO MUON TOWERS INSTALLED ON OCTANT 1
- ENDCAPS MOVED INTO OPERATING POSITION
- FORWARD TOROID BEING LOWERED TO HALL FLOOR ON NORTH END

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MC 25

ICF KAISER ENGINEERS 9-17-91 MODEL 523M0045.DG MONTH25.HLN



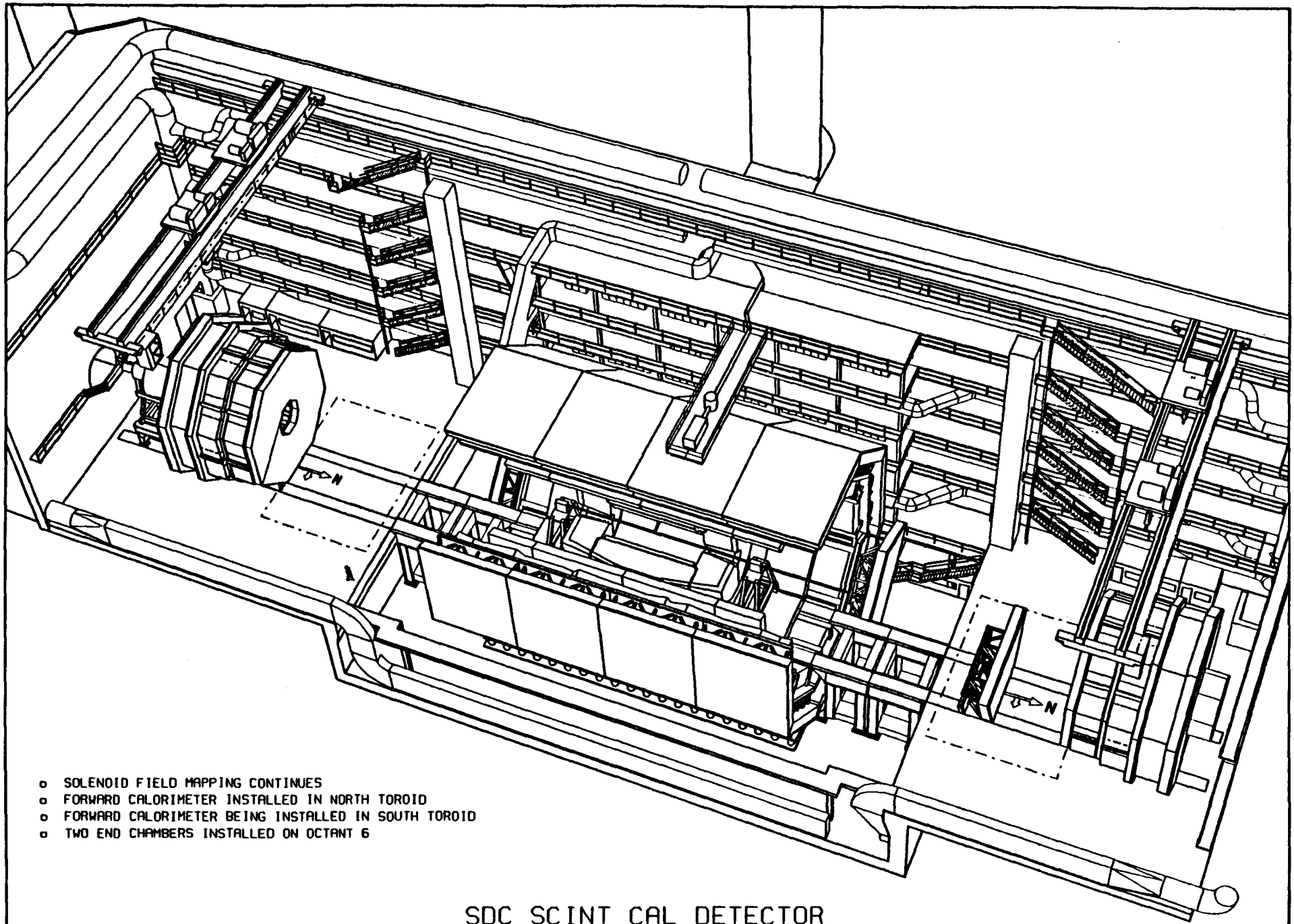
- ALL MUON TOWERS INSTALLED ON BARREL
- FORWARD CALORIMETER BEING INSTALLED ON NORTH TOROID
- FORWARD CALORIMETER BEING LOWERED TO HALL FLOOR ON SOUTH END
- STARTED SOLENOID FIELD MAPPING

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 26

ICF KAISER ENGINEERS 9-17-91 MODEL 523M0045.DGN MONTH26.HLN

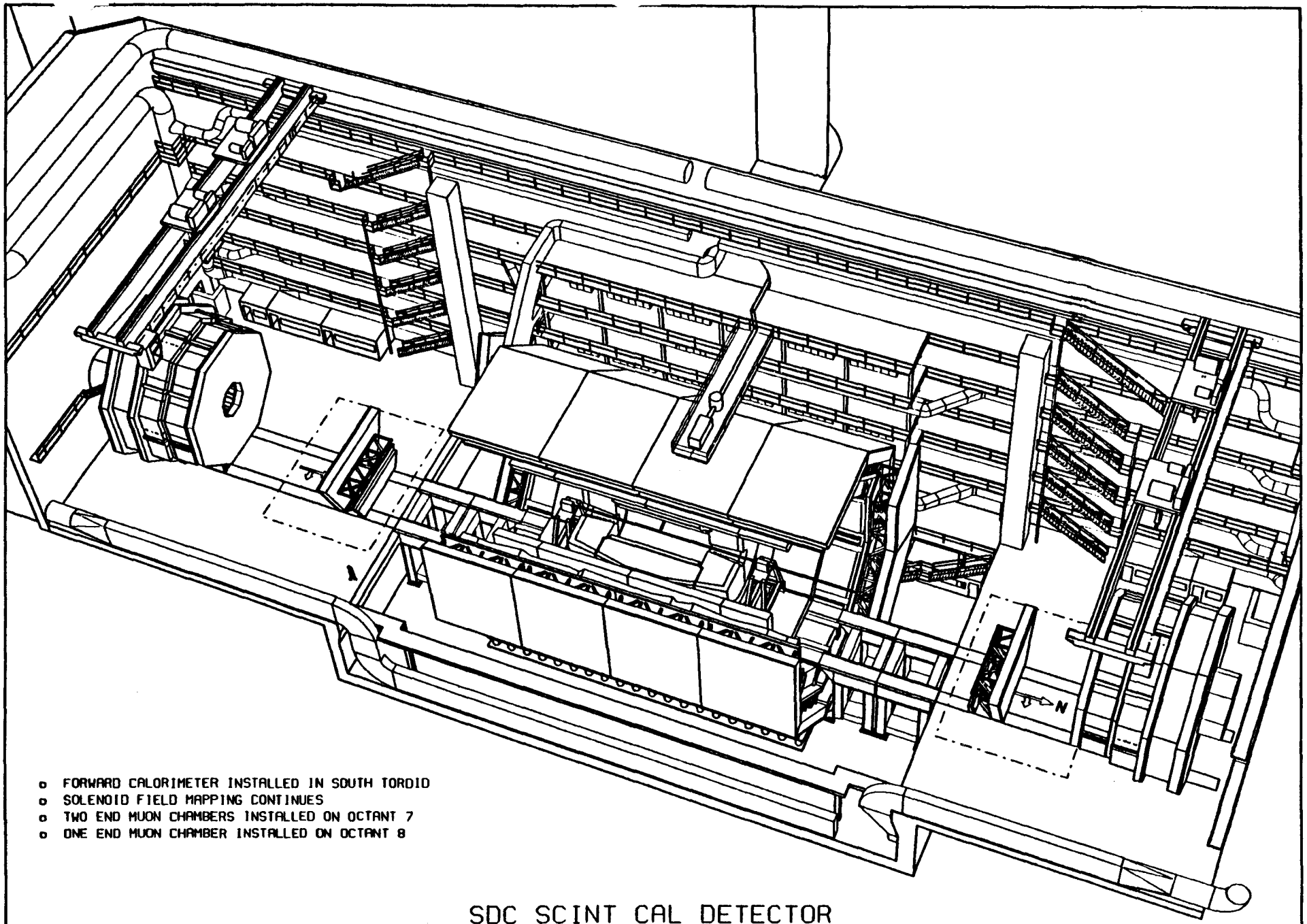


- SOLENOID FIELD MAPPING CONTINUES
- FORWARD CALORIMETER INSTALLED IN NORTH TOROID
- FORWARD CALORIMETER BEING INSTALLED IN SOUTH TOROID
- TWO END CHAMBERS INSTALLED ON OCTANT 6

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MO 27



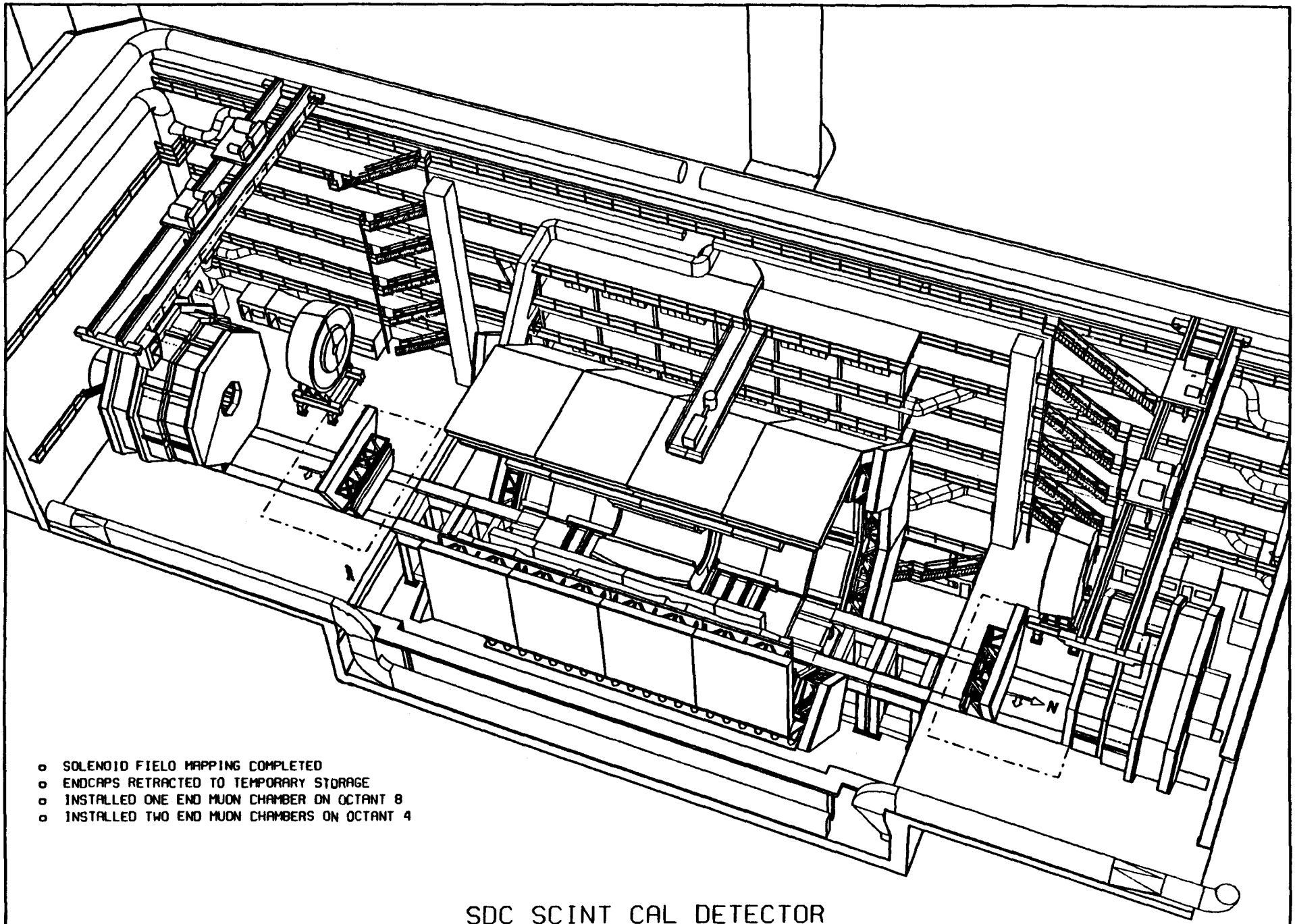
- FORWARD CALORIMETER INSTALLED IN SOUTH TORDID
- SOLENOID FIELD MAPPING CONTINUES
- TWO END MUON CHAMBERS INSTALLED ON OCTANT 7
- ONE END MUON CHAMBER INSTALLED ON OCTANT 8

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 28

ICF KAISER ENGINEERS 9-17-91 MODEL 523M0045.DGN MONTH28.HLN



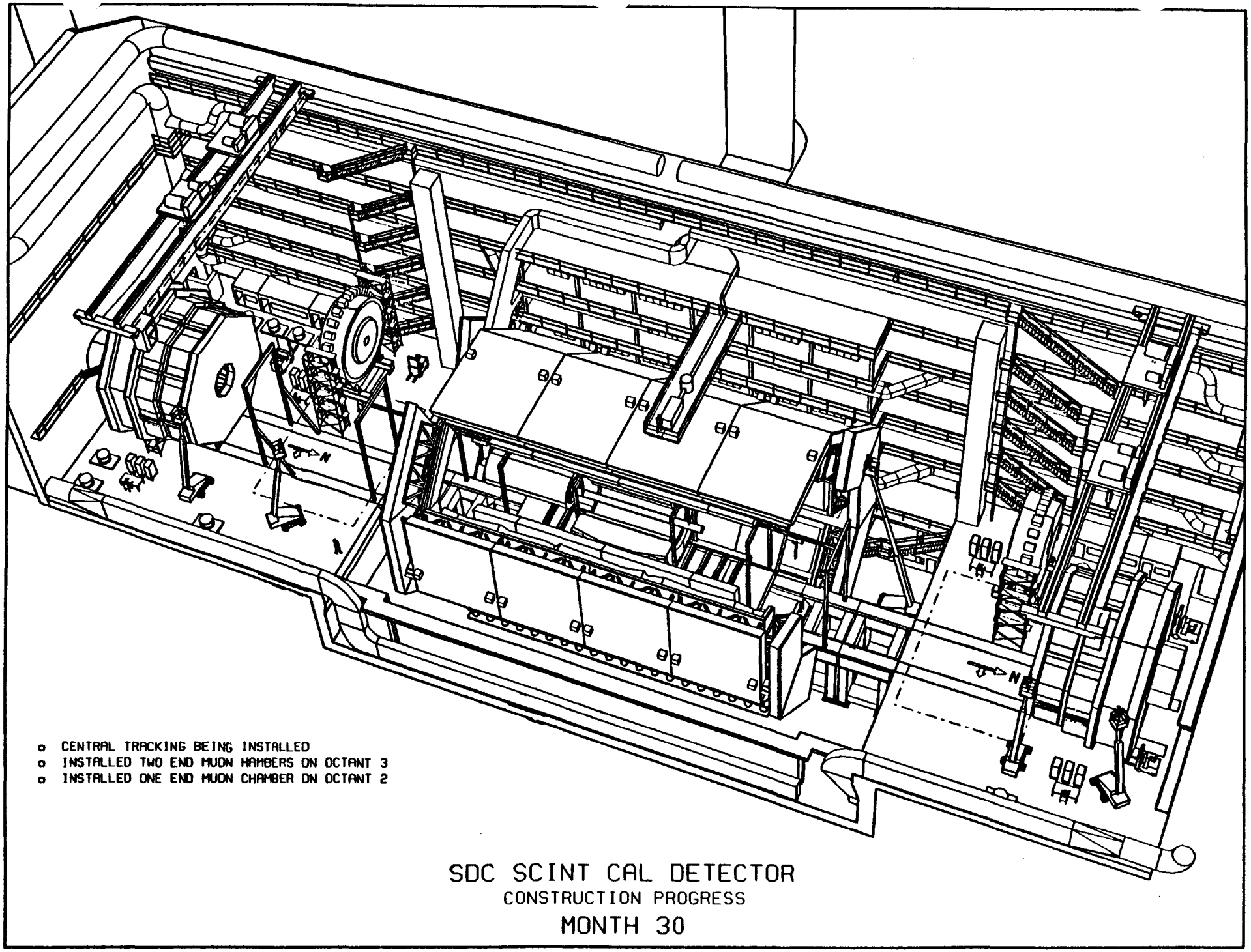
- SOLENOID FIELD MAPPING COMPLETED
- ENDCAPS RETRACTED TO TEMPORARY STORAGE
- INSTALLED ONE END MUON CHAMBER ON OCTANT 8
- INSTALLED TWO END MUON CHAMBERS ON OCTANT 4

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

M(1 29

ICF KAISER ENGINEERS 9-17-91 MODEL 523M0045.I MONTH29.HLN



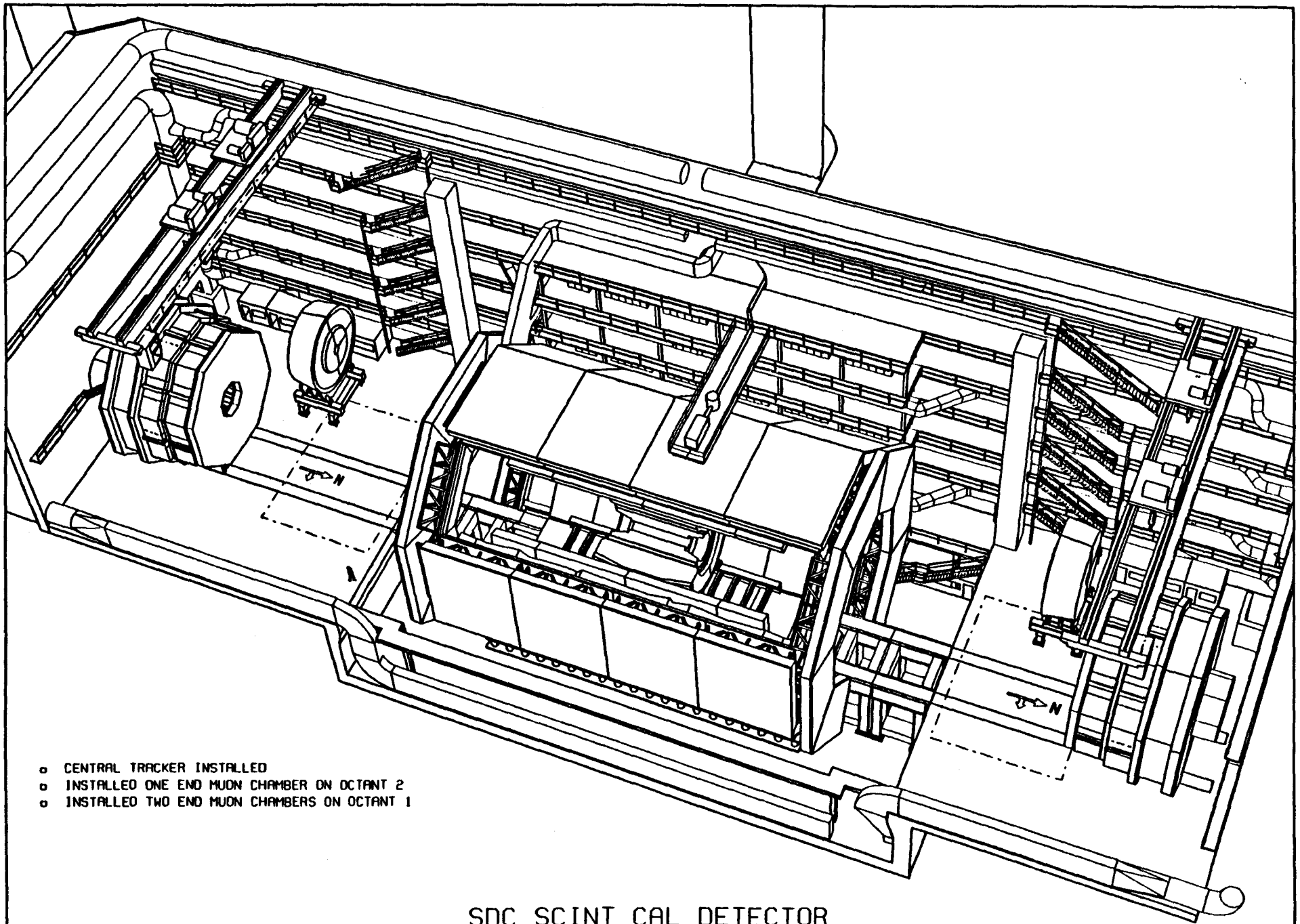
- CENTRAL TRACKING BEING INSTALLED
- INSTALLED TWO END MUON HAMBERS ON OCTANT 3
- INSTALLED ONE END MUON CHAMBER ON OCTANT 2

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 30

ICF KAISER ENGINEERS 9-30-91 MODEL 523M0045.DGN MONTH30.HLN



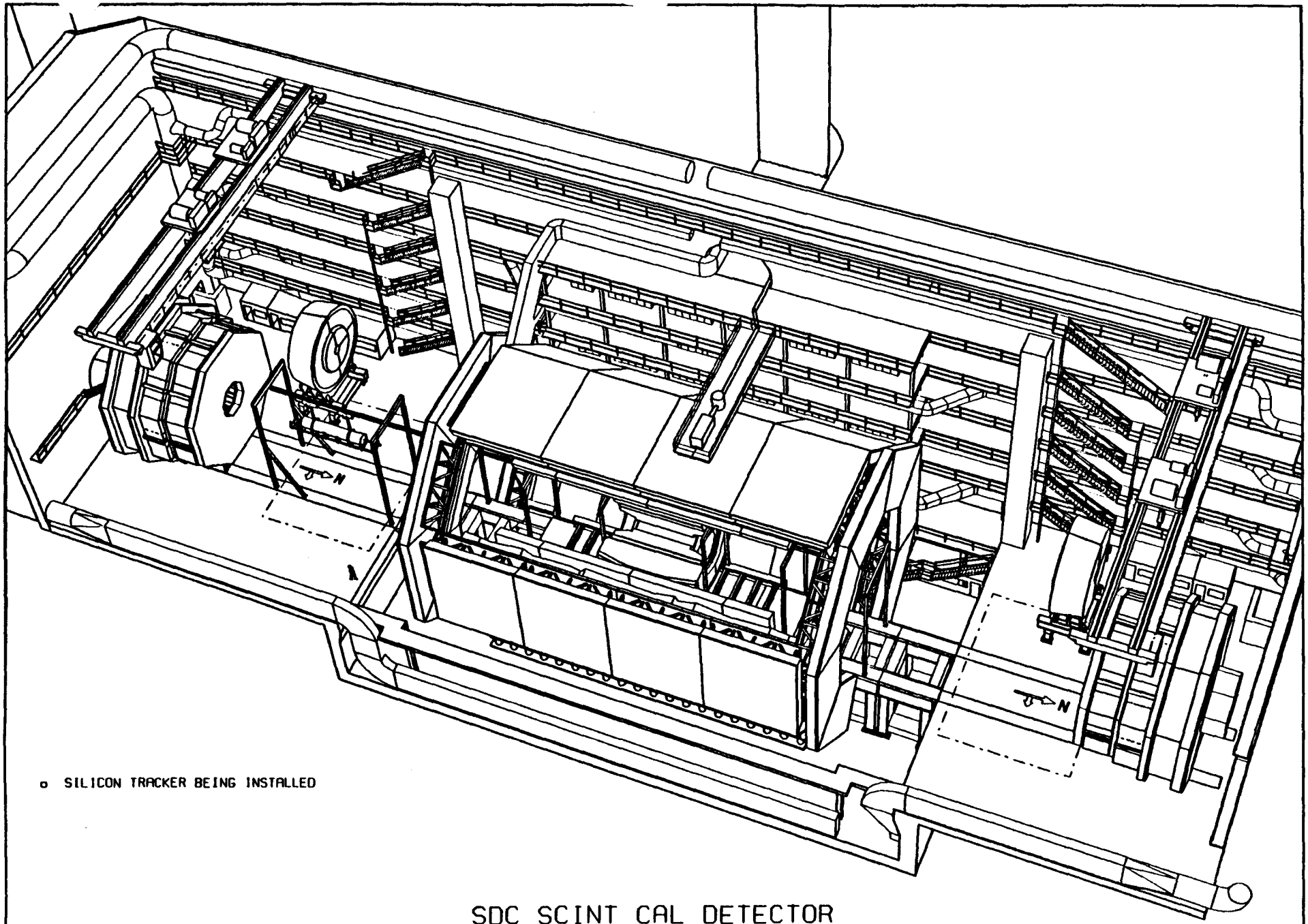
- CENTRAL TRACKER INSTALLED
- INSTALLED ONE END MUON CHAMBER ON OCTANT 2
- INSTALLED TWO END MUON CHAMBERS ON OCTANT 1

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MO ' 31

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045. (MONTH31.HIN)



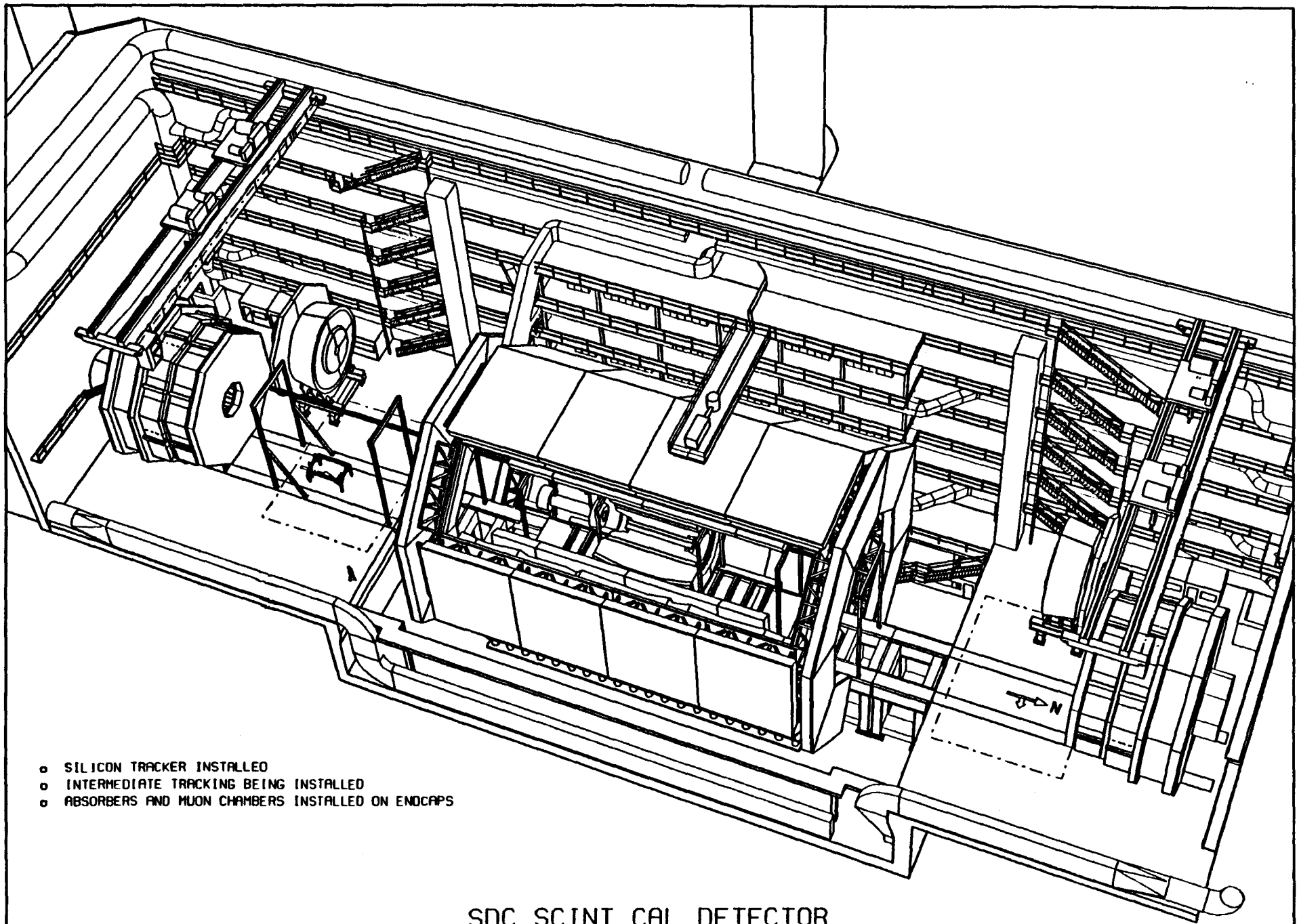
o SILICON TRACKER BEING INSTALLED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 32

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045.DGN MONTH32.HLN



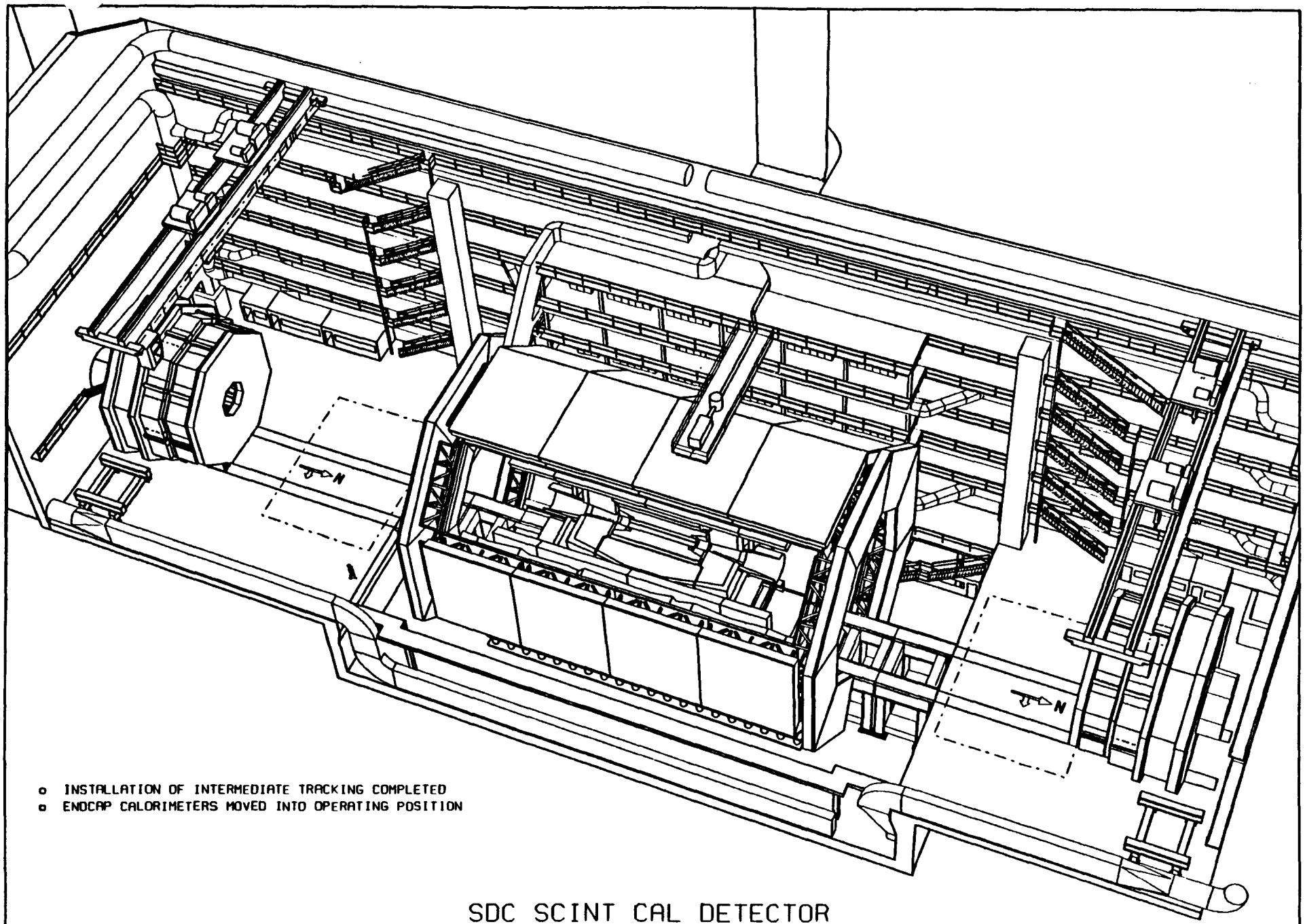
- SILICON TRACKER INSTALLED
- INTERMEDIATE TRACKING BEING INSTALLED
- ABSORBERS AND MUON CHAMBERS INSTALLED ON ENDCAPS

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MO 35

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045.DG 10NTM35.HLN



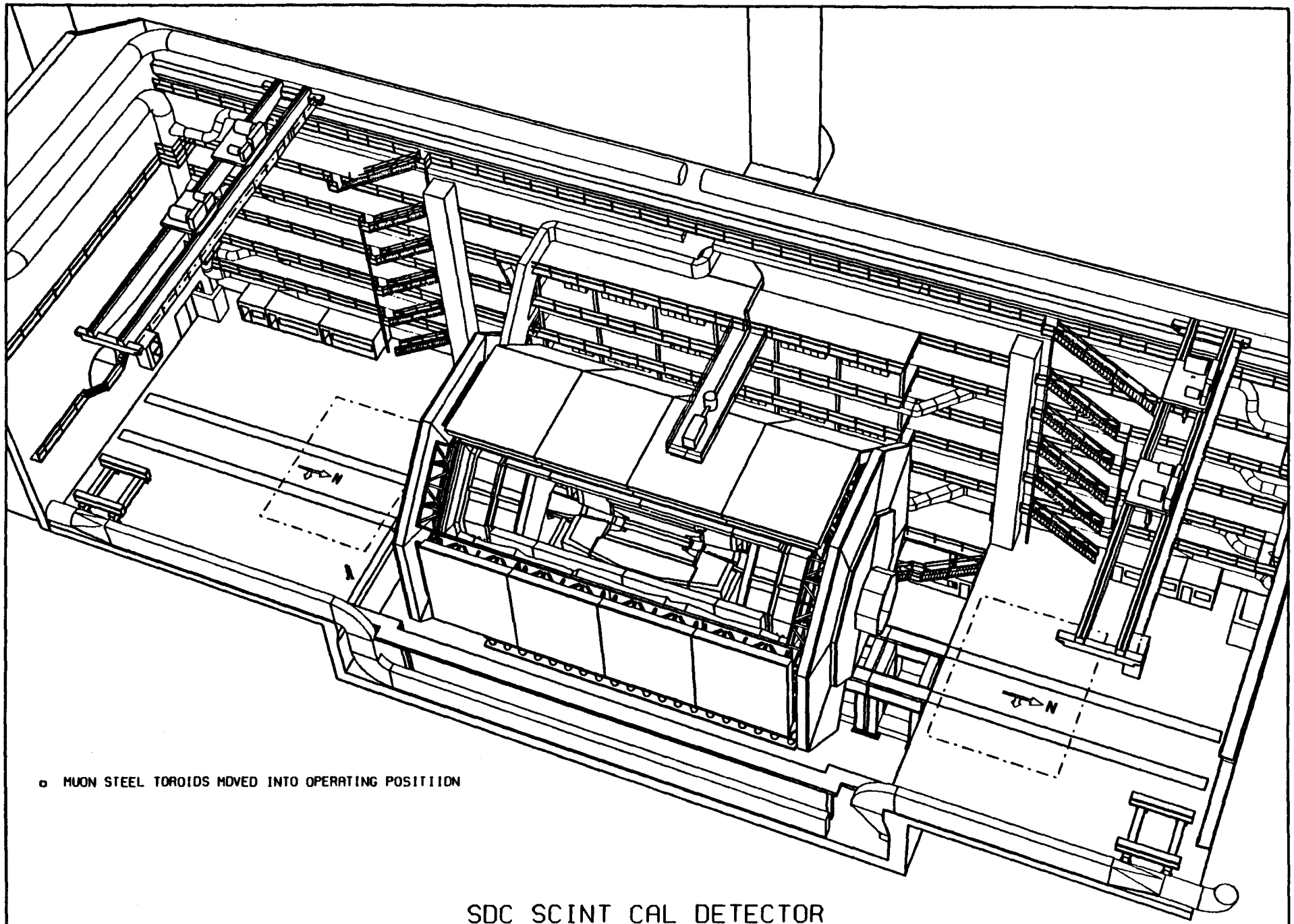
- INSTALLATION OF INTERMEDIATE TRACKING COMPLETED
- ENDCAP CALORIMETERS MOVED INTO OPERATING POSITION

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 36

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045.DGN MONTH36.HLN

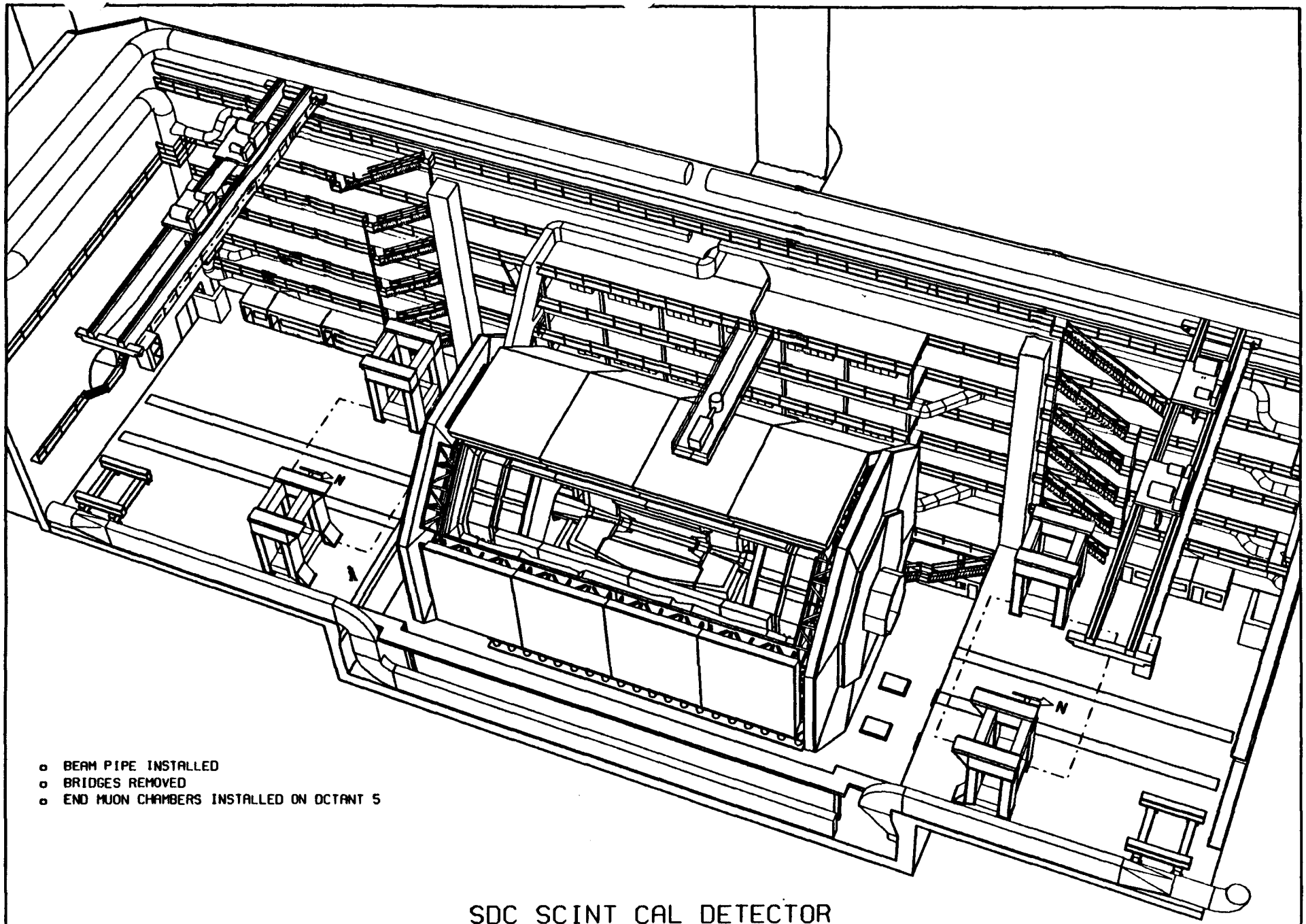


o MUON STEEL TOROIDS MOVED INTO OPERATING POSITIION

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MO 37



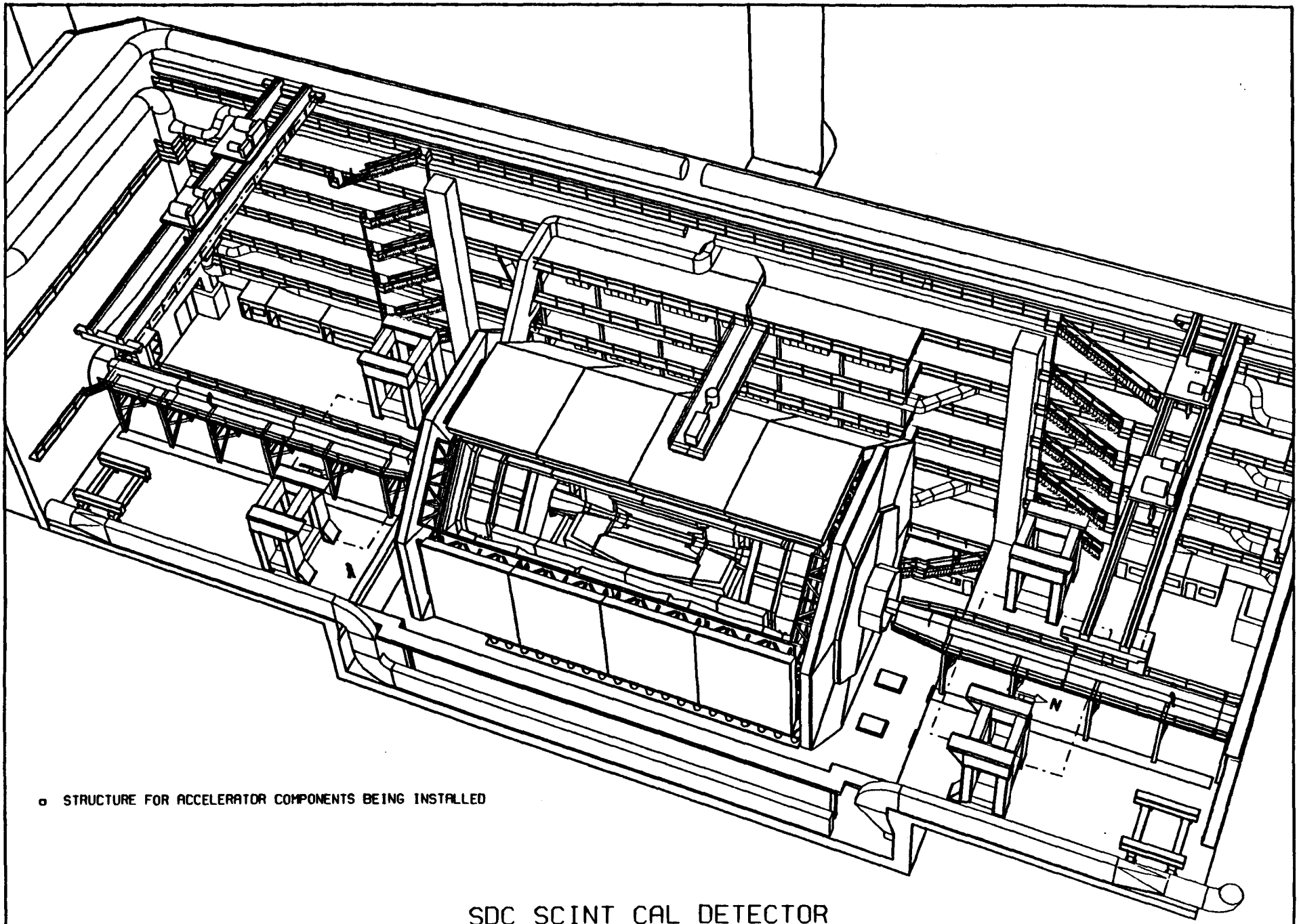
- BEAM PIPE INSTALLED
- BRIDGES REMOVED
- END MUON CHAMBERS INSTALLED ON OCTANT 5

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 38

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045.DGN MONTH38.HLN



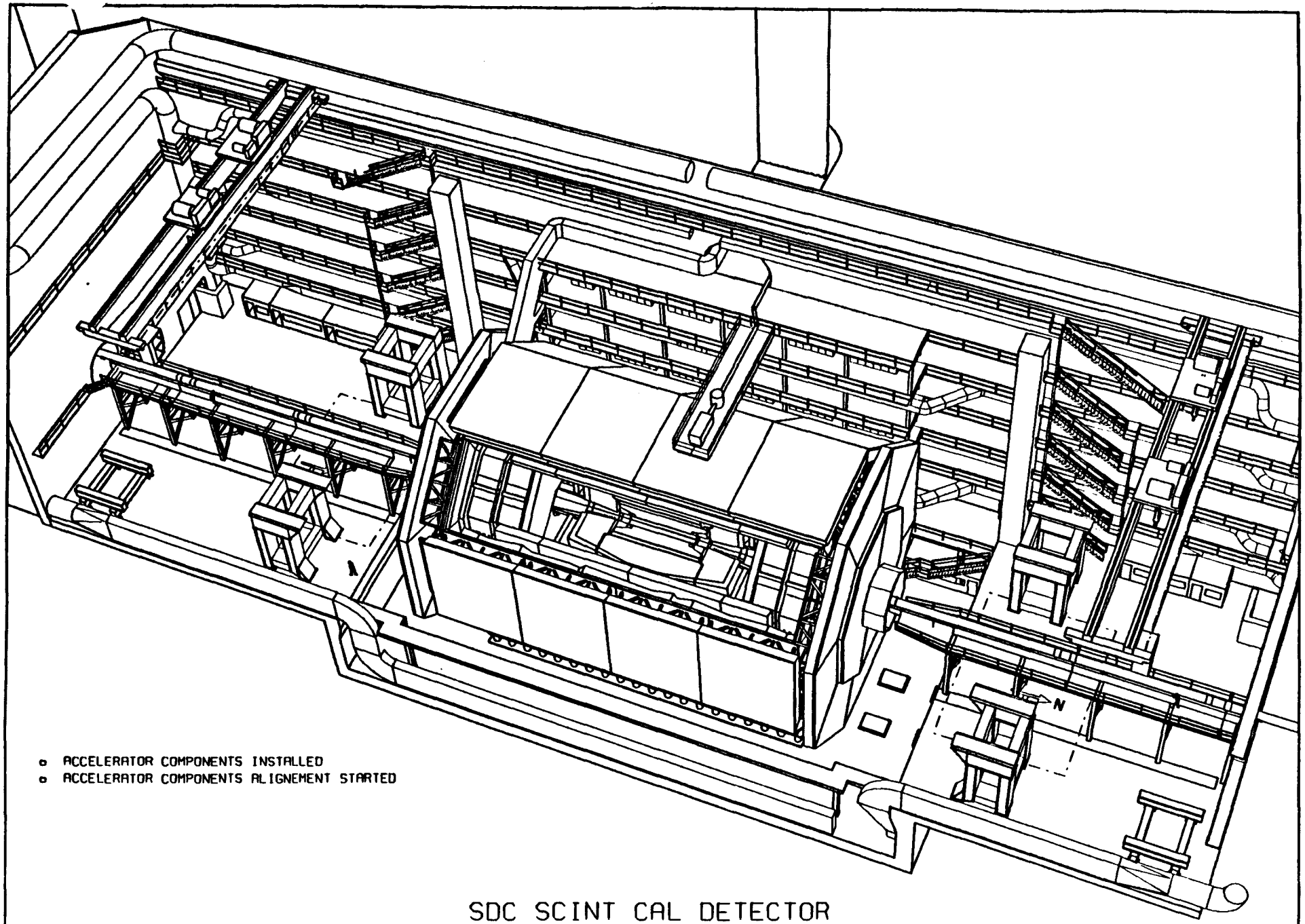
o STRUCTURE FOR ACCELERATOR COMPONENTS BEING INSTALLED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MI 1 39

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045.C MONTH39.HLN



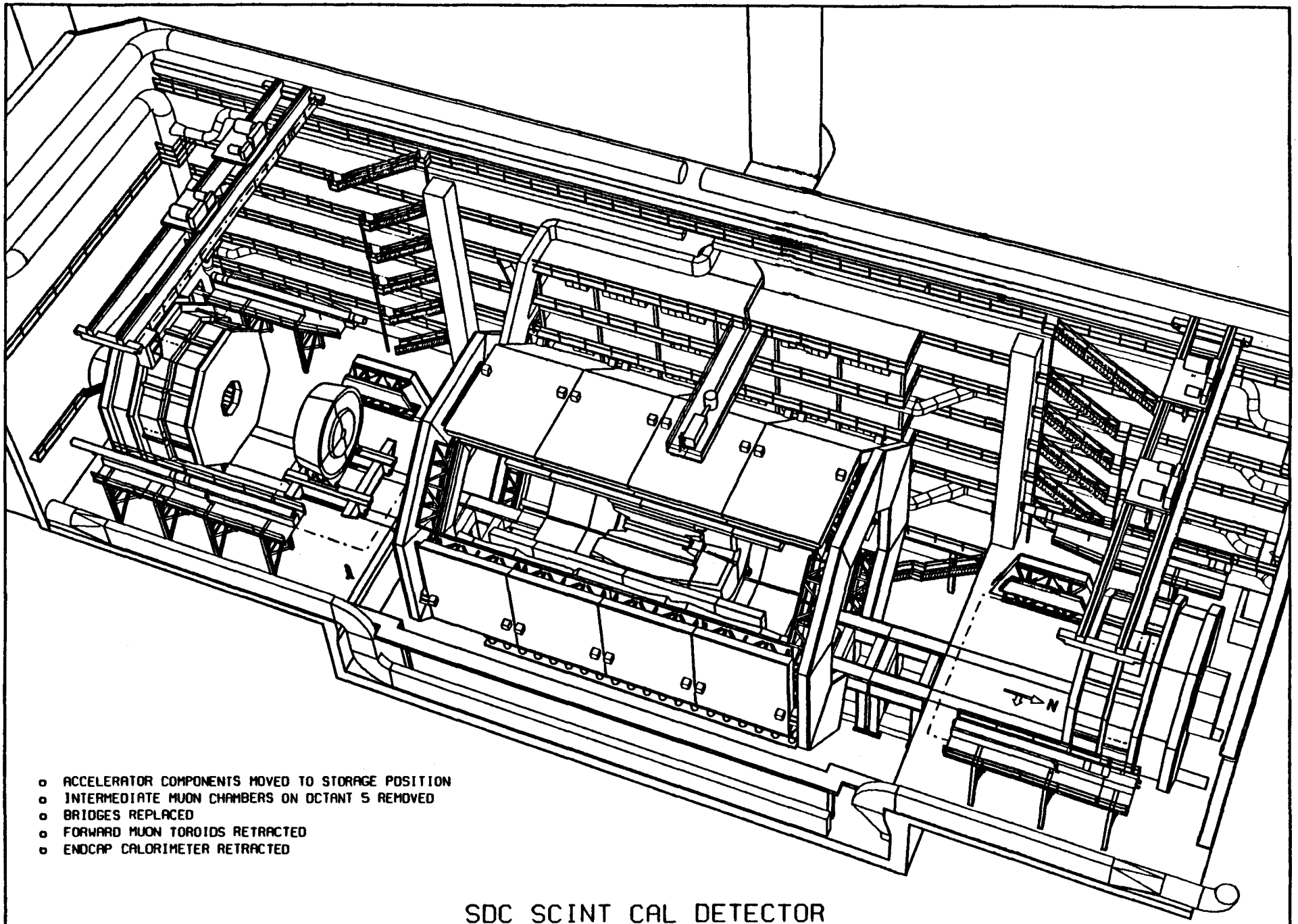
- ACCELERATOR COMPONENTS INSTALLED
- ACCELERATOR COMPONENTS ALIGNEMENT STARTED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 40

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045.DGN MONTH40.HLN



- ACCELERATOR COMPONENTS MOVED TO STORAGE POSITION
- INTERMEDIATE MUON CHAMBERS ON OCTANT 5 REMOVED
- BRIDGES REPLACED
- FORWARD MUON TOROIDS RETRACTED
- ENDCAP CALORIMETER RETRACTED

SDC SCINT CAL DETECTOR

OPEN FOR MAJOR REPAIRS

ICF KAISER ENGINEERS 9-22-91 MODEL 523M0045.I REPAIR.HLN.

10. LAWRENCE BERKELEY LABORATORY (LBL)

Integration and Management

Mechanical Integration

The new liquid argon calorimeter piping scheme (LBL - SDC ~ 0052) was developed (drwg 23D0401) to eliminate the need for four 20" & 24" pipes to exit the detector at each end. The amount of axial motion of the forward muon system, to provided for easy servicing of the calorimeter, was reduced from 8 meters to 1 meter. These two changes allowed a great reduction in the size of the power track supports for these large pipes and made the LAC proposal a more reasonable option in so far as its installation impacted the space and access within the hall. The above drawing was presented at the Technical Advisory Committee meeting in Dallas, Sept 11-12.

Layouts of versions A and B for descope option 2 (drwg 23D0285 and 23D0275) were revised for the STC (Scintillating Tile Calorimeter) and the LAC (Liquid Argon Calorimeter) versions of the detector, as well as internal electronics and services arrangements for both versions, were prepared for presentation at the SDC Technical Board meeting (Sept 11, 12 in Dallas) at which the calorimeter technology choice was evaluated.

Following the TAC meeting, the detector was redefined and a new cross section drawing (23D0355) was generated to illustrate the latest calorimeter envelope and other criteria. A composite calorimeter envelope was identified which would accommodate either the current lead/iron or iron/iron versions. A spread sheet was developed to generate a table of the important detector dimensions, as a checking aid and to speed up generating layout revisions. A vertical calorimeter rail was proposed and illustrated as a way to provide improved access to the calorimeter electronics crates .

A technical note (LBL SDC 0051) was prepared to summarize the currently identified services, and the space required for them, by subsystem. This note contained schematic diagrams identifying the services required by each tracker and calorimeter subsystem. The cross sectional areas required to bring the services to the detectors were tabulated for each of two possible routing options: a) with a large cryostack opening in octant 8 to carry all services for the tracker and the center part of the calorimeter; and, b) with the minimum sized cryostack opening required to handle the cryogens and the length sensitive cables. A layout was generated to illustrate possible arrangements of the services as they transit both the maximum and the minimum cryostats. The impact of these two options upon the muon chamber coverage was illustrated. Definitions of pipes, cables, crates, VLPC cryostats, calibration sources, etc., were updated with new input from other collaborators and from vendors.

Based on the above detector, the redefined cross section drawing, and the services technical note, a layout (23D0345) was prepared to illustrate a proposed arrangement of these services and electronic crates for the case in which the outer tracker uses scintillating fibers. An additional layout (23D0295) was prepared for the case in which a straw tube outer tracker is used.

The above drawings and technical notes were presented to the collaboration at its ORNL meeting on Sept 27. In response to decisions of the TAC at the conclusion of that meeting, a new layout (23D0375) has been generated which incorporates a thicker inner muon chamber (450 vs 350 mm) and 400 mm of additional radial space for electronics and access. A technical note was generated (LBL SDC 0062) to analyze the resulting effective depth of steel as a function of the polar angle.

Two SSCL engineers were briefed, at LBL, on the current mechanical integration status and the work load of the LBL engineering group. Copies of all available SDC documents were made available to the SSCL team. This briefing was in preparation for the integration function to be transferred to SSCL.

Electrical Integration

The joint (LBL/SSCL) efforts have been directed primarily in support of the Technical Board choice of calorimeter options and preparation for the next cost iteration in October.

Detailed estimates were developed for the calorimeters with similar performance characteristics. The Scintillating Tile option was found to be more favorable in cost and cost flexibility as well as its impact on detectors and the hall. Results of the review are documented in the Technical Board report on the calorimeter decision. We've analyzed and developed solutions to many of the problems encountered in previous cost iterations. We developed a comprehensive C/S Procedures Manual and procedures for interfacing the scheduling systems in use by the subsystem C/S teams. We will present these at the kick-off for the next cost iteration 23-24 Oct.

Silicon Tracking

Thermal & Structural Analysis

Thermal and stress analysis of several front end electronics and detector configurations have been completed. These designs are the "oreo" type which have the electronics placed directly on the detectors. Layouts of the three models designated a, b and c, are shown on Figure 1. The initial design called for the oreo stack to be directly over the cooling ring, but assembly considerations necessitated the offset shown by Figure 1. The thickness of each layer of material is also indicated on the figure for each design. While the temperature of the electronics is not critical, maintaining a low detector temperature is crucial. A low detector temperature reduces the thermal noise and maintains a higher signal to noise ration.

The results obtained by use of the ANSYS code indicated the following:

Configuration	Maximum Electronic temperature °C	Detector temperature °C
a	21.8	5.0
b	19.7	4.1
c	5.9	3.3

The improvement of design c is a result of the beryllium shield extending from the electronic stack to the cooling ring, therefore, shunting the detector. This increases the area for heat flow with a corresponding reduction of detector temperature.

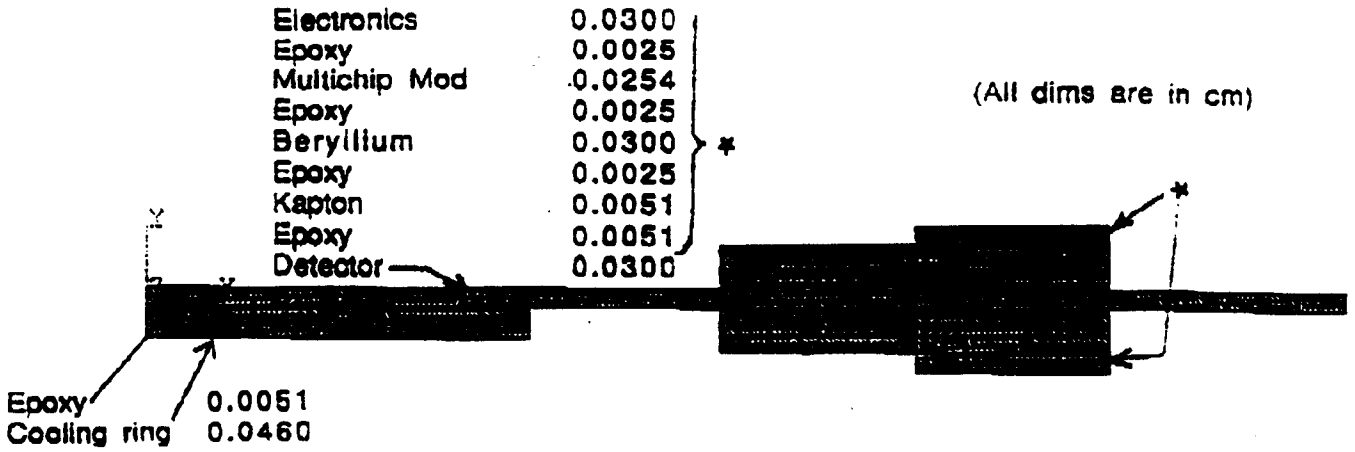
A stress analysis was completed on configuration c. The stresses were a result of the calculated thermal gradients. The maximum value was 1.5 Mpa (217 psi). Preliminary testing determining the strength of silicon wafers indicate that this level of stress is not a concern. These results were documented in LBL-SD 0054 on 9/13/91 by Carol Corradl.

Radiation Length Calculations

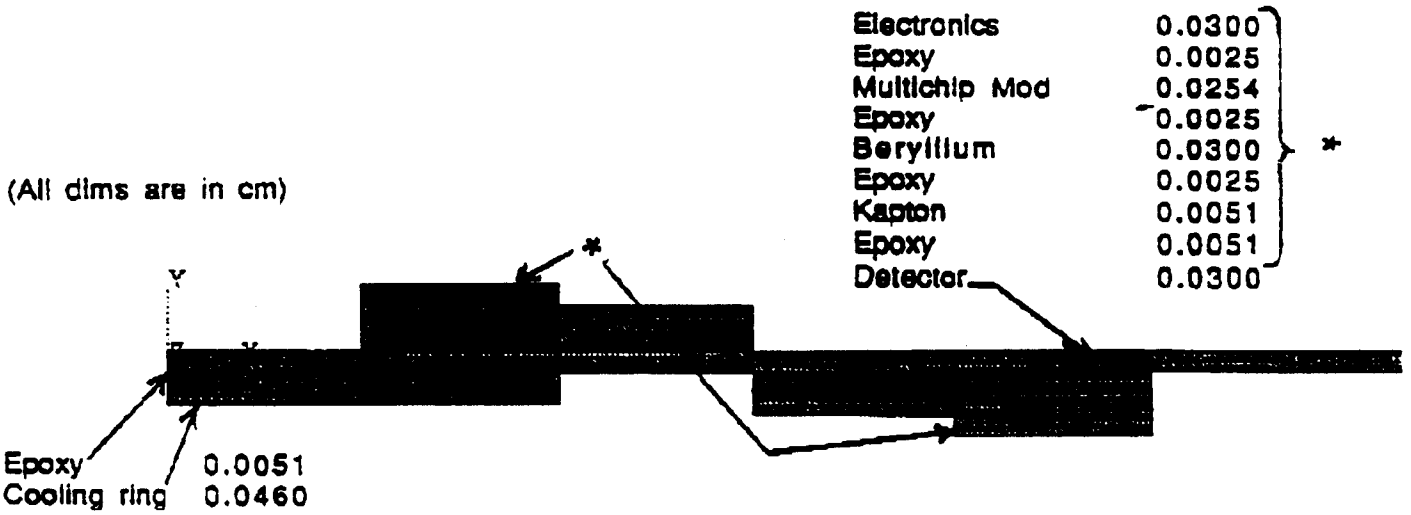
A users manual for the radiation length code has been completed. In addition, the code has been successfully run on a PC. The manual and code are available to any interested parties.

General

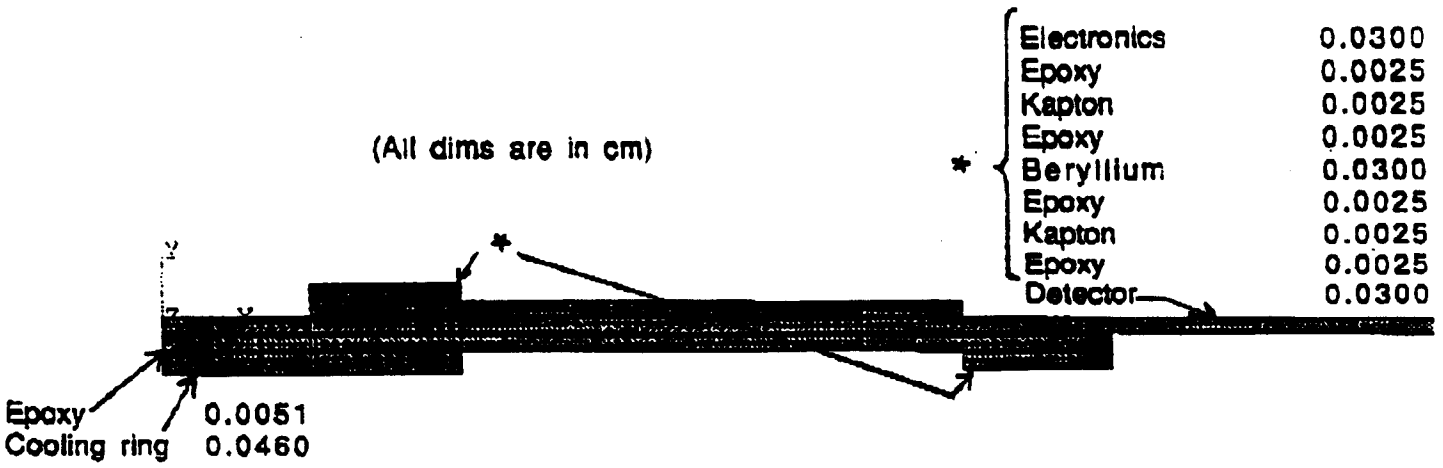
An order for a precision XY measuring machine has been placed. This machine will be used to develop techniques for accurate placement of detectors on a variety of substrates. By use of standards and reference lines, the desired tolerances for assembly should be met by this equipment.



a. Baseline symmetric oreo



b. Oreo design offset from cooling ring



c. Offset design with revised stacking

Figure 1. Finite element thermal models of three oreo design configurations.

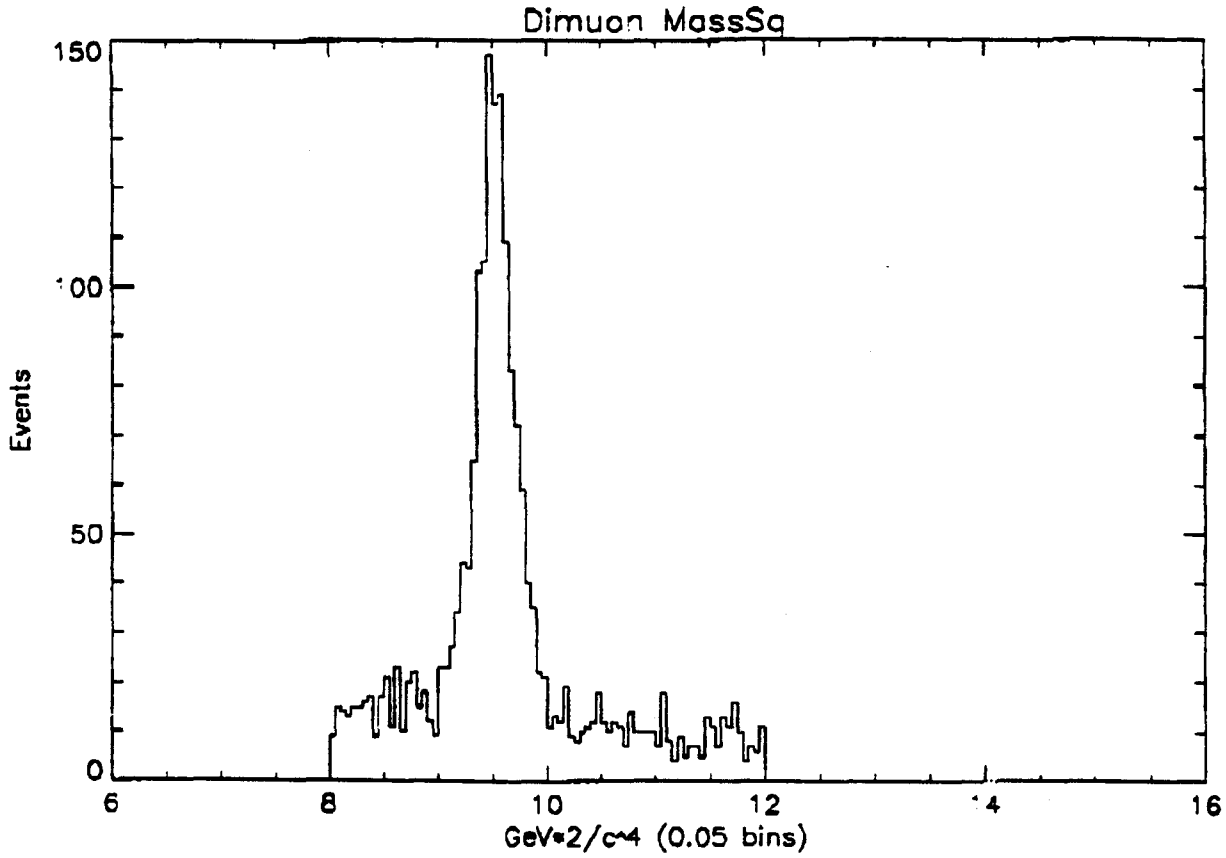
Computing Systems

Efforts were directed to improve the load time of the Object Store database for the Ψ data. Initial results were very disappointing, requiring nearly five days to load the 220 MBytes of data. Discussions were held with the Object Design support people. The main source of the poor behavior appears to have been severe thrashing in the ObjectStore cache system. The database was too big for the disk cache space allocated. The support people suggested breaking up the data into a series of segments of controlled size such that all segments in active use would fit into the disk cache. [The segmented structure of the resulting databases would have no visible effect to anyone coding queries against the database.] They also suggested increasing the size of the disk cache. These changes have resulted in a 10-fold reduction in the load time. This is still very long, but short enough that gains in query time over traditional sequential data analysis win overall.

Other improvements are possible. The client requesting the load and the database server process are currently running on the same machine. This machine has a fault with its CPU motherboard which limits its memory to 24 MBytes. The two major processes are large enough that they begin to cause thrashing in the virtual memory system which can seriously hurt performance. There is some partial evidence that this can be improved. If the client is run on a separate machine from the server, then the loading time grows linearly with the size of the database, whereas the growth is more quadratic with the processes on one machine. The overall load time is not much different, but the split process case requires multiple movements of the data over Ethernet, rather than direct moves over the SCSI bus. The best course of action will be to get the hardware fixed so that additional physical memory can be used.

A full 220 MByte database has been built in ObjectStore. Using that database, a simple query to reproduce the Ψ peak result obtained in July using the 60KByte, trivial database. The resulting plot is included. The query processing against the complete 220 MByte database took 42 seconds of wall clock time. For comparison, reading the original sequential dataset from disks on the LBL VAX cluster using standard CDF programs took 1 hour and 14 minutes. The overwhelming part of the time improvement with the database approach is because the database only accesses the small amount of the data actually needed for the query while the traditional sequential approach reads all the data regardless. While this particular query may be unusually favorable, it demonstrates the strong potential of the approach.

Information was collected regarding how analysis is being done within CDF for B meson lifetime studies. This included data about which data sets are used, how big they are, how often they are accessed and how many people are involved in the analysis. This information was written up in preliminary form and sent to the IBM Houston team for their Operations Concepts analysis. One of the reasons for chosing B meson lifetime studies for Operations Concepts work is to find additional queries which can be usefully made against the available dataset.


Dimuon MassSq
150
100
50
0
Events
6
8
10
12
14
16
GeV*2/c^4 (0.05 bins)

B. PROGRAM COSTS

The budgets indicated below are for FY91 "post-LoI" funds allocated April 1991 and August - September 1991.

Institution	Budget	September Cost (Actual or Estimated)	Prior Months (actual cost) K$	Total Cost
1. ORNL	210	0	0	0
2. PSL - Muon	80	5.4	3.1	8.5
3. PSL-Trigger	75	8.5	17.1	25.6
4. FNAL				
A. SC Solenoid	393	70.0	190.1	260.1
B. Calorimetry	159	37.0	76.9	113.0
C. Data Acq. Sys.	50	2.0	0	2.0
D. Muon	63	6.0	4.5	10.5
E. Fiber Tracker Read-out	65	0	0	0
F. Calorimeter Electronics	65	10.0	126.9	136.6
5. ANL	230	7.2	111.2	118.4
6. WSTC	123	17.0	106.0	123.0
7. U. MICHIGAN	83	0	0	0
8. LANL	150	NA	135.0	NA
9. KE	210	29.0	142.9	171.9
10. LBL				
A. Integration & Mgmt.	673	30.0	665.8	695.8
b. Liq. A Calorimetry	213	0	217.2	217.2
C. Silicon Tracker	72	11.0	38.0	49.0
D. Computing Systems	119	13.0	96.6	109.6
E. Calorimetry Electronics	25	10.0	20.4	30.4
F. Contract Costs	53	0	53.0	53.0
11. IBM	35	—	—	—
12. U. CHICAGO	47	—	—	—
13. HARVARD	47	—	—	—
14. U. PENNSYLVANIA	62	—	—	—
15. SANDIA	38	—	—	—