SDC-91-117

SDC
SOLENOIDAL DETECTOR NOTES

SDC Scintillator Calorimeter Detector (Preliminary Construction Planning)

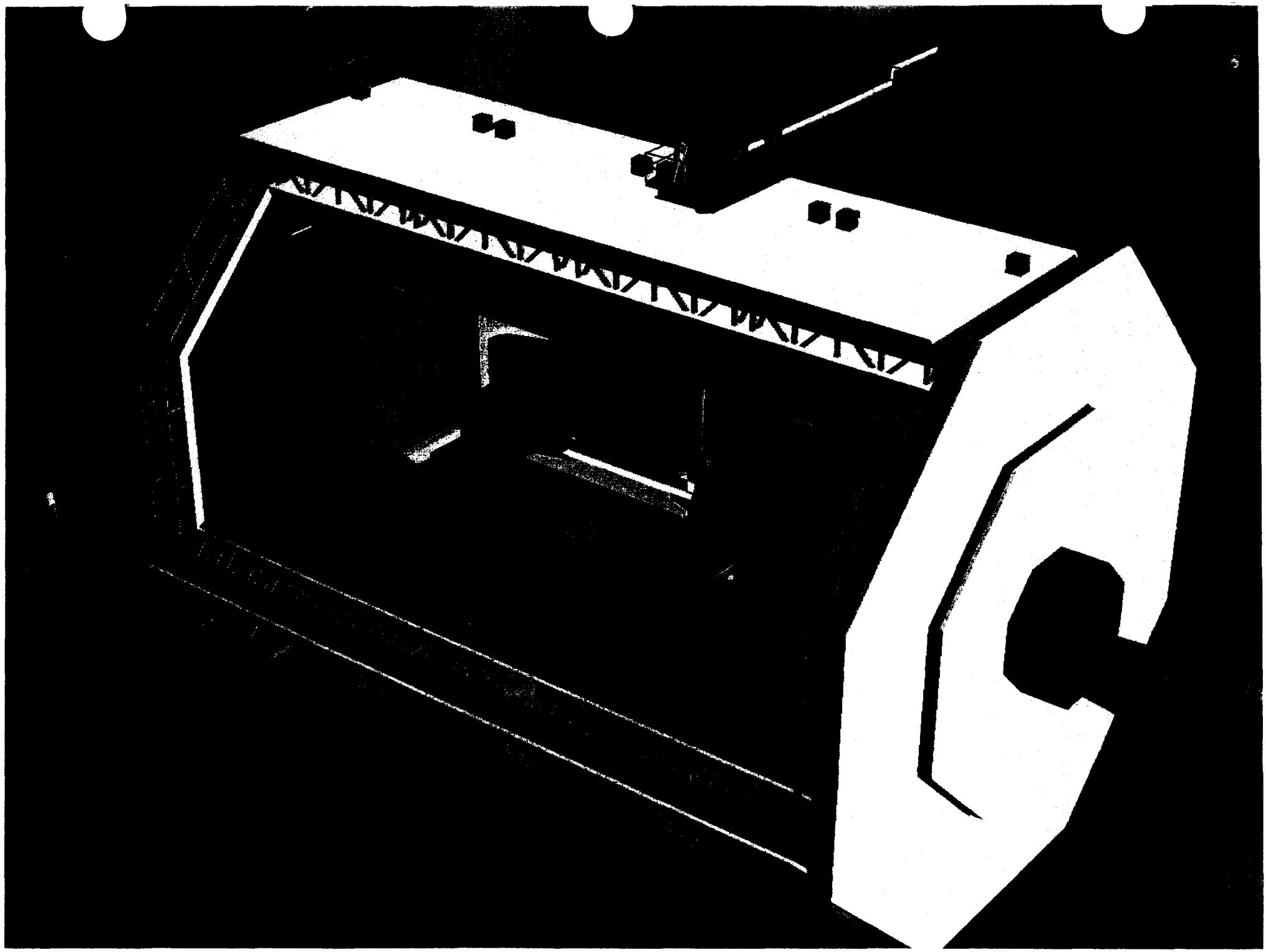
October 1991

ICF KAISER ENGINEERS, Oakland
Les Dittert, Alan Nunez and Jorge Brown

Preliminary Construction Planning

SCINTILLATOR CALORIMETER DETECTOR

ICF KAISER ENGINEERS



Preliminary Construction Planning

SCINTILLATOR CALORIMETER DETECTOR

October 1991

ICF KAISER ENGINEERS

Les Dittert · Alan Nunez · Jorge Brown

CONSTRUCTION PLANNING AND SCHEDULING

INTRODUCTION

This document reports the activities performed by ICF Kaiser Engineers in preliminary construction planning of the baseline SDC Scintillator Calorimeter Detector in the Interaction Region hall. Construction activities that occur on the surface are being planned by others.

Three dimensional modeling on the workstation was used to develop conceptual tools and fixtures and to simulate status situations at different stages of construction. This allows for better visualization of the following steps required to continue the construction in an efficient manner, and for better visualization of access and space requirements.

Planning and estimates of construction activity durations is usually done based on past experience with similar facilities. The technique of simulating these activities becomes especially useful for this project as its scale is significantly greater than previous detector constructions.

Because of the size and weight of the various components of the detector, the development of special assembly frames, lifting cradles, installation frames and temporary supports were required. Structural calculations were performed to insure that the size and configuration of these assemblies and installation aids shown on the drawings are feasible and realistic. Conceptual designs of movable rigid frames (bridges) used to roll the calorimeters and forward toroids into the muon steel barrel during assembly were also performed. These frames will also be used to move the forward toroids from the barrel steel onto the operating floor of the hall to gain full access to the calorimeters and tracking systems.

Modeling these assembly and installation frames in three dimensions was especially useful in determining space requirements, interference with detector components at all stages of the detector assembly, and disassembly of the detector.

Modeling in 3D was also done to represent monthly status of the construction progress.

3D MODELING

Intergraph's Microstation software was used for all 3D modeling; perspectives and shaded views were made with Intergraph's ModelView software. Hidden line removed drawings and perspectives were extracted from the three dimensional models using RVHL software by Intergraph.

OTHER DELIVERABLES

35 mm color slides were made of all monthly progress situations plus other

more detailed illustrations. This material was delivered to the Lawrence Berkeley Lab personnel.

All computer 3D models and drawings were taped and delivered to SSC Lab personnel, together with tables that combine all reference files and levels required for the reproduction of the monthly progress pictures.

RECOMMENDATIONS FOR FUTURE WORK

The construction planning presented in this report was done for the baseline scintillator calorimeter detector and should be considered at the conceptual stage. For more accurate planning and scheduling the following points should be observed in future work:

o The detector model should be updated as design progresses. Designs of the various subsystems should also be updated.

o Piping, cable trays, major cabling harnesses, air conditioning for the detector, walkways and access aisleways inside the detector should be included in the construction status drawings. This would insure that proper access space exists and that safety considerations are met.

o Hydraulic pushers for the movement of the heavy loads on the hall floor and inside the detector should be developed and included in the layouts.

o Facilities such as portable toilets, lunchrooms if any, control offices, etc should be shown on the hall floor.

o Views should be made in critical areas from surveying equipment locations, to see if interferences occur with the line of sight.

o Cryogenic equipment and facilities other than the accelerator components should be included in the construction progress drawings.

o The configuration of the hall construction should be updated per PBMK design.

o Manpower estimates of construction labor should be updated once the design is further developed and should include all activities, not only the major hardware installation.

o The construction schedule should be updated using full CPM analysis.

o The CPM schedule should be resource loaded with the estimated manpower and resource leveling should be performed to optimize the construction sequencing and resource requirements.

CONSTRUCTION SCHEDULE

Two bar chart schedules were developed. The first one assumes early procurement and delivery of most subsystems and the second assumes late procurement and delivery of all non critical-path subsystems.

Both schedules are based on one shift per day for construction personnel.

ALTERNATE A - EARLY NON CRITICAL-PATH SUBSYSTEM ARRIVAL

This schedule was used to make the construction status drawings contained in this report.

This bar chart schedule is based on a more detailed schedule developed by Bill Edwards shown on drawing entitled "Detector #1- Preliminary Schedule", dated July 17, 1991. Necessary minor modifications to this schedule were made when developing the monthly status drawings.

ALTERNATE B - LATE NON CRITICAL-PATH SUBSYSTEM ARRIVAL

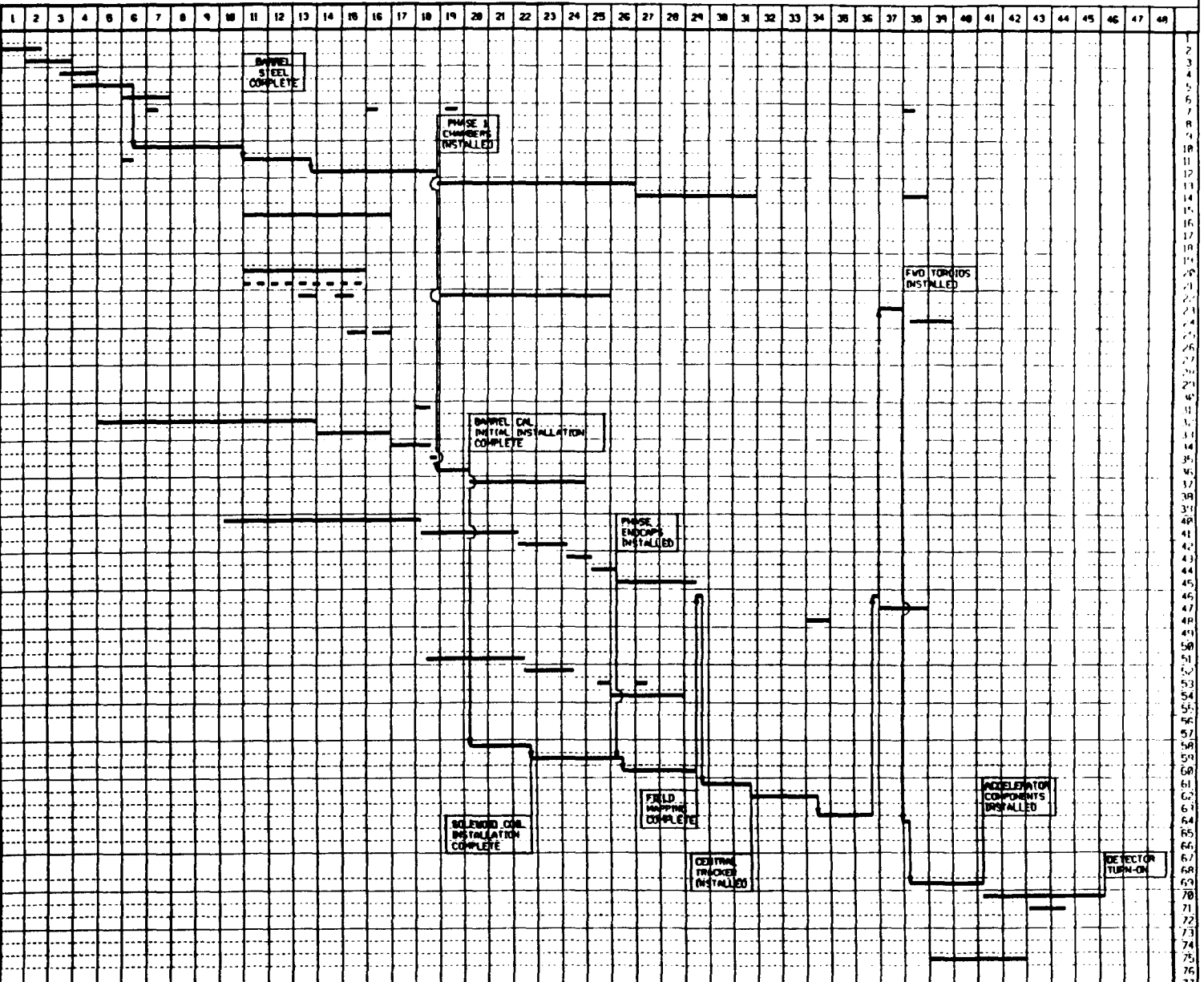
After completion of the main effort, an alternate schedule was developed to indicate the effect on the program considering the late procurement and delivery of all non-critical subsystems. Utilization of this alternate should have the effect of improving cash flow by stretching out payments and also create less congestion in the hall and surface facilities during the early stages of construction.

Subsystems delayed in their installation are the forward and intermediate muon chamber systems and the forward calorimeters.

SDC SCINTILLATOR CALORIMETER DETECTOR CONSTRUCTION SCHEDULE - ALT A

MONTHS

MUON STEEL INSTALLATION	
HALL PREPARATION	1
MOBILIZATION	2
INSTALL SUPPORT BASE AND TIE BEAMS	3
INSTALL SOLE PLATES, JACKS & HYDRAULICS	4
INSTALL INCLINED PLATES, TRUSSES & ALIGN 1 CREW	5
ASSEMBLE BARREL ERECTION FRAME & TEMP SUPPORT 1 CR.	6
BRIDGE INSTALLATION & REMOVAL	7
	8
MUON STEEL BARREL	9
CONSTRUCT MUON STEEL BARREL - 2 CREWS	10
COIL INSTALLATION & BEGIN UTILITY HOOK-UP	11
PHASE 1 MUON CHAMBER INSTALLATION	12
PHASE 2 MUON CHAMBER INSTALLATION	13
INTERMEDIATE CHAMBER INSTALLATION	14
CHAMBER GAS, CHW, & CABLE TRAY PREP AND	15
RAILS INSTALLATION WORK	16
	17
	18
MUON STEEL FORWARD TOROIDS	19
CONSTRUCT FORWARD TOROIDS	20
INSTALL COILS ON TOROIDS	21
INSTALL FORWARD TOROID MUON CHAMBERS & CERENKOV CTR	22
MOVE IN TOROIDS	23
FINAL CABLING AND SYSTEM CHECKOUT	24
ASSEMBLE SUPPORT CYLINDERS ON FORWARD TOROIDS	25
	26
	27
CALORIMETER ASSEMBLY	28
	29
BARREL CALORIMETERS:	30
LOWER CALORIMETER SUPPORT & INSTALL	31
PHASE 1 CENTRAL CALORIMETER ASSEMBLY	32
PHASE 2 CENTRAL CALORIMETER ASSEMBLY	33
CENTRAL CALORIMETER CHECK-OUT	34
LOWER CENTRAL CALORIMETER INTO HALL	35
INITIAL CALORIMETER INSTALLATION WORK	36
REMAINING CALORIMETER INSTALLATION WORK	37
	38
ENDCAP CALORIMETERS:	39
PHASE 1 END CALORIMETER ASSEMBLY	40
PHASE 2 END CALORIMETER ASSEMBLY	41
ENDCAP CALORIMETER CHECK-OUT	42
LOWER ENDCAP CALORIMETERS INTO HALL	43
ROLL IN ENDCAPS (PHASE 1 INSTALLATION)	44
ENDCAP CALORIMETER INSTALLATION PHASE 1	45
ROLL OUT, ROLL IN ENCAPS	46
ENDCAP CALORIMETER INSTALLATION PHASE 2	47
INSTALL ABSORBER AND MUON CHAMBER FWI	48
	49
FORWARD CALORIMETERS:	50
FORWARD CALORIMETER ASSEMBLY	51
FORWARD CALORIMETER CHECK-OUT	52
LOWER FORWARD CALORIMETERS INTO HALL	53
INSTALL FORWARD CALORIMETERS IN END TOROIDS	54
	55
	56
COIL & TRACKING	57
SOLENOID INSTALLATION AND UTILITY HOOK-UP	58
SOLENOID SYSTEM COOLDOWN AND TEST	59
FIELD MAPPING	60
INSTALL CENTRAL TRACKING SYSTEM	61
INSTALL SI TRACKING SYSTEM	62
INSTALL INTERMEDIATE TRACKING SYSTEM	63
BEAM PIPE INSTALLATION	64
	65
	66
ACCELERATOR	67
	68
ACCELERATOR COMPONENT INSTALLATION	69
ACCELERATOR COMMISSIONING	70
FINAL CHECKS AND REPAIRS	71
	72
	73
	74
COSMIC RAY TESTING OF ALL SUBSYSTEMS	75
	76
	77



JCF RAISER ENGINEERS 10-17-91 SCINTR150.DGN

SDC SCINTILLATOR CALORIMETER DETECTOR CONSTRUCTION SCHEDULE - ALT B

MONTHS

MUON STEEL INSTALLATION	
HALL PREPARATION	1
MOBILIZATION	2
INSTALL SUPPORT BASE AND TIE BEAMS	3
INSTALL SOLE PLATES, JACKS & HYDRAULICS	4
INSTALL INCLINED PLATES, TRUSSES & ALIGN 1 CREW	5
ASSEMBLE BARREL ERECTION FRAME & TEMP SUPPORT 1 CR.	6
BRIDGE INSTALLATION & REMOVAL	7
	8
MUON STEEL BARREL	9
CONSTRUCT MUON STEEL BARREL - 2 CREWS	10
COIL INSTALLATION & BEGIN UTILITY HOOK-UP	11
PHASE 1 MUON CHAMBER INSTALLATION	12
PHASE 2 MUON CHAMBER INSTALLATION	13
INTERMEDIATE CHAMBER INSTALLATION	14
CHAMBER GAS, CHW, & CABLE TRAY PREP AND	15
RAILS INSTALLATION WORK	16
	17
	18
MUON STEEL FORWARD TOROIDS	19
CONSTRUCT FORWARD TOROIDS	20
INSTALL COILS ON TOROIDS	21
INSTALL FORWARD TOROID MUON CHAMBERS & CERENKOV CTR	22
MOVE IN TOROIDS	23
FINAL CABLING AND SYSTEM CHECKOUT	24
ASSEMBLE SUPPORT CYLINDERS ON FORWARD TOROIDS	25
	26
	27
CALORIMETER ASSEMBLY	28
	29
BARREL CALORIMETERS:	30
LOWER CALORIMETER SUPPORT & INSTALL	31
PHASE 1 CENTRAL CALORIMETER ASSEMBLY	32
PHASE 2 CENTRAL CALORIMETER ASSEMBLY	33
CENTRAL CALORIMETER CHECK-OUT	34
LOWER CENTRAL CALORIMETER INTO HALL	35
INITIAL CALORIMETER INSTALLATION WORK	36
REMAINING CALORIMETER INSTALLATION WORK	37
	38
ENDCAP CALORIMETERS:	39
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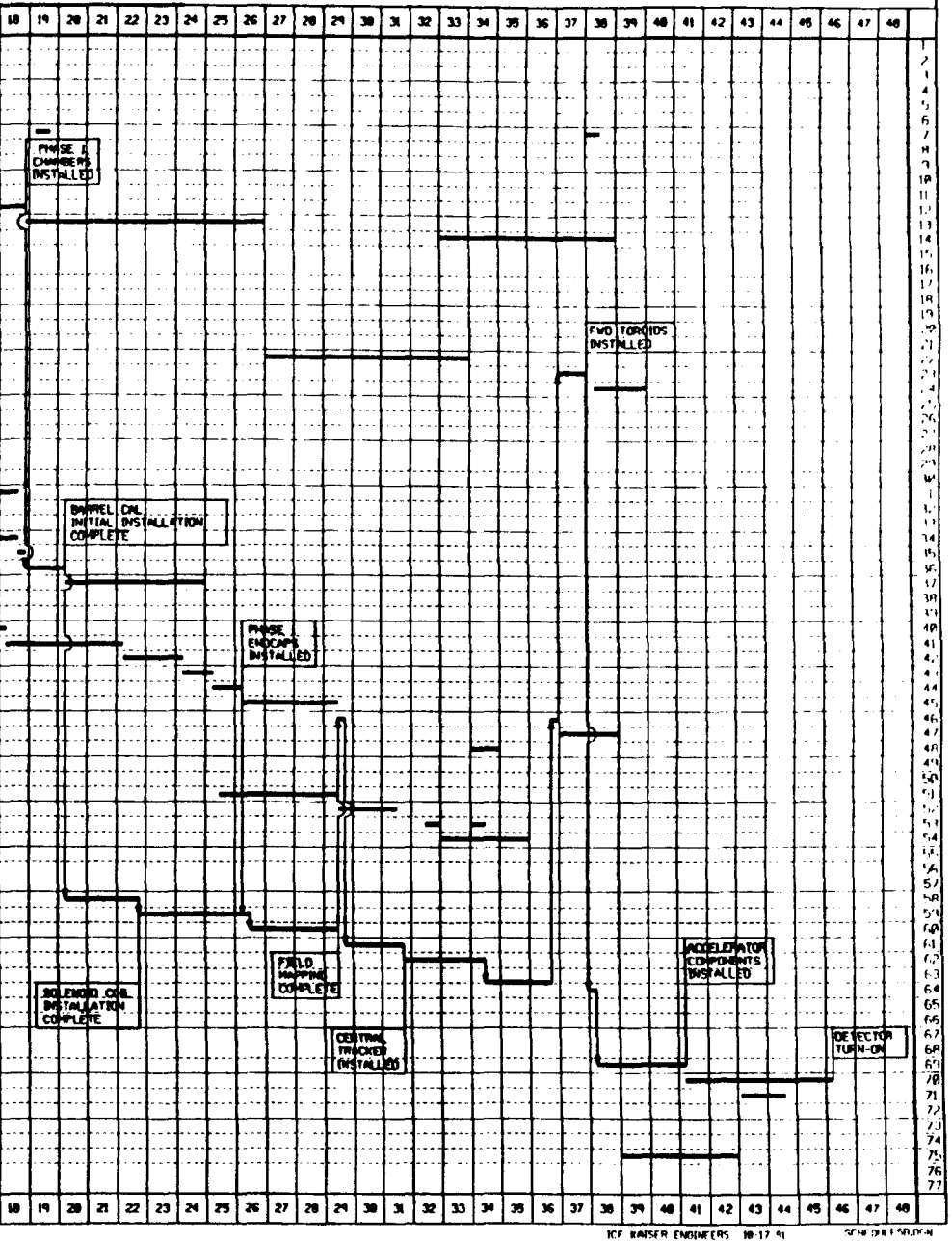
ENDCAP CALORIMETER CHECK-OUT	42
LOWER ENDCAP CALORIMETERS INTO HALL	43
ROLL IN ENDCAPS (PHASE 1 INSTALLATION)	44
ENDCAP CALORIMETER INSTALLATION PHASE 1	45
ROLL OUT, ROLL IN ENCAPS	46
ENDCAP CALORIMETER INSTALLATION PHASE 2	47
INSTALL ABSORBER AND MUON CHAMBER FWI	48
	49
FORWARD CALORIMETERS:	50
FORWARD CALORIMETER ASSEMBLY	51
FORWARD CALORIMETER CHECK-OUT	52
LOWER FORWARD CALORIMETERS INTO HALL	53
INSTALL FORWARD CALORIMETERS IN END TOROIDS	54
	55
COIL & TRACKING	56
	57
SOLENOID INSTALLATION AND UTILITY HOOK-UP	58
SOLENOID SYSTEM COOLDOWN AND TEST	59
FIELD MAPPING	60
INSTALL CENTRAL TRACKING SYSTEM	61
INSTALL SI TRACKING SYSTEM	62
INSTALL INTERMEDIATE TRACKING SYSTEM	63
BEAM PIPE INSTALLATION	64
	65
	66
ACCELERATOR	67
	68
ACCELERATOR COMPONENT INSTALLATION	69
ACCELERATOR COMMISSIONING	70
FINAL CHECKS AND REPAIRS	71
	72
	73
	74
COSMIC RAY TESTING OF ALL SUBSYSTEMS	75
	76
	77



ICF KAISER ENGINEERS 10-17-91

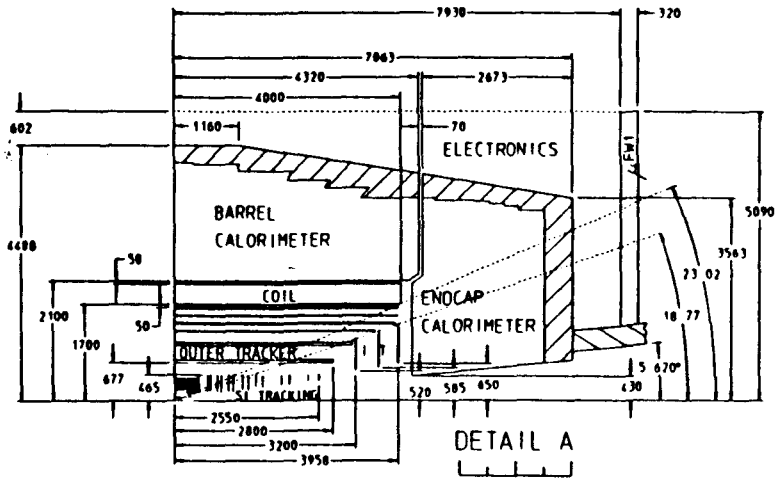
SCHEDULE 5/01/91

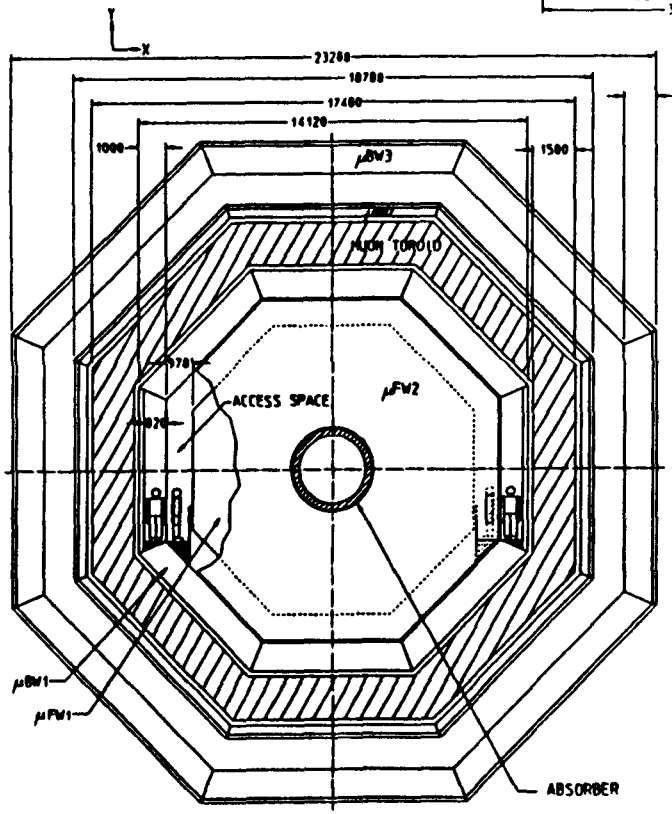
BASIS FOR MODELING

The computer 3D models shown for the detector in this report are based on the dimensions shown on LBL drawing number 23D0135, dated May 31, 1991.

The dimensions for the hall are based on SSC drawing numbers R20000293, rev D, (transverse section) dated 7-17-91, R20000294, rev B (front elevation) dated 8-26-91, and SCD000036, rev A (plan view), dated 8-23-91.

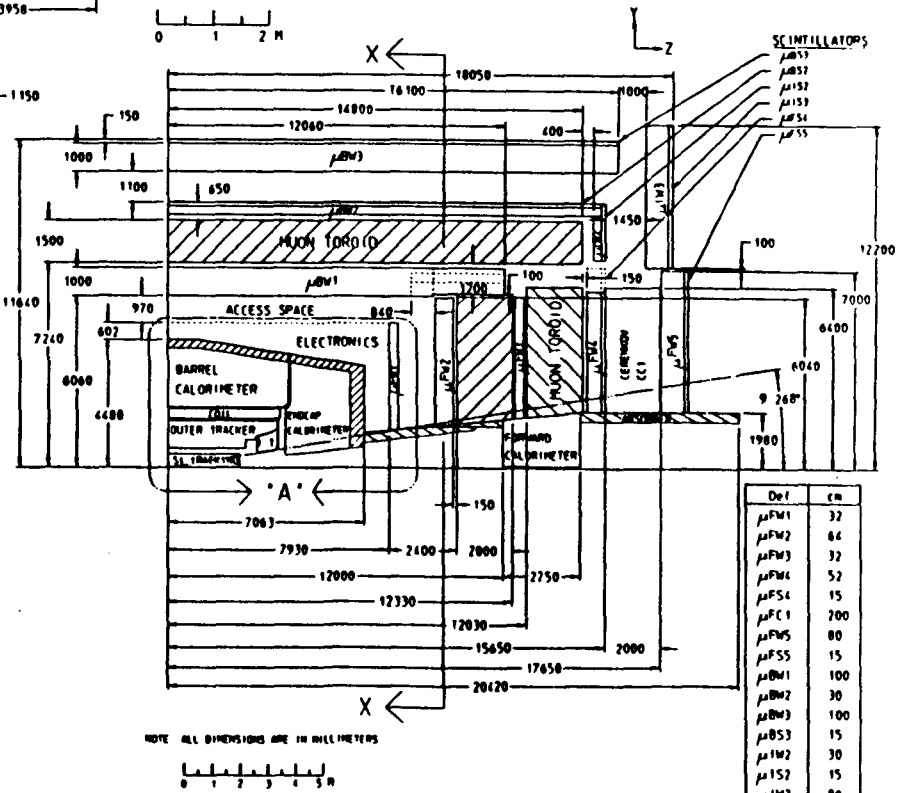
Modeling for the hall gallery platforms and utilities were done by the SSC lab personnel. The models were taped and loaded onto the ICF Kaiser Engineers network and modified to suit the installation planning effort.





SECTION X - X

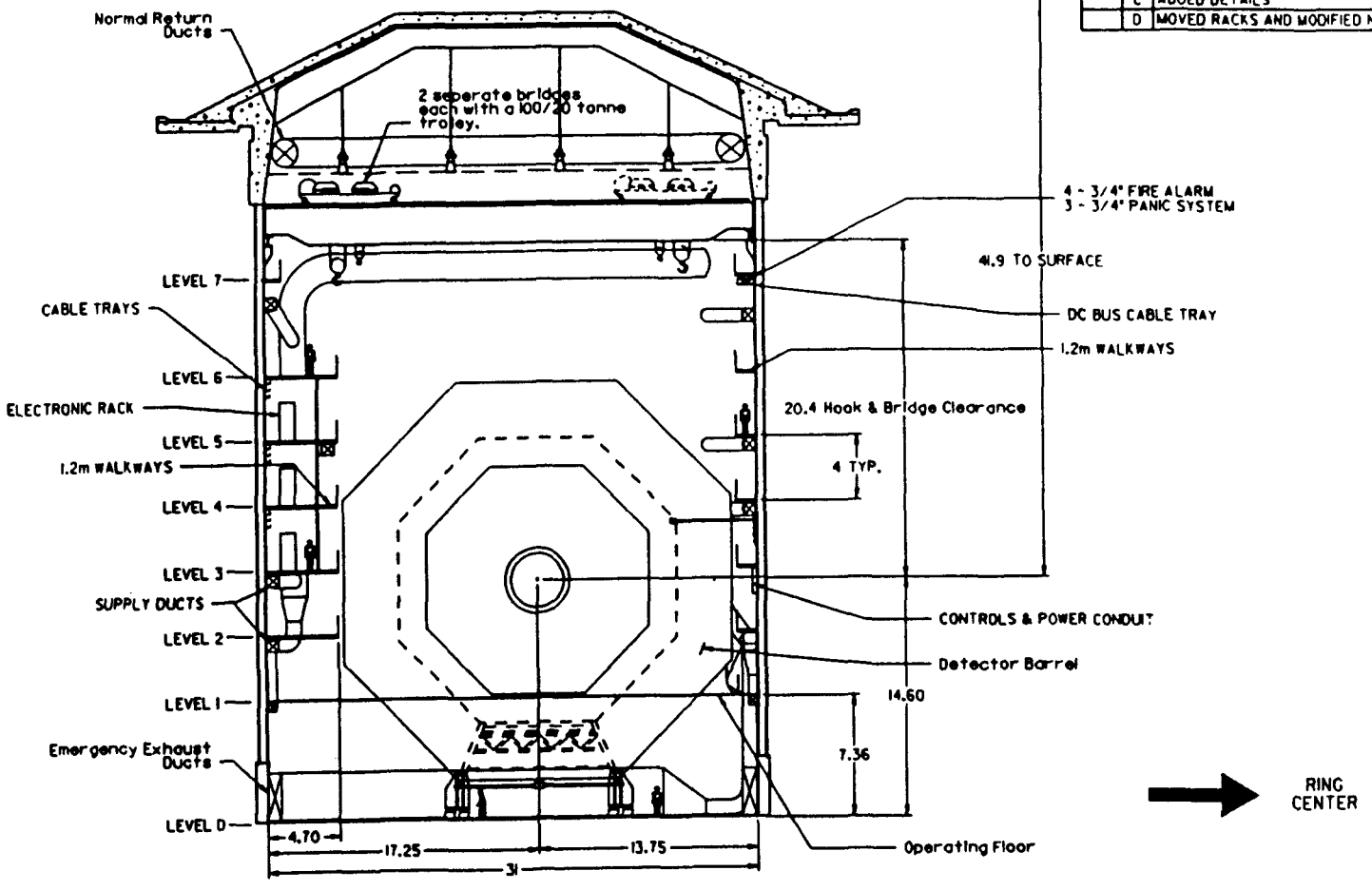
NOTE ALL DIMENSIONS ARE IN MILLIMETERS



Det	cm
μFW1	32
μFW2	64
μFW3	32
μFW4	52
μFS4	15
μFC1	200
μFW5	80
μFS5	15
μBW1	100
μBW2	30
μBW3	100
μBS3	15
μIW2	30
μIS2	15
μIW3	80
μIS3	15

SDC SCINTILLATOR CALORIMETER OPTION
CROSS SECTIONS
MAY 31, 1991 Y. MINAMIHARA
LBL DWG NO 2300135

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	MODIFIED DUCTS	6/10/91	
	B	ADDED TOP WALKWAY ON RIGHT SIDE	6/17/91	
	C	ADDED DETAILS	7/11/91	
	D	MOVED RACKS AND MODIFIED NOTES	7/17/91	



SECTION (A)

ALL DIMENSIONS ARE IN METERS

QTY	QTY	QTY	PART NUMBER	DESCRIPTION	CAGECO	ZONE	ITEM

LIST OF MATERIALS / PARTS LIST

REF ONLY - NOT TO BE MAINTAINED

DASH NO.	NEXT ASSY.	USED ON
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS

TOLERANCE OF WHOLE NUMBERS +-0.5

TOLERANCE OF DECIMALS

.X +-0.5 | .XX +-0.13 | ∠ +-5°

1. BREAK ALL SHARP EDGES 0.5 MAX.
2. DO NOT SCALE THIS DRAWING.
3. DIM. TO APPLY TO ALL - FINAL
4. MAX. ALL MACH. SURFACES.

DRAWN	PENNINGTON	DATE 5/23/91
CHKR	PILES	1/25/91
APPD		
APPD		
APPD		
APPD		
APPD		
APPD		
CONTRACT NO.		

SSC

SDC EXPERIMENTAL HALL
Transverse Section

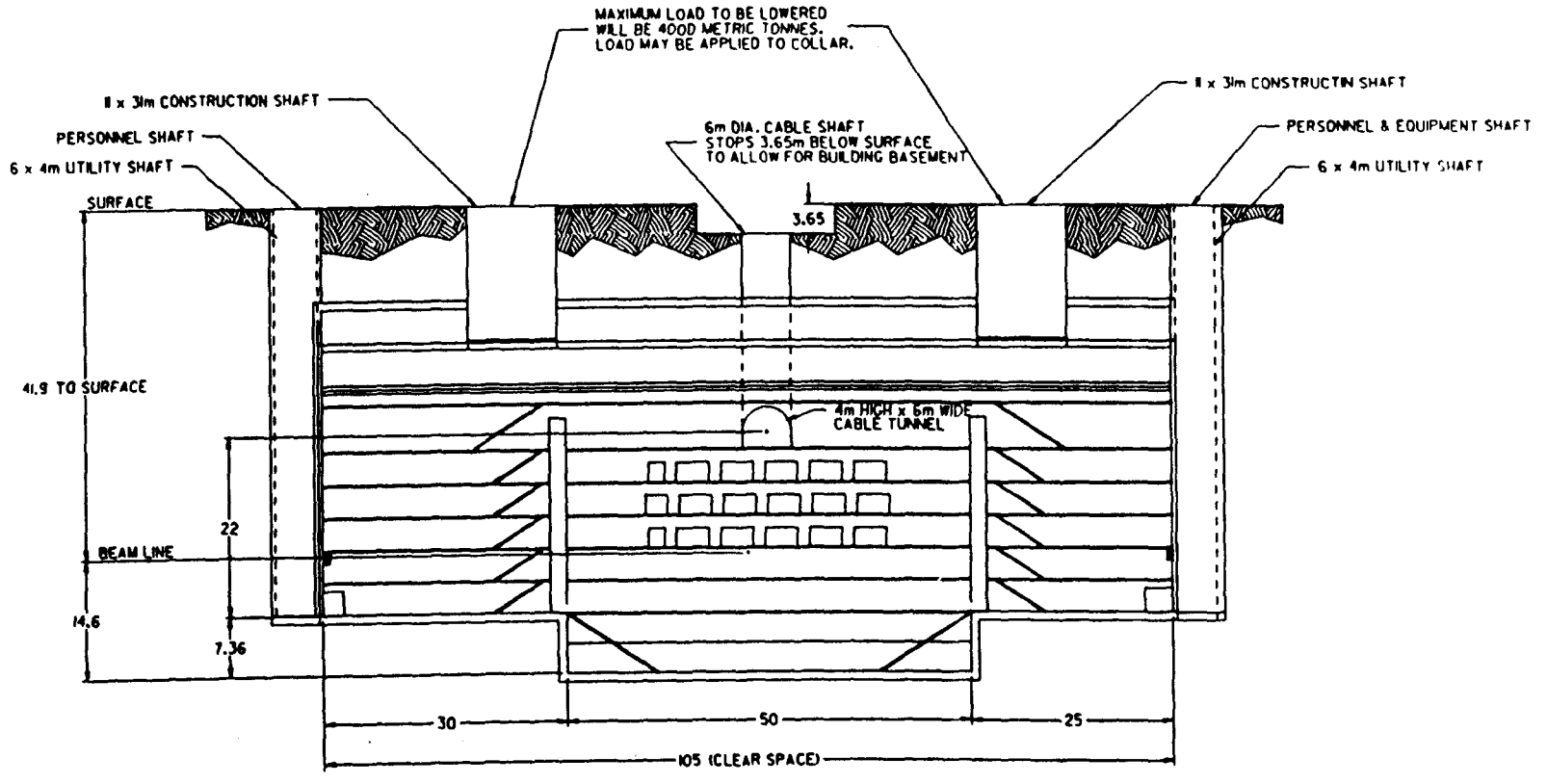
SIZE	CAGECO	DRAWING NO	REV
C		R20000293	D

WBS

SCALE | WEIGHT | SHEET OF

FIGURE 4.1.7-d

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	MOVED ELEC. RACKS AND ADDED WALKWAY	7/18/91	
	B	CABLE SHAFTED UPDATED	8-26-91	



1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.

QTY	QTY	QTY	PART NUMBER	DESCRIPTION	CAGECO	ZONE	ITEM

LIST OF MATERIALS / PARTS LIST

REF ONLY-NOT TO BE MAINTAINED		
DASH NO.	NEXT ASSY.	USED ON
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS
TOLERANCE OF WHOLE NUMBERS ±0.5
TOLERANCE OF DECIMALS .X ±0.5 .XX ±0.13 ∠ ±0°
1. BREAK ALL SHARP EDGES 0.5 MAX.
2. DO NOT SCALE THIS DRAWING.
3. DIM. TO APPR VALS - FROZ.
4. MAX. ALL MACH. SURFACES.

DRAWN	PENNINGTON	DATE 5/22/9
CHKD		
APPD		
APPD		
APPD		
APPD		
APPD		
APPD		
CONTRACT NO.	DE-AC02-89ER40...	

SSC

SDC EXPERIMENTAL HALL
FRONT ELEVATION

SIZE	CAGECO	DRAWING NO	REV
C		R20000294	B
SCALE 1:400	WEIGHT	WBS	SHEET OF

FIGURE 4.1.7-e

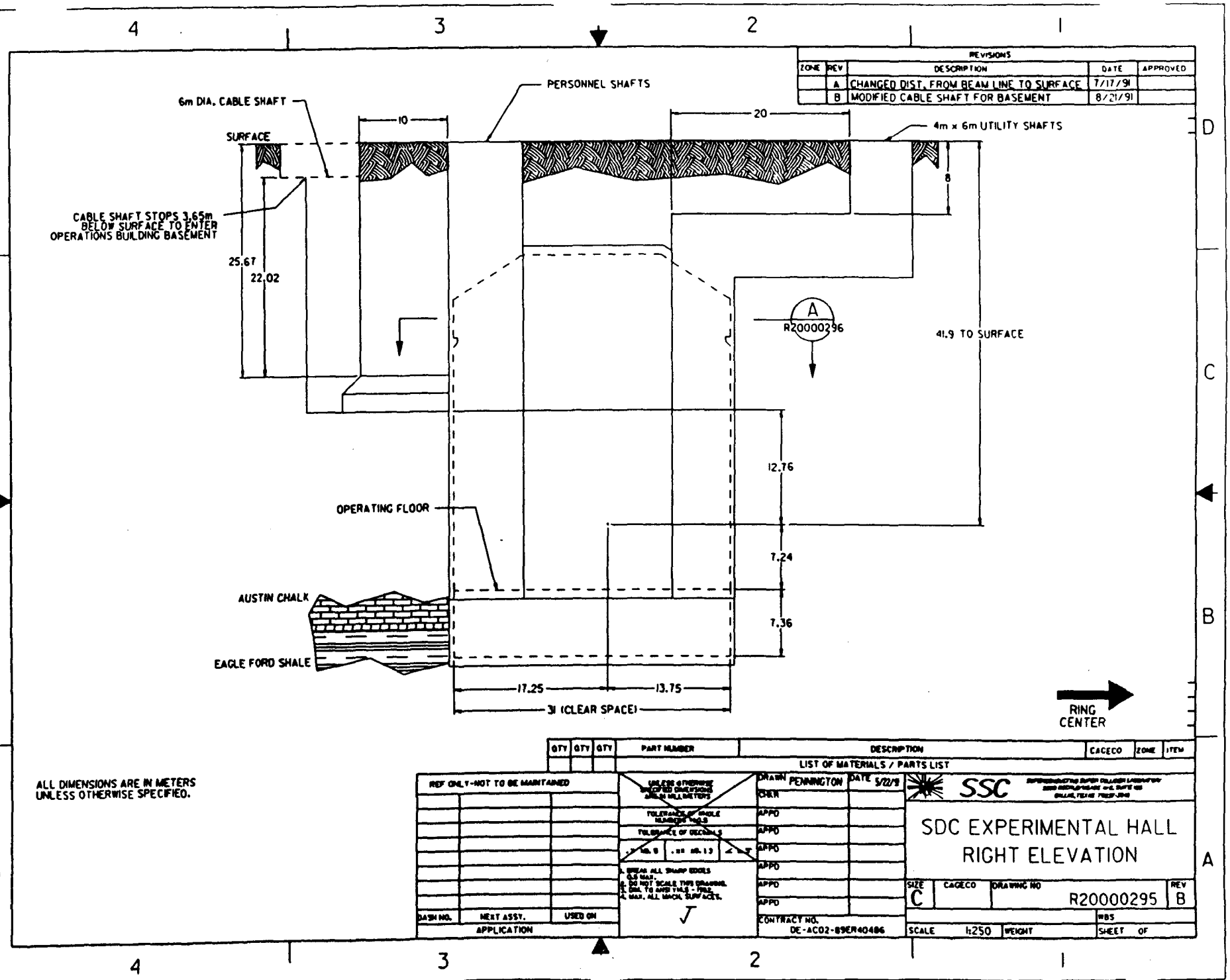

REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
A CHANGED DIST. FROM BEAM LINE TO SURFACE 7/17/91
B MODIFIED CABLE SHAFT FOR BASEMENT 8/21/91
PERSONNEL SHAFTS
6m DIA. CABLE SHAFT
SURFACE
10
20
4m x 6m UTILITY SHAFTS
8
CABLE SHAFT STOPS 3.65m BELOW SURFACE TO ENTER OPERATIONS BUILDING BASEMENT
25.67
22.02
A
R20000296
41.9 TO SURFACE
12.76
OPERATING FLOOR
7.24
AUSTIN CHALK
7.36
EAGLE FORD SHALE
17.25
13.75
31 (CLEAR SPACE)
RING CENTER
ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
QTY QTY QTY PART NUMBER DESCRIPTION CAGECO ZONE ITEM
LIST OF MATERIALS / PARTS LIST
REF ONLY-NOT TO BE MAINTAINED
DASH NO. NEXT ASSY. USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS
TOLERANCE OF WHOLE NUMBERS
TOLERANCE OF DECIMALS
1. BREAK ALL SHARP EDGES 0.5 MAX.
2. DO NOT SCALE THIS DRAWING.
3. DIM. TO AMPS VALS - TYPE.
4. MAX. ALL MACH. SURFACES.
DRAWN PENNINGTON DATE 5/22/9
CHKD
APPD
CONTRACT NO. DE-AC02-89ER40486
SSC
SDC EXPERIMENTAL HALL
RIGHT ELEVATION
SIZE C CAGECO DRAWING NO R20000295 REV B
WBS
SCALE 1:250 WEIGHT SHEET OF

FIGURE 4.1.7-8

CONSTRUCTION STATUS DRAWINGS

The drawings that follow were made during a stage of design development of the detector and therefore will not represent final design or construction concepts. However, all significant detector subsystems are present and are sized close to expected final dimensions. The drawings are thus useful for the preliminary planning that is presented in this report and should be useful as a basis for future planning.

Except for months 33 and 34, construction status drawings have been created for every month up to month 40. Beyond this month, little physical change occurs, so no further drawings arre required.

Interleaved with the monthly status drawings, construction sequence drawings have been created for some of the complex operations. These drawings also depict necessary or suggested tooling and fixtures required to perform the operations. Floor plans are also shown for some of the critical months.

For each month there is a brief narrative explaining the activities that occur during the month.

The cranes shown in the hall are shown with two trolleys per crane,wich may be necessary for some of the operations, mainly the handling of the large muon chamber trusses attached to the barrel steel. The need for the two trolleys should be studied in more detail in the future.

MANPOWER AND CRANE UTILIZATION ESTIMATE

Facing each monthly construction status drawing is a page describing the main activities that ocurr during the month. At the bottom of each page is an estimate of manpower required, crane and shaft utilization. These estimates are very preliminary.

The manpower requirements are based on the preliminary construction schedule and assumed crew sizes which have not been optimized for resource leveling.

The estimate of manhours required only includes the manhours of the subcontractor doing the work for the major peces of mechanical hardware. Manhours of crane operators, surveyors, inspectors and other lab personnel are not included. Also not included are manhours for the installation and testing of electrical or electronic equipment, conduit, cable trays, piping and hvac ductwork.

Similarly, the crane utilization hours only include the crane requirements for the major operations described. Crane utilization time for handling other items such as pallets with general supplies, materials for piping, electric wire harnesses, cable trays, etc. are not included in the estimate.

The estimated crane usage was based on the following assumed characteristics:

SHAFT CRANES: Each construction shaft is serviced by a gantry crane equipped

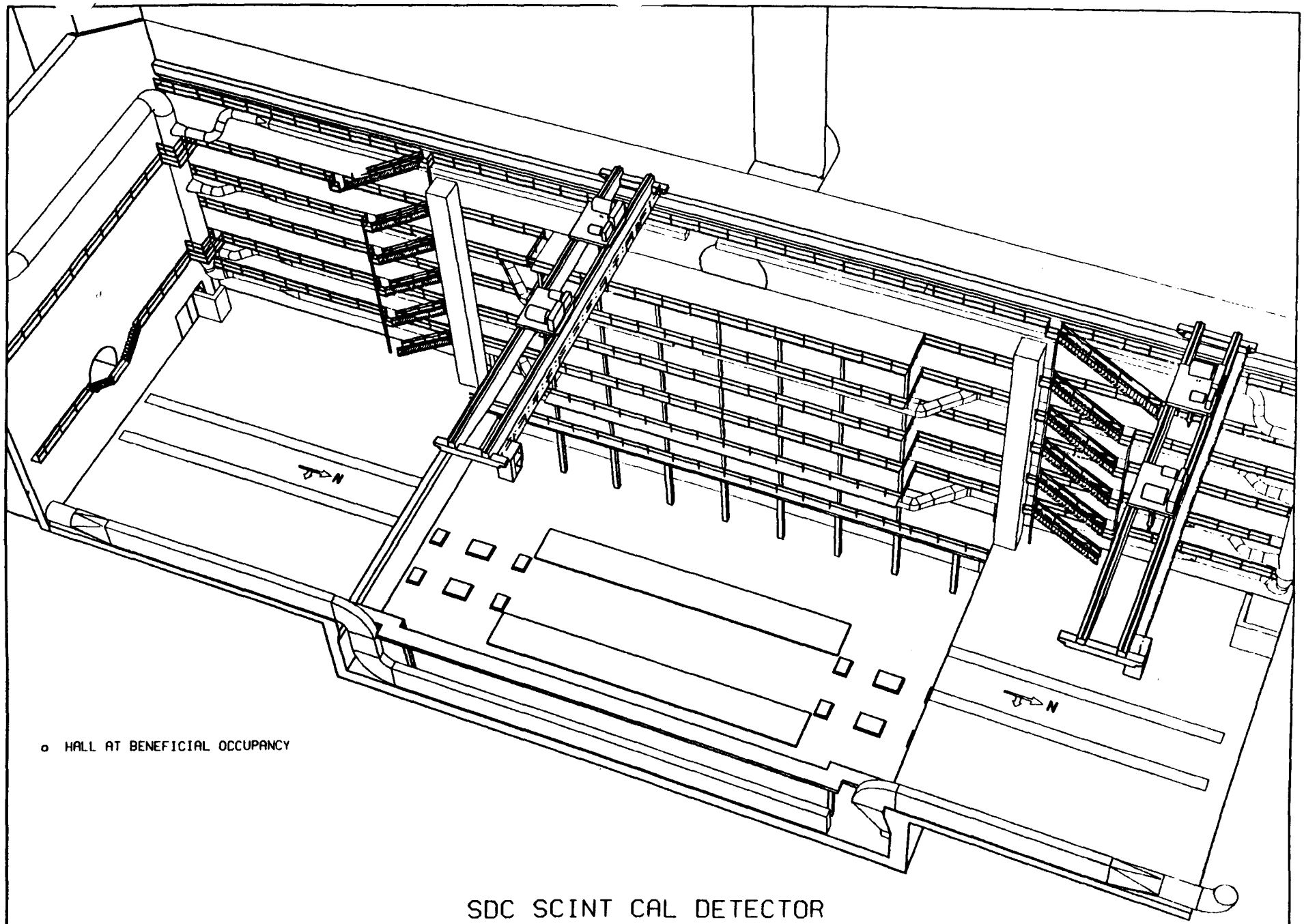
with two trolleys. Each trolley has a 50 Mton capacity, equipped with a stepless adjustable frequency control to permit gradual lowering of the loads. The crane usage times assume that loads are transported from a staging area located about 250 feet away from the construction shaft on the surface and 165 feet above the operating floor of the hall. Crane travelling and lowering speeds are 100 feet/minute and 15 feet per minute.

BRIDGE CRANES: Each hall bridge crane is equipped with a 100 Mton capacity main trolley and a 50 Mton capacity second trolley. Each trolley will be supplied with a stepless adjustable frequency hoist control. Crane travelling speed is 100 feet per minute, trolley travelling speed is 50 feet/minute and a hoist speed of 10 feet/minute.

MONTH 0

MONTH 0 shows the status of the hall when the detector assembly crews arrive (beneficial occupancy). The following are assumptions as to what constitutes beneficial occupancy:

- Hall structural concrete completed with hatches open and cover to protect from the elements.
- Electrical power supply available.
- Stairs and elevators for access to the hall completed and operational.
- Two 100 metric ton capacity overhead bridge cranes installed and operational.
- Air conditioning and all ductwork installed and operating.
- Fire protection system installed and tested.
- Internal stairs, elevators, walkways, and gallery platforms completed.
- Lighting completed.
- Power outlets and welding outlets available.
- All roller tracks and floor plates on the operating floor are installed.
- All sole plates, anchor bolts and lifting pads in the detector basement are installed.



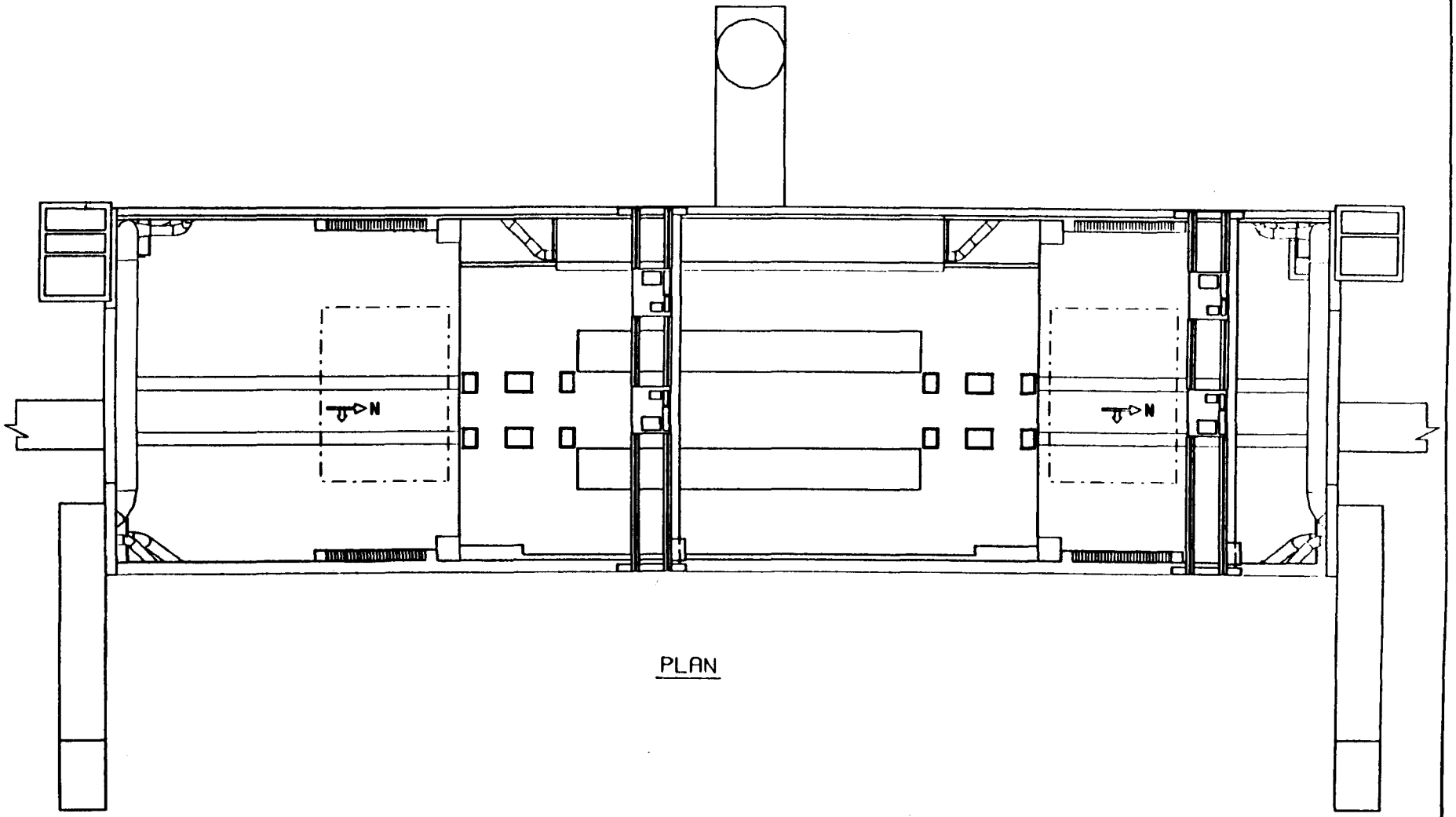
o HALL AT BENEFICIAL OCCUPANCY

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 0

ICF KAISER ENGINEERS 8-22-91 MODEL 523M0045.DGN MONTH00.HLN



PLAN

SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 0

ICF KAISER ENGINEERS 9-19-91 523M46.MTH0

MONTH 1

During month 1, mobilization of the contractors will occur. The contractors will establish their shops, offices and warehousing of their tools and supplies. Temporary lunch rooms and portable toilets will be installed.

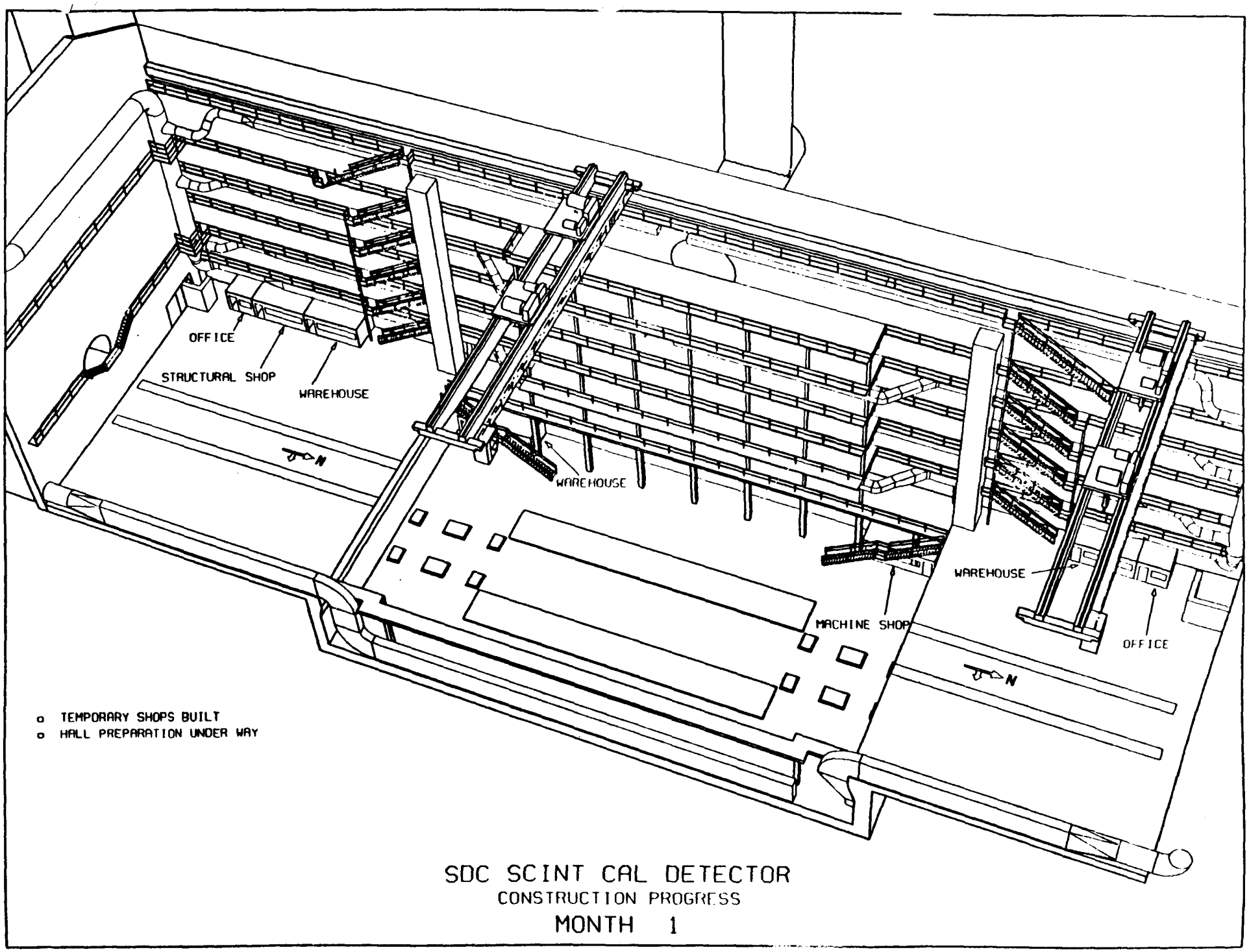
During this period, training of operating personnel will take place, including the crane operators.

Accurate surveying monuments will be installed.

Location of anchor bolts and other embedded items in the concrete will be checked.

MANPOWER AND CRANE UTILIZATION ESTIMATE FOR ABOVE ITEMS

Manpower required	3000 manhrs	
	SOUTH END	NORTH END
Shaft crane usage	75 hrs	50 hrs
Bridge crane usage	100 hrs	75 hrs
Large objects lowered from surface	4 construction trailers	3 construction trailers



SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 1

ICF KAI 8-22-91 MODEL 523M0045.DGN MONTH01.HLN

MONTH 4

The hydraulic jacking system will be installed during this month and the temporary supports removed. Final alignment of the support beams will be done before inclined plate installation begins.

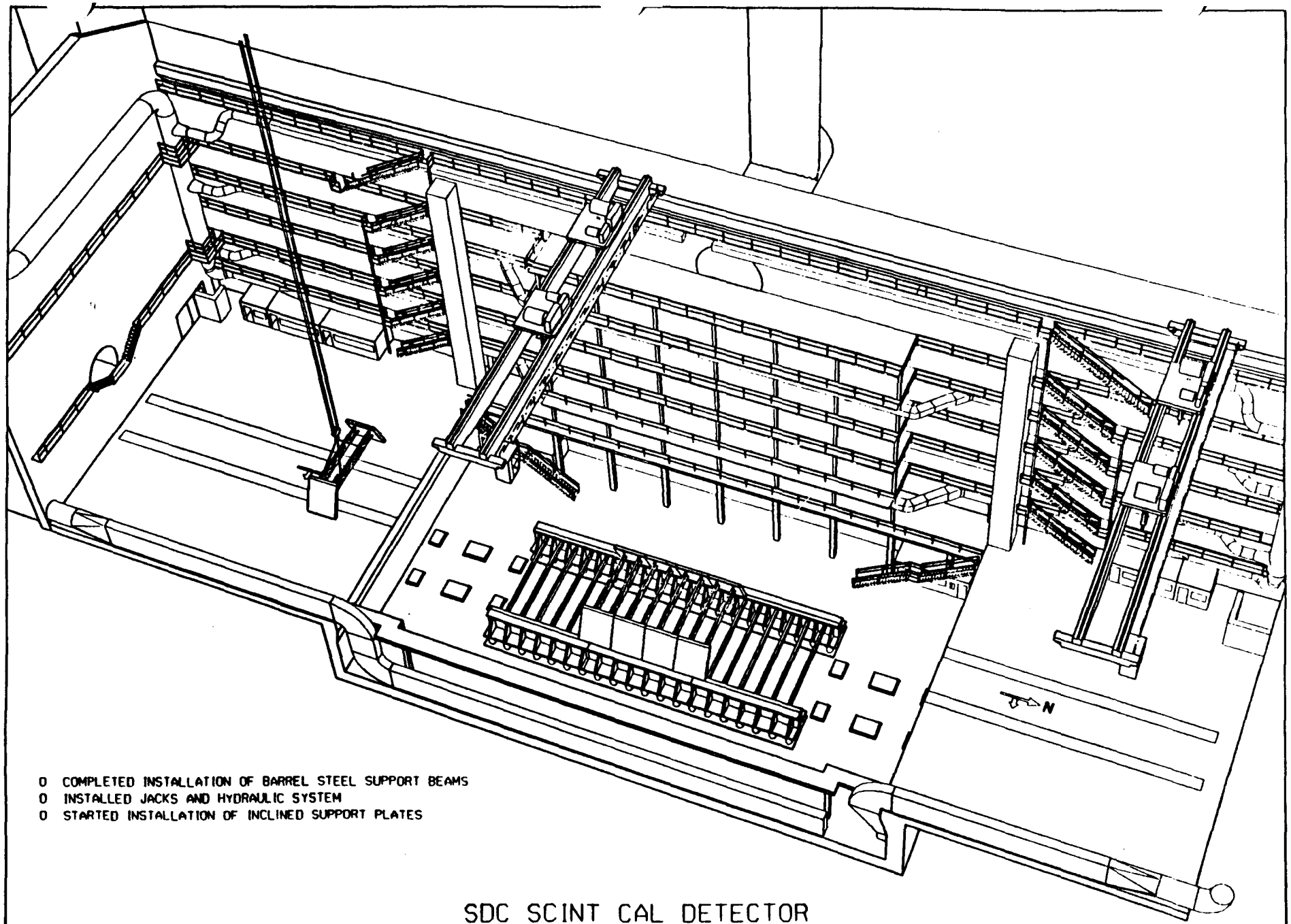
The hydraulic jacking system will be used to level and align the detector during construction. Later it will be used to realign the detector to compensate for settling or heave of the foundation system.

The hydraulic jacks are provided with adustable collars so that once alignement is accomplished the detector weight will rest on the collars, after which the hydraulic system can be de-pressurized.

Installation of the inclined barrel support plates will also be started during the month. These plates will be preassembled on the surface in modules weighing in the order of 80 metric tons so that they can be handled by the bridge cranes.

MANPOWER AND EQUIPMENT UTILIZATION ESTIMATE

Manpower required	3000 manhrs	
	SOUTH END	NORTH END
Shaft cranes usage	40 hrs	30 hrs
Bridge cranes usage	80 hrs	60 hrs
Large objects lowered from surface	3 inclined support plate trusses	2 inclined support plate trusses



- COMPLETED INSTALLATION OF BARREL STEEL SUPPORT BEAMS
- INSTALLED JACKS AND HYDRAULIC SYSTEM
- STARTED INSTALLATION OF INCLINED SUPPORT PLATES

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 4

[illegible] ENGINEERS 8-22-91 MODEL 523M0045.DGN MONTH04.HLN

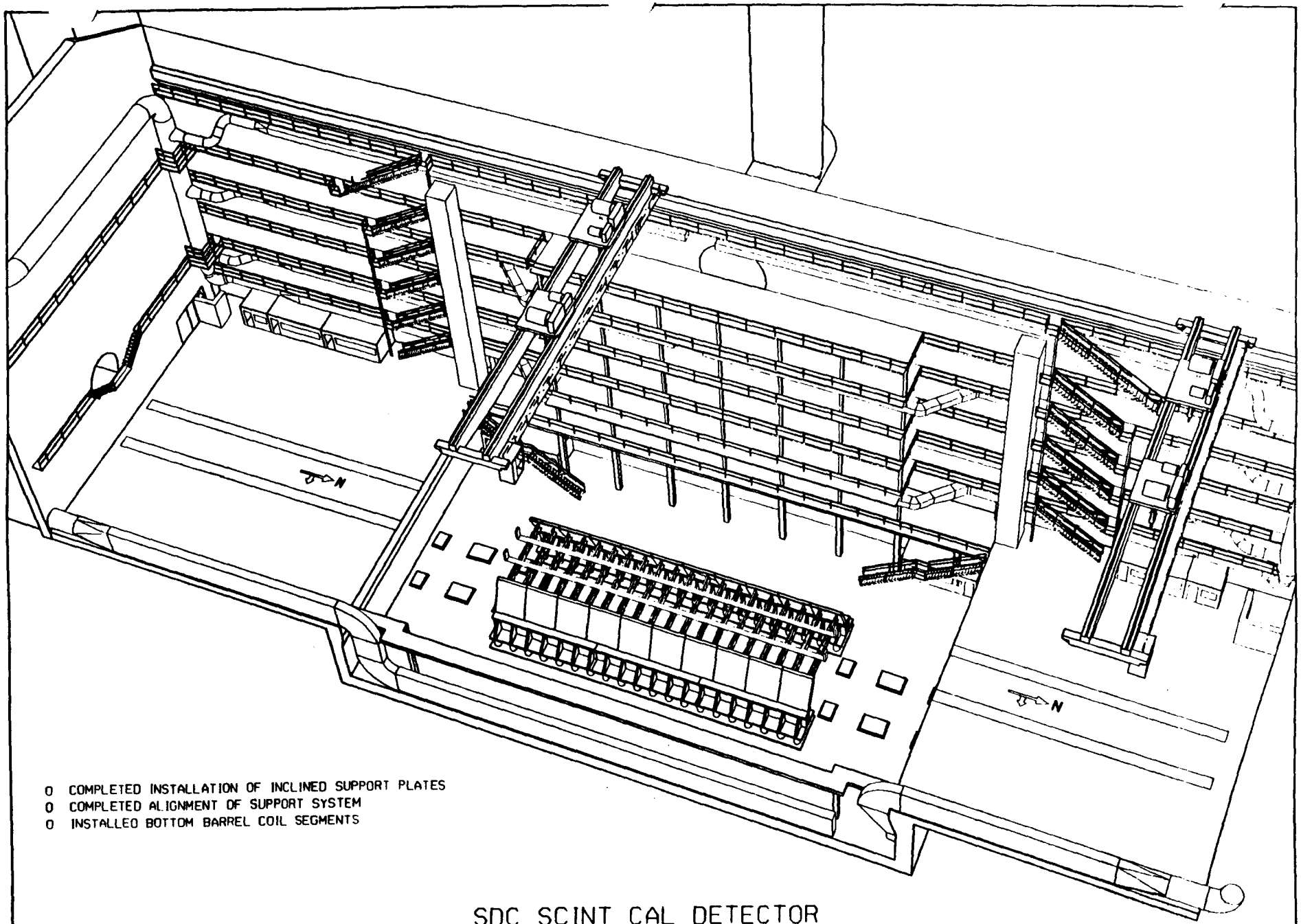
MONTH 5

The installation and alignment of the inclined support plates is completed during this month. Alignement of the inclined plates will be accomplished with hydraulic jacks while the bolts fastening the plates to the transverse trusses are loose.

During the early periods of design it was established that the muon steel barrel coil bottom segments could not be installed after the muon barrel was erected. It has therefore been necessary to plan on placing these items in their final location on temporary supports at this time.

MANPOWER AND EQUIPMENT UTILIZATION

Manpower required	2000 manhrs	
	SOUTH END	NORTH END
Shaft cranes usage	50 hrs	40 hrs
Bridge cranes usage	100 hrs	80 hrs
Large objects lowered from surface	2 inclined support plates 2 barrel coil segments	3 inclined support plates



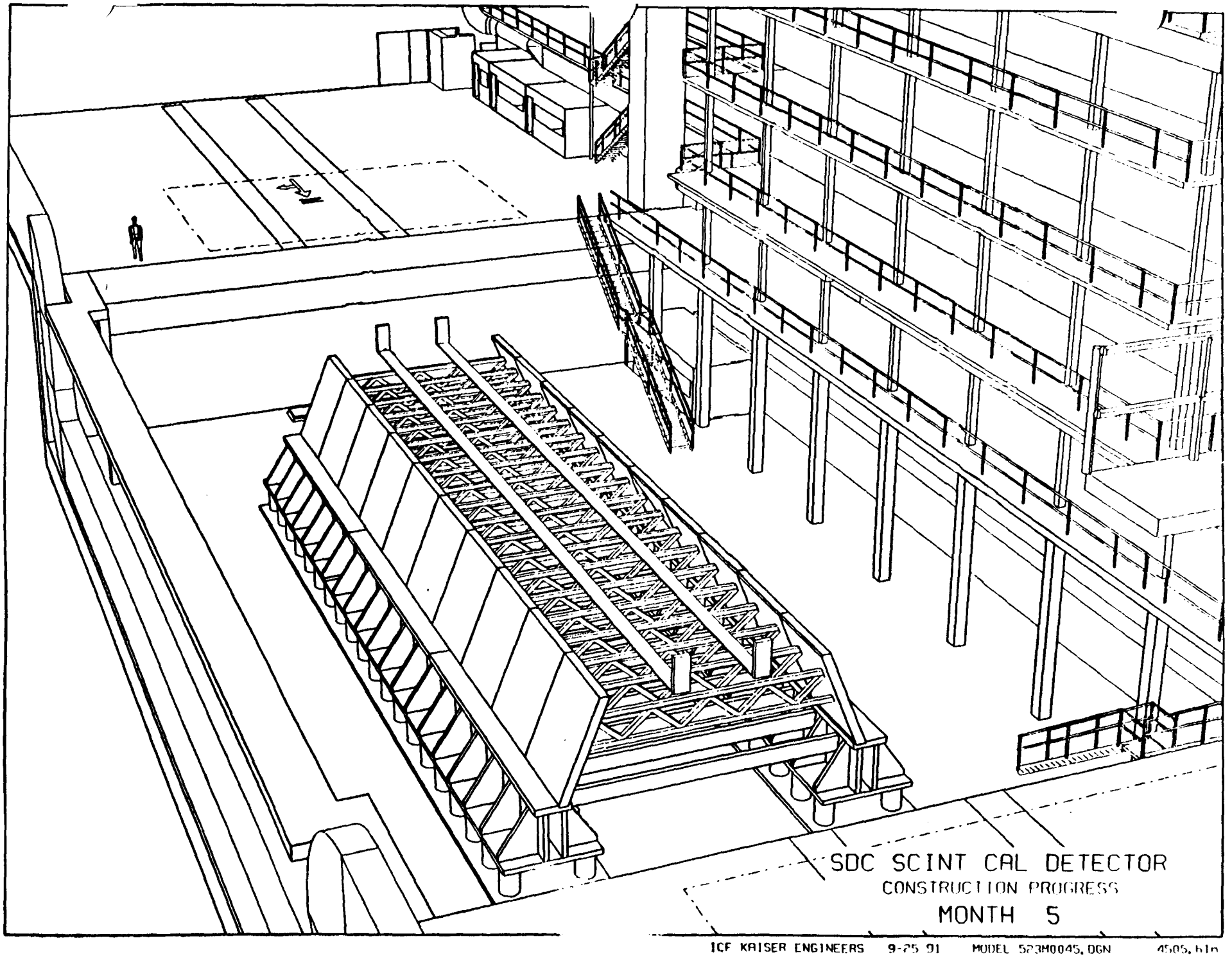
- COMPLETED INSTALLATION OF INCLINED SUPPORT PLATES
- COMPLETED ALIGNMENT OF SUPPORT SYSTEM
- INSTALLED BOTTOM BARREL COIL SEGMENTS

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 5

ICF KAISER ENGINEERS 8-22-91 MODEL 523M0045.DGN MONTH05.HLN



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

MONTH 6

During month 6, the bottom segment of the muon steel barrel blocks will be placed on the inclined plate supports. Each block weighs in the order of 80 metric tons. These blocks will be assembled from four plates by bolts, machined at the contractor's yard and transported to the job site where they will be picked up by the surface cranes and lowered to the hall floor. Both construction shafts will be used for this operation.

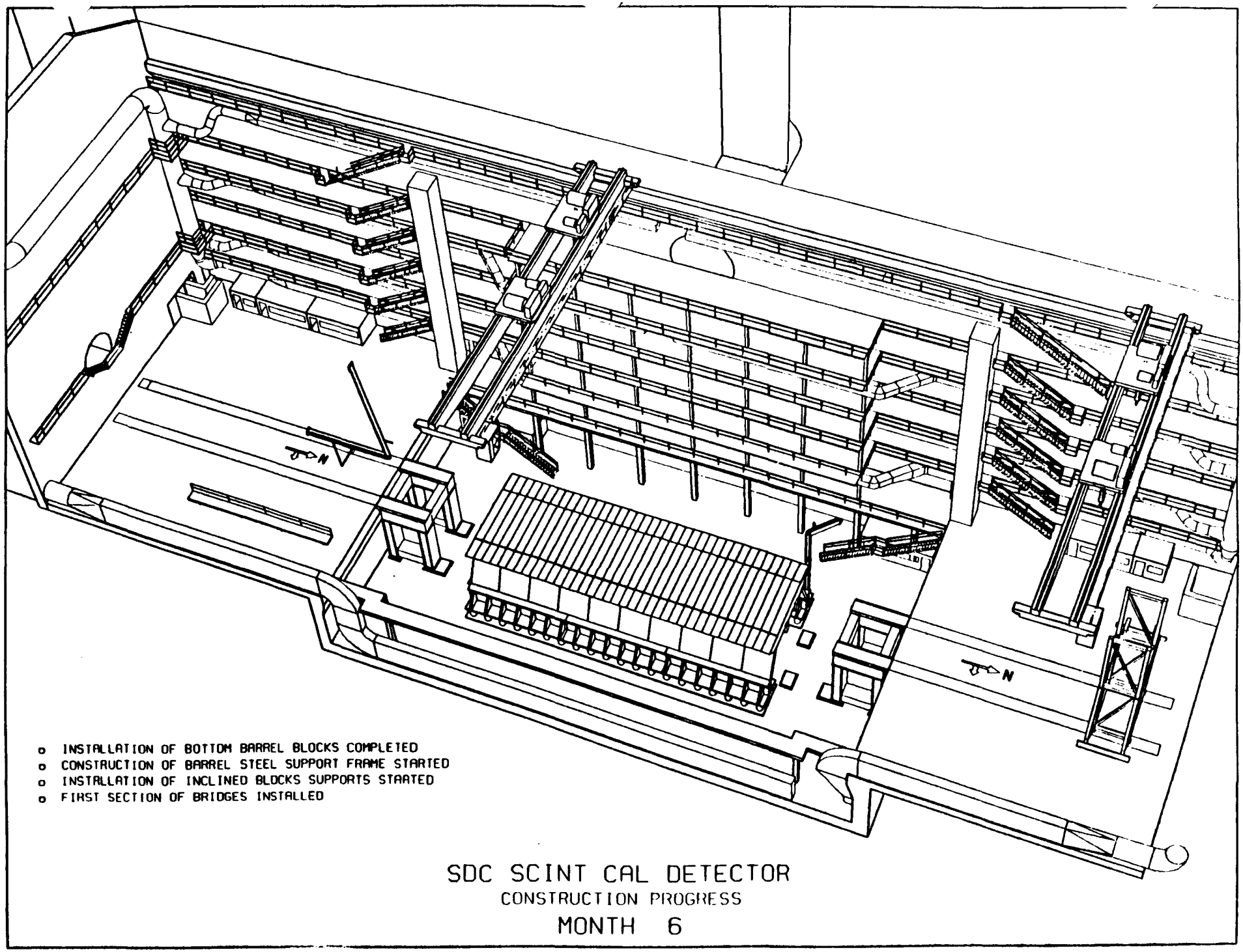
Construction of the barrel steel assembly frame has started. This frame could be constructed in modules on the surface to speed-up the erection.

Erection of the inclined block supports has also started this month. Again these supports would be modularized and prefabricated on the surface.

Installation of the pit bridges has started. These bridges will be made in two sections to facilitate their removal when the detector is assembled. Each section will weigh in the neighborhood of 75 metric tons. One of these sections at each end of the detector is designed to permit the lowering or elevating the forward toroid to match rails before rolling it into the operating floor during disassembly of the detector.

MANPOWER AND CRANE UTILIZATION ESTIMATE FOR THE ABOVE ITEMS

Manpower required	3000 manhrs	
	SOUTH END	NORTH END
Shaft crane usage	50 hrs	60 hrs
Bridge cranes	100 hrs	120 hrs
Large objects lowered from surface	19 bottom barrel blocks one bridge section 2 inclined plates support bents 1 walkway section	18 bottom barrel blocks one bridge section 4 prefab sections of barrel assembly frame



- INSTALLATION OF BOTTOM BARREL BLOCKS COMPLETED
- CONSTRUCTION OF BARREL STEEL SUPPORT FRAME STARTED
- INSTALLATION OF INCLINED BLOCKS SUPPORTS STARTED
- FIRST SECTION OF BRIDGES INSTALLED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 6

ICF KAISER ENGINEERS 8-20-91 MODEL 523M0045.DGN MONTH06.HLN

MONTH 7

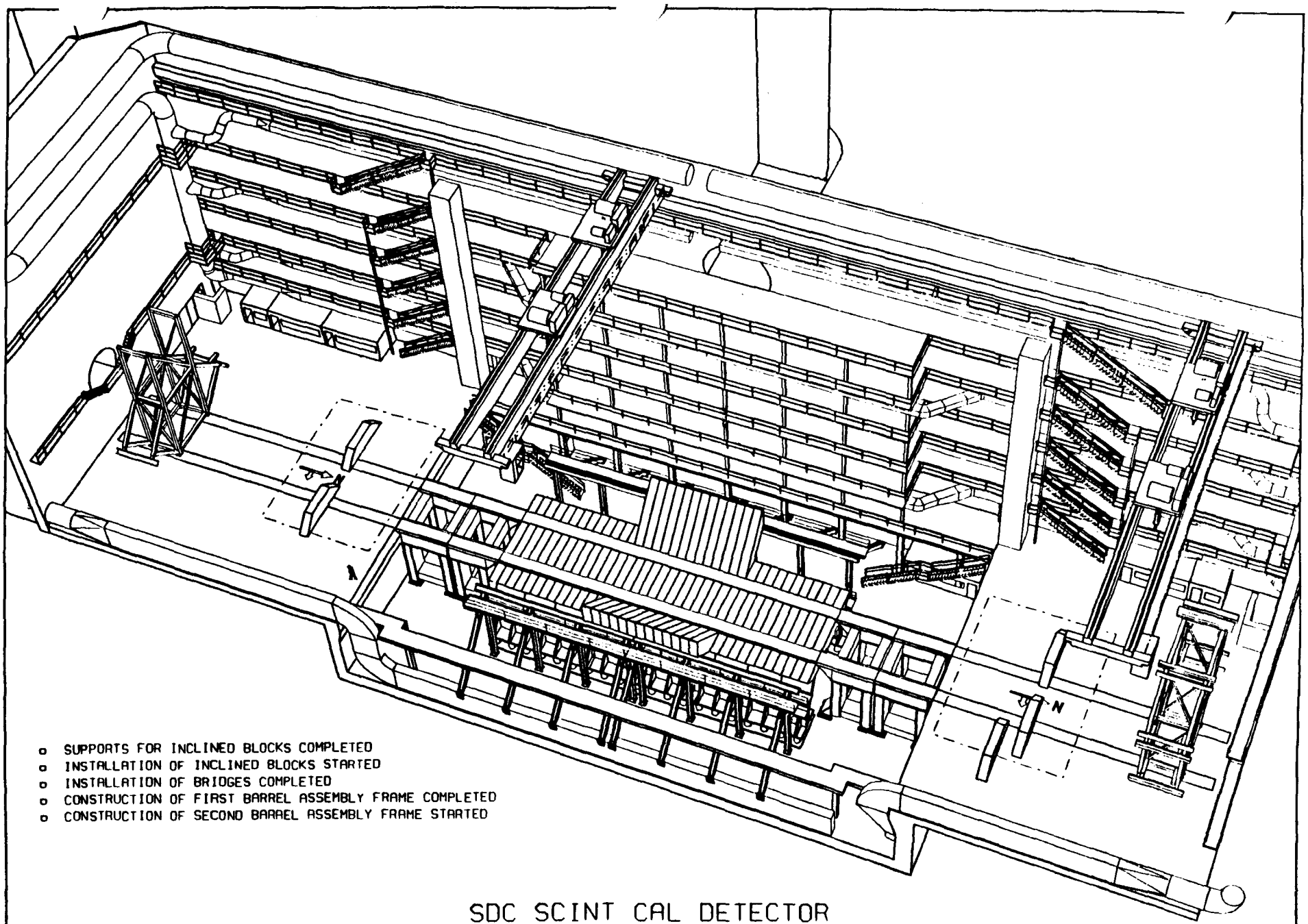
Temporary supports for the installation of the inclined blocks for the muon steel barrel are completed this month. This allows for the inclined block installation. These blocks are toe bolted to the bottom blocks. Platforms are needed for access to the bolts. Please note the platforms provided at two different levels on the drawings for month 7. The temporary block supports will permit the alignment of the inclined blocks before bolting to the bottom blocks, and preclude any shock loading of the bolts when the hall crane is used to support the blocks while installing the toe bolts. Using temporary supports will increase availability of the cranes for block installation.

Installation of the pit bridges are completed this month. Construction personnel are thus allowed easier access to the bottom barrel blocks in order to complete the toe bolting of the inclined plates to the bottom plates. The bridges will also be used on the following month for rolling the assembly frames onto the barrel floor.

One barrel assembly frame is completed this month while the erection of the second one is started.

MANPOWER AND CRANE UTILIZATION ESTIMATE FOR THE ABOVE ITEMS

Manpower required	3000 manhours	
	SOUTH END	NORTH END
Shaft cranes usage	70 hrs	70 hrs
Bridge cranes usage	120 hrs	120 hrs
Large objects lowered from surface	16 inclined blocks one bridge section 4 prefab sections of barrel assembly frame 7 inclined blocks support bents 3 walkway sections	16 inclined blocks one bridge section 4 prefab sections of barrel barrel assembly frame 7 inclined blocks support bents 4 walkway sections



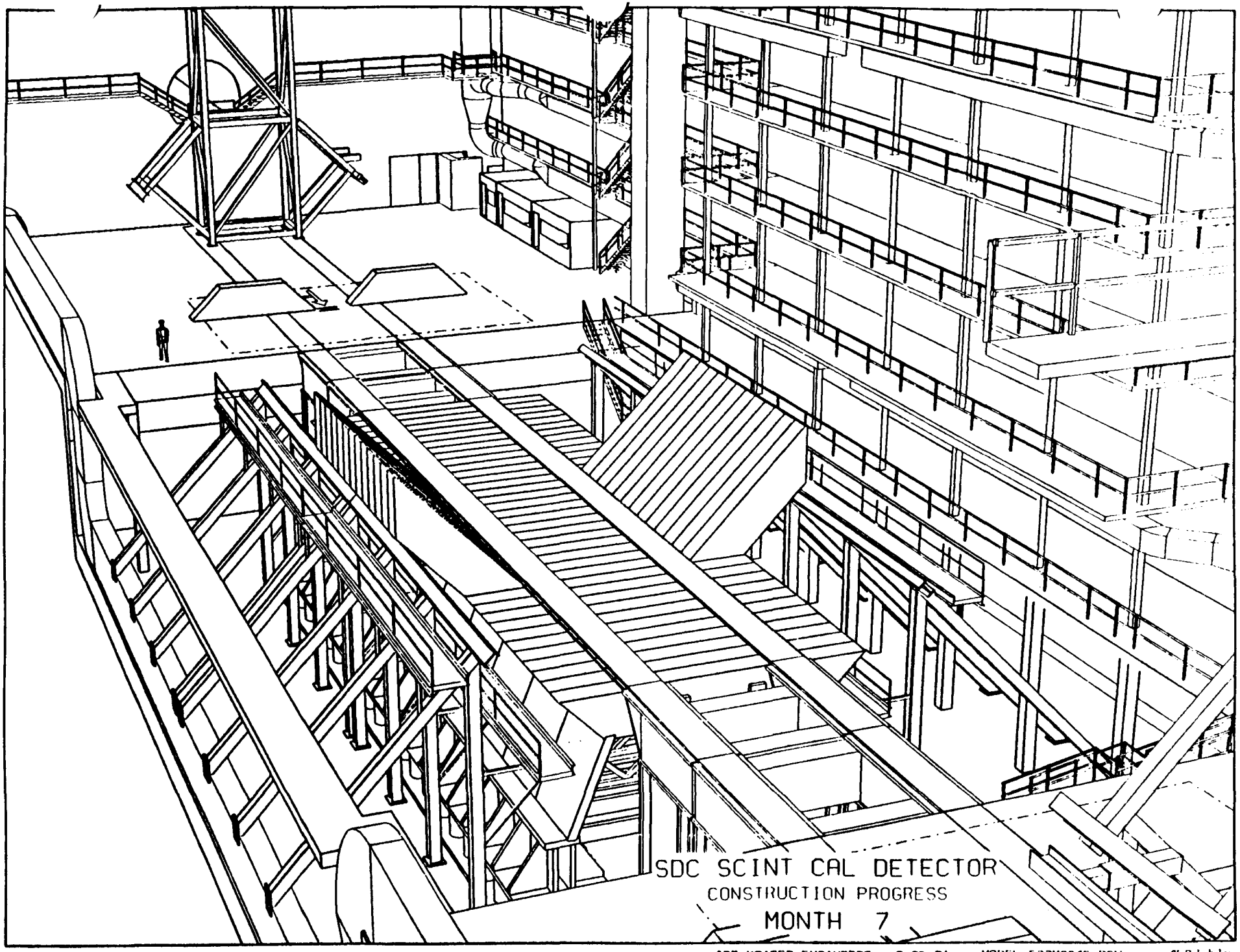
- SUPPORTS FOR INCLINED BLOCKS COMPLETED
- INSTALLATION OF INCLINED BLOCKS STARTED
- INSTALLATION OF BRIDGES COMPLETED
- CONSTRUCTION OF FIRST BARREL ASSEMBLY FRAME COMPLETED
- CONSTRUCTION OF SECOND BARREL ASSEMBLY FRAME STARTED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 7

ICF KAISER ENGINEERS 9-24-91 MODEL 523M0045.DGN MONTH07.HLN



ICF KAISER ENGINEERS 9-25-91 MODEL 523M0045.DGN 4507.bin

MONTH 8

The first barrel assembly frame is rolled into place and erection of the first ring of blocks has been started. The assembly frame is fully adjustable by means of hydraulic jacks, and is designed to support the weight of the top three segments of the barrel.

The assembly frames are used to support the barrel blocks around it and permit alignement of the blocks while they are being bolted. When all blocks in the ring are installed, the frame will contract slightly so that it can be moved to the next position.

Depending on the longitudinal bolt arrangement used to hold the blocks together, the previously completed ring of blocks may have to be preset by jacking posts before the next ring of blocks are completed and the assembly frame is moved.

Please note on the drawing for month 8 the temporary platforms installed for toe bolting the blocks.

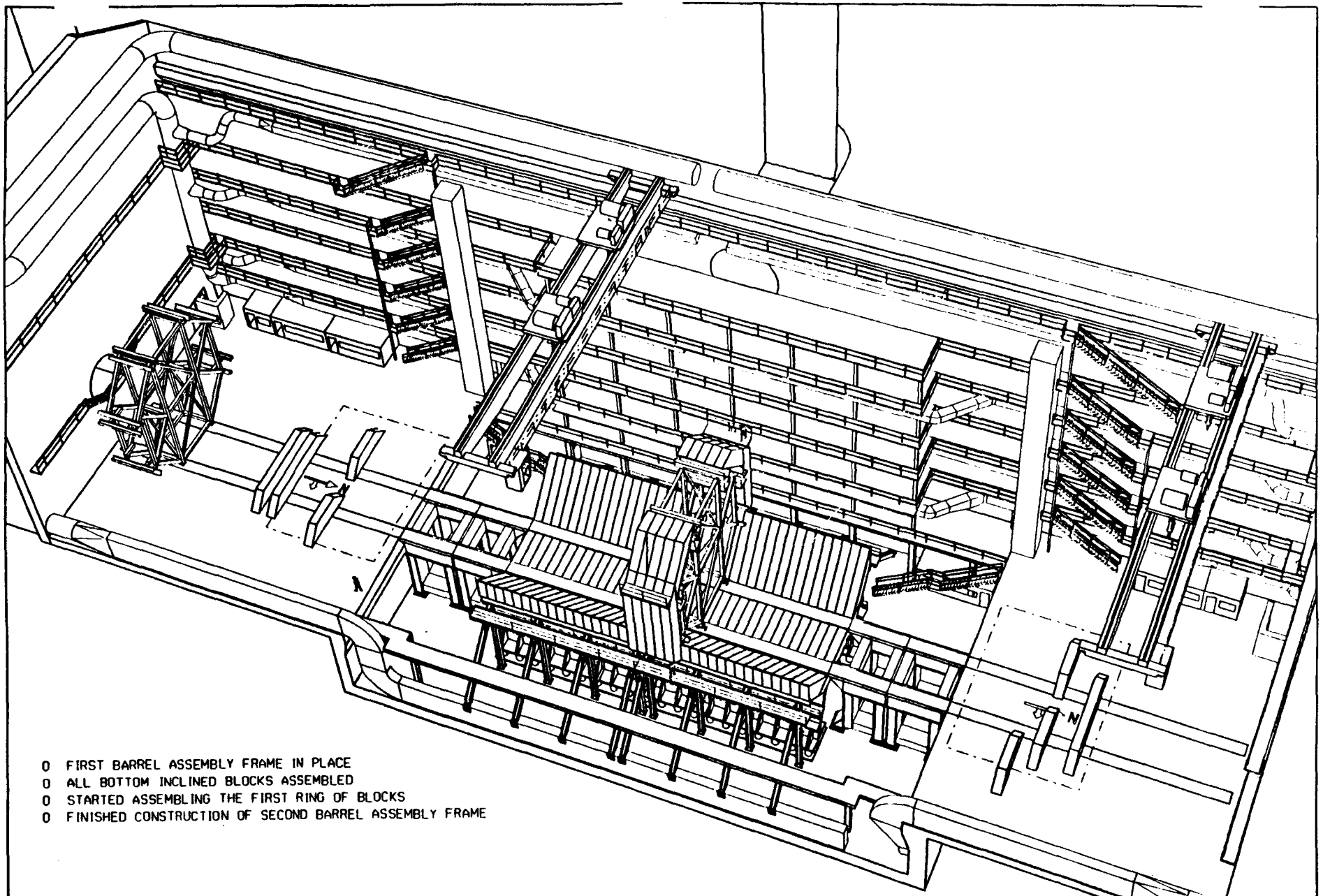
A second assembly frame has been completed on the south side of the hall and will soon be rolled into the barrel.

Since these assembly frames will be rather expensive, it may not be necessary to build a second one if some delay in the schedule can be tolerated. A cost to benefit study should be done before a decision is made on the subject. The schedule however reflects the utilization of two assembly frames.

MANPOWER AND EQUIPMENT UTILIZATION ESTIMATE FOR THE ITEMS ABOVE

Manpower required 3000 manhrs

	SOUTH END	NORTH END
Shaft cranes usage	90 hrs	70 hrs
Bridge cranes usage	150 hrs	120 hrs
Large objects lowered from surface	26 inclined blocks 7 vertical blocks 4 sections of barrel assembly frame	26 inclined blocks 6 vertical blocks

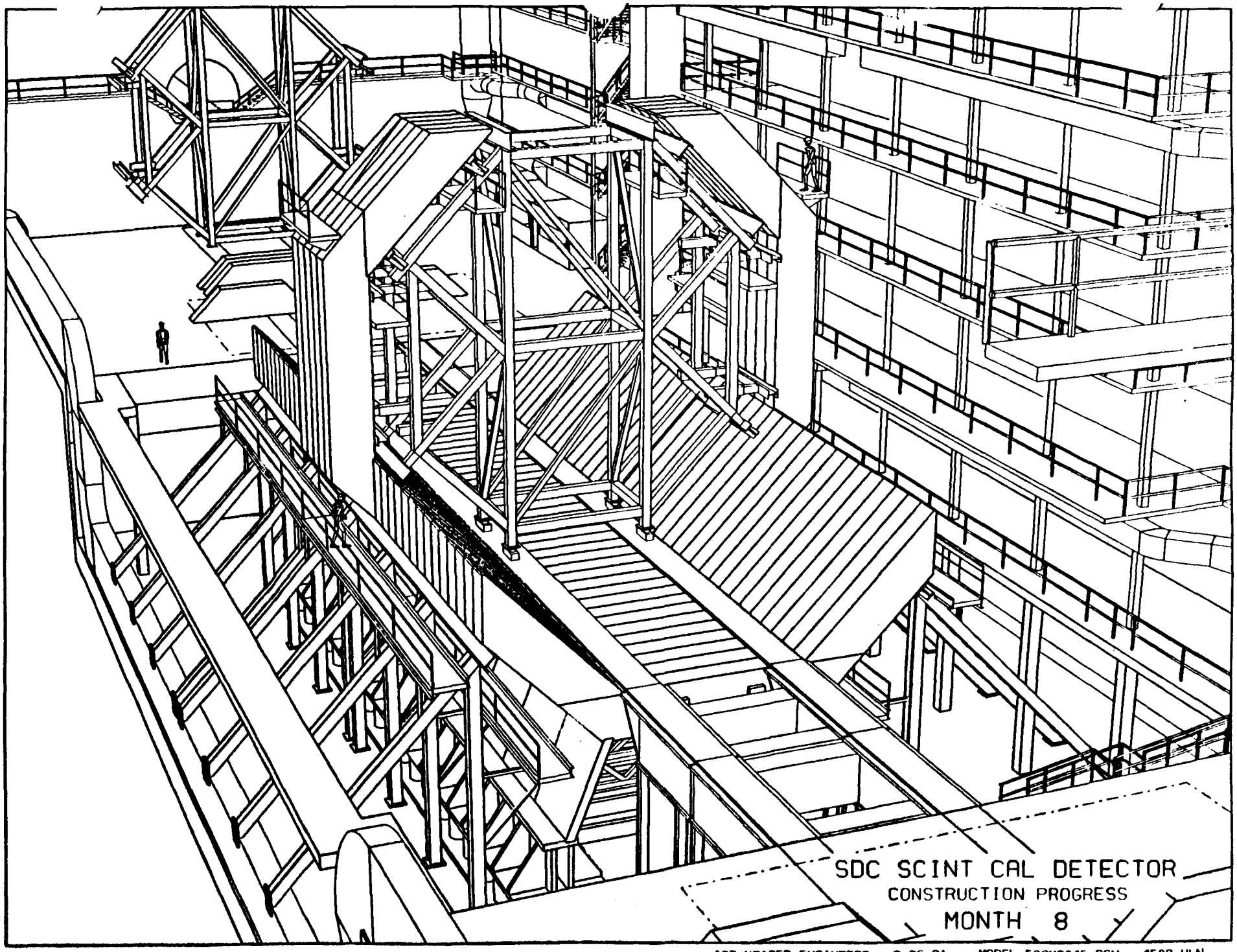


SDC SCINT CAL DETECTOR

CONSTRUCT

MONTH 8

KAISER ENGINEERS 9-24-91 MODEL 523MPH45.DGN MONTH08.HLN



ICF KAISER ENGINEERS 9-26-91 MODEL 523M0045.DGN 4508.HLN

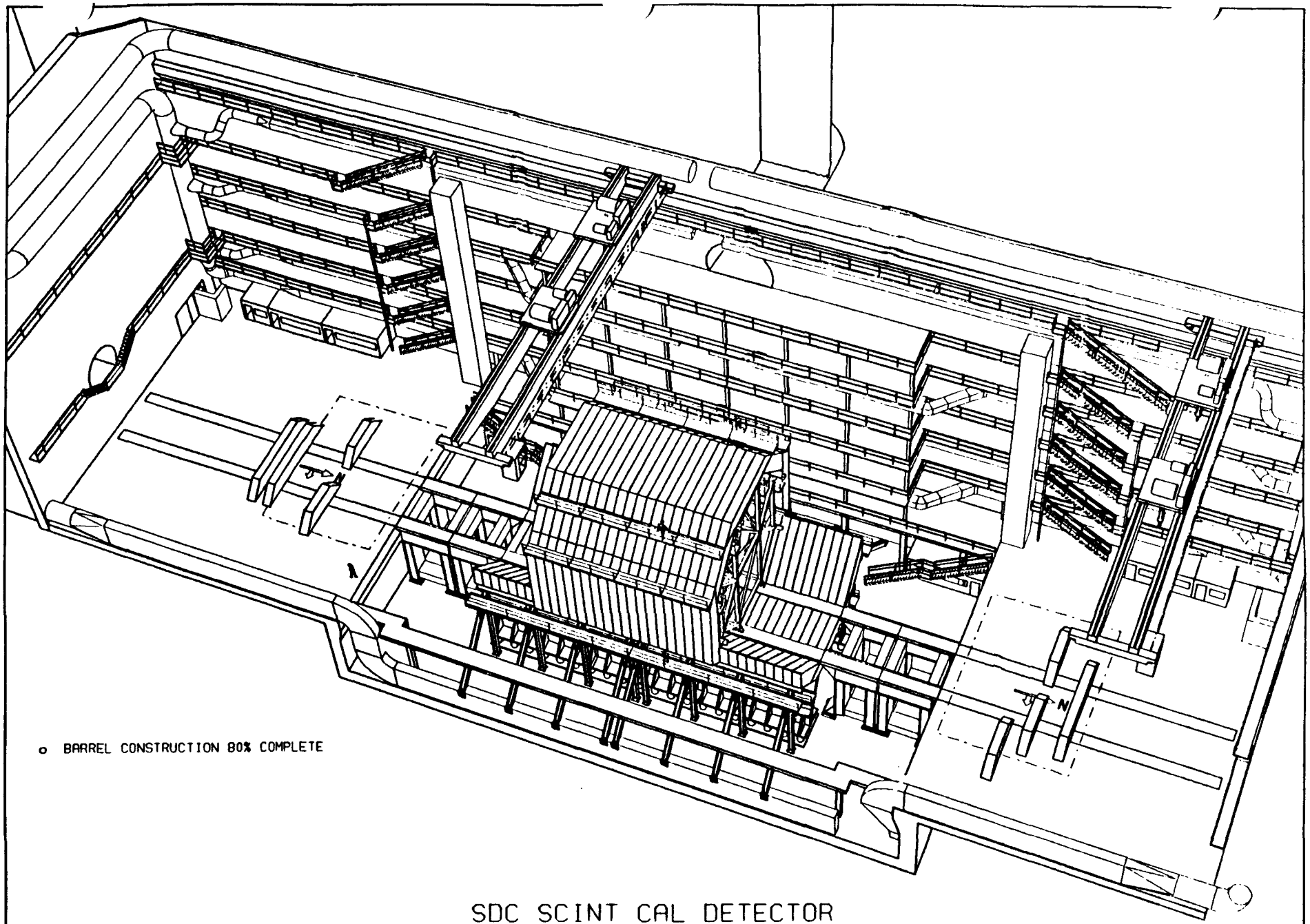
MONTH 9

Month 9 shows the barrel 91% completed. 82 new blocks were installed on the muon steel barrel.

An end view drawing allows a better view of the situation at month 9.

MANPOWER AND CRANE UTILIZATION ESTIMATE FOR THE ABOVE ITEMS

Manpower required	3000 manhrs	
	SOUTH END	NORTH END
Shaft cranes usage	90 hrs	90 hrs
Bridge cranes usage	150 hrs	150 hrs
Large objects lowered from the surface	15 inclined blocks 15 vertical blocks 11 horizontal blocks	15 inclined blocks 15 vertical blocks 11 horizontal blocks

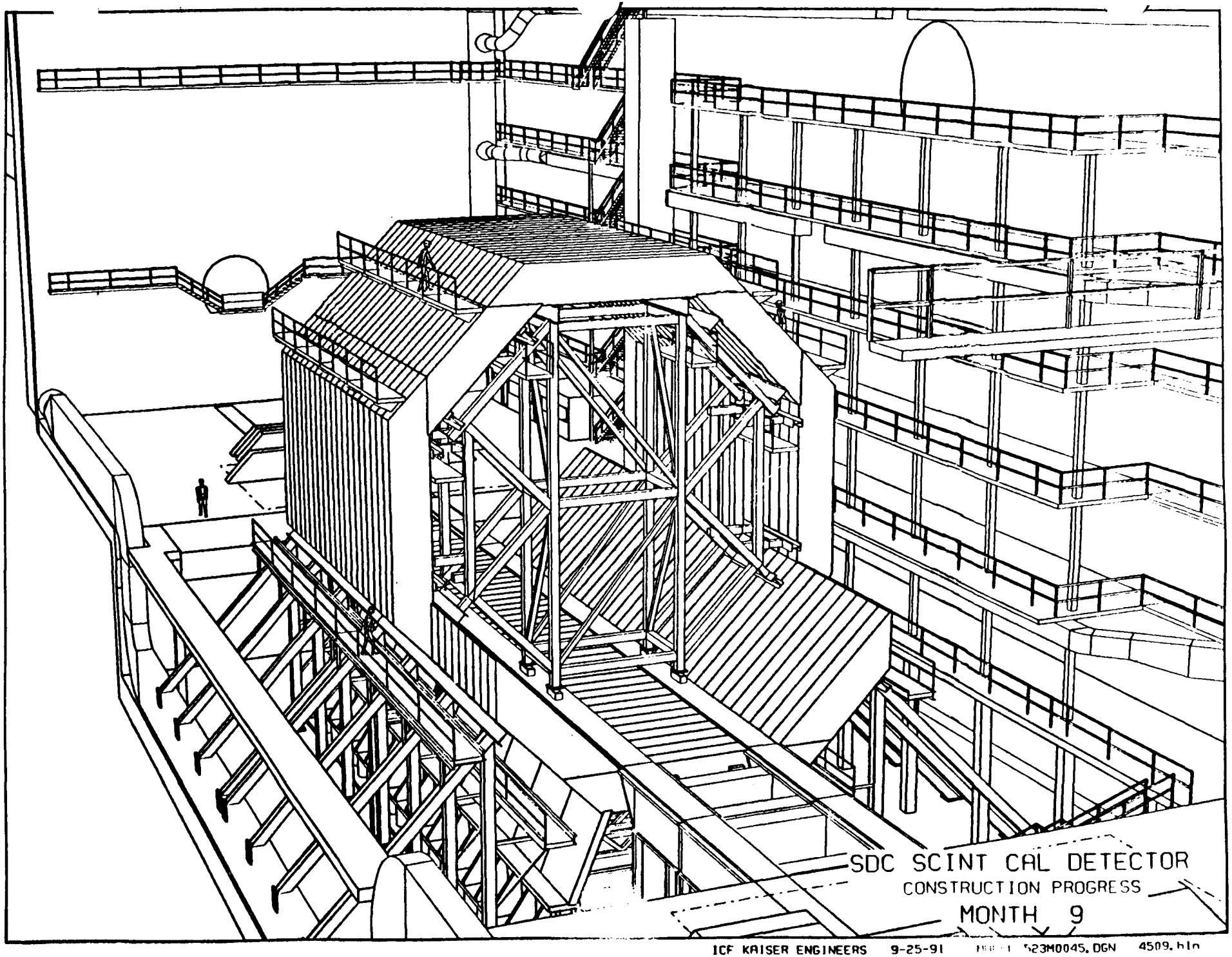


SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 9

ICF KAISER ENGINEERS 9-24-91 MODEL 523M0045.DGN MONTH09.HLN



ICF KAISER ENGINEERS 9-25-91 523M0045.DGN 4509.hln

MONTH 10

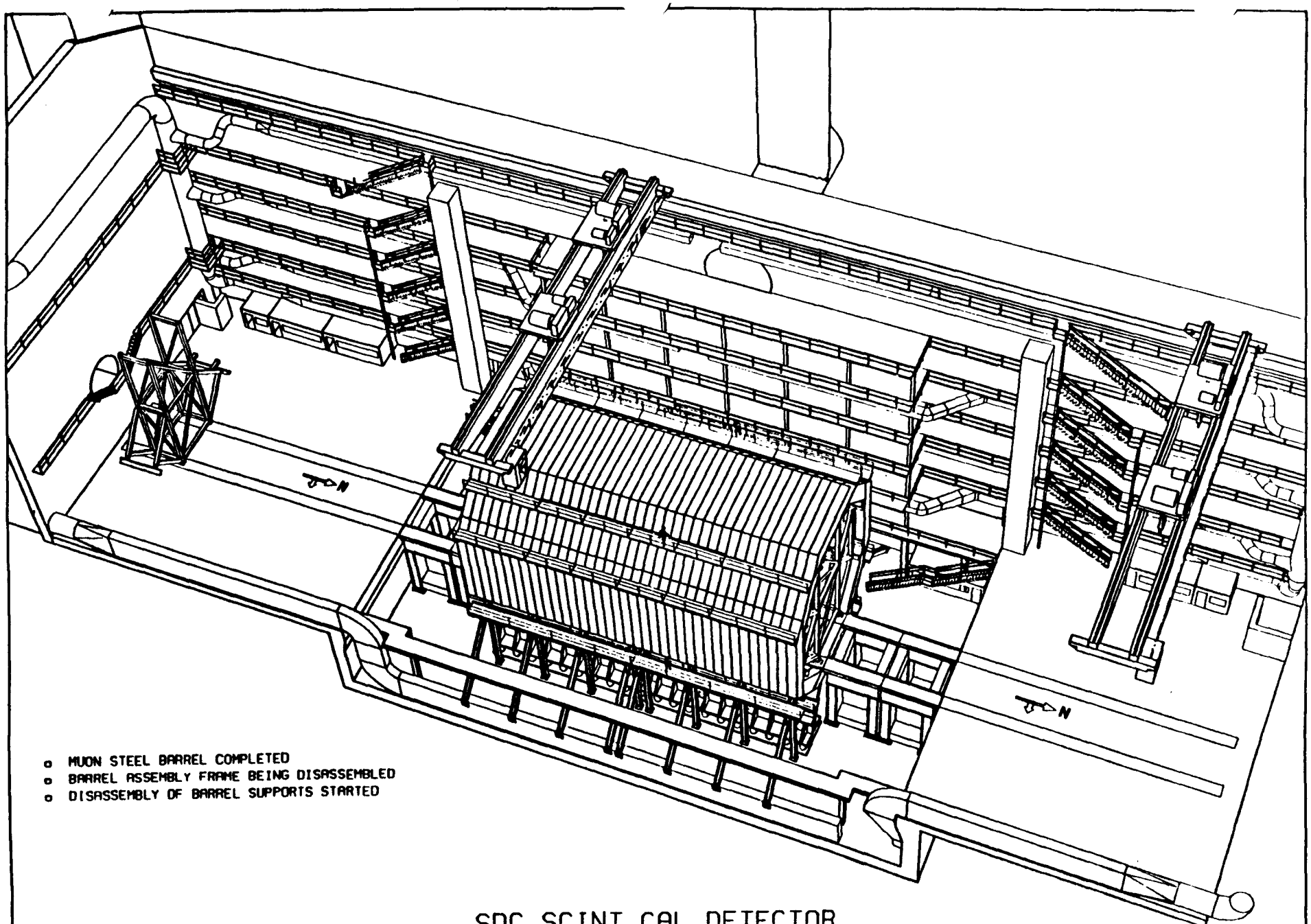
Erection of the muon barrel steel will be finished by the end of month 10.

The assembly frames have started to be dismanteled and raised to the surface.

MANPOWER AND CRANE UTILIZATION ESTIMATE FOR THE ABOVE ITEMS

Manpower required 3500 manhrs

	SOUTH END	NORTH END
Shaft cranes usage	100 hrs	90 hrs
Bridge cranes usage	160 hrs	150 hrs
Large objects lowered from the surface	16 vertical blocks 16 inclined blocks 8 horizontal blocks	16 vertical blocks 16 inclined blocks 8 horizontal blocks
Large objects lifted to the surface	4 sections of barrel assembly frame	



- MUON STEEL BARREL COMPLETED
- BARREL ASSEMBLY FRAME BEING DISASSEMBLED
- DISASSEMBLY OF BARREL SUPPORTS STARTED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 10

ICF KAISER ENGINEERS 8-21-91 MODEL 523M0045.DGN MONTH10.HLN

MONTH 11

The installation of the exterior barrel coils segments begins this month.

These segments have to be built and installed in one piece which demands a large maneuvering space for them and their support frames.

For purposes of transportation and handling, the coil segments are attached to installation frames, necessary to maintain the rigidity of the coils and protect them from damage. The frames depicted are large enough to allow a worker to get in, bolt the coil to the barrel and unfasten it from the installation frame.

The installation maneuver starts by lowering the coil to the hall floor as shown in figure 11.1.

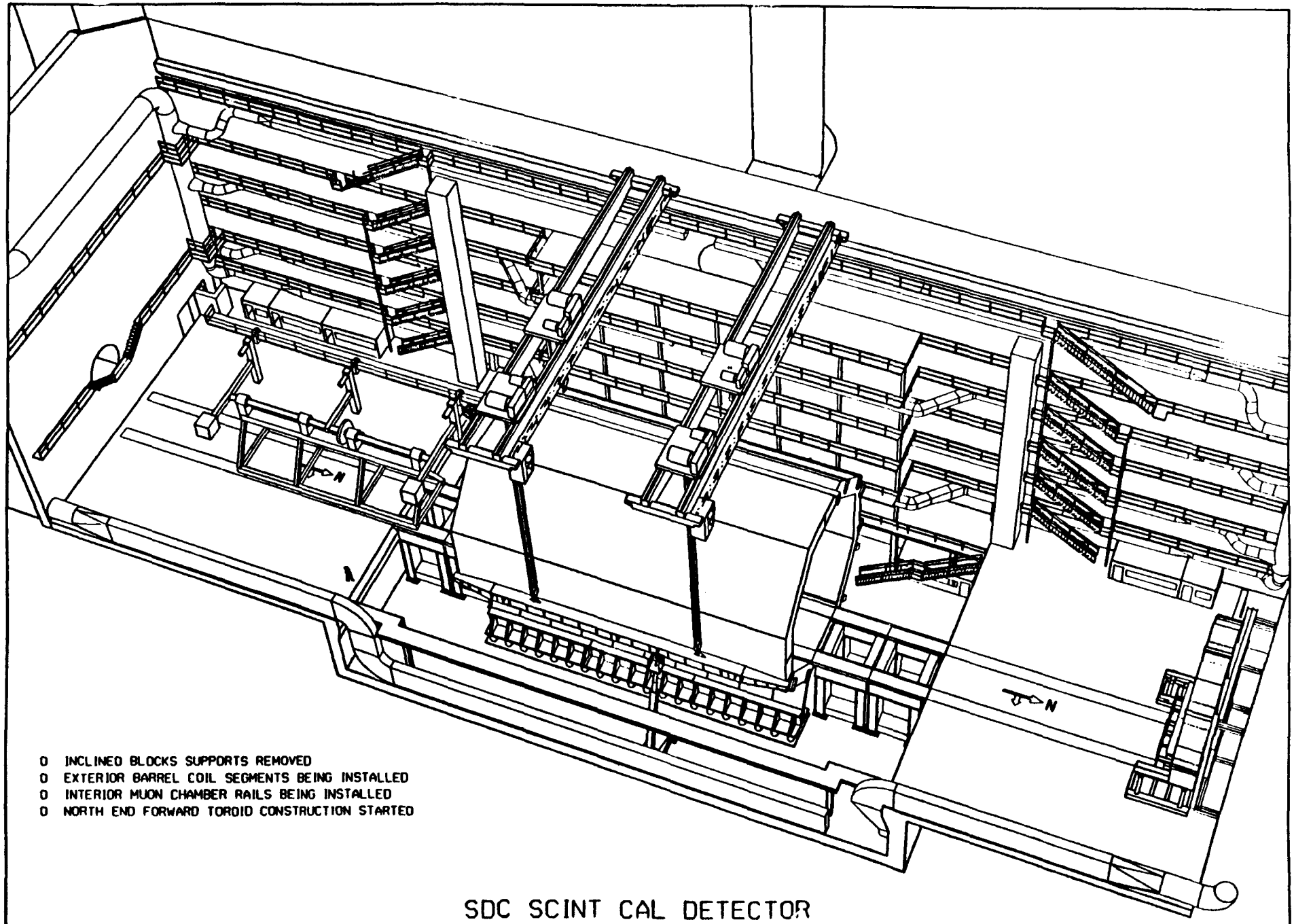
Figures 11.2 and 11.3 show coil segments being installed on the exterior of the barrel steel. Two cranes are needed to accomplish the installation. The frame is temporarily bolted to the barrel while the coil is aligned and bolted to the barrel.

Rails for the support and installation of muon chambers will also begin to be installed during the month. Figure 11.2 shows a preliminary concept of a device that can be used for this purpose. The device holds a platform for installation workers and can rotate 270 degrees. The device will receive rails outside the barrel from either the bridge cranes or the surface crane and then be towed or travel on its own into the barrel for the installation. Since the rails may weigh over 100 kg the platforms will be provided with a jacking system to locate the rails into position for bolting and also for accurate aligning.

Building of the north end forward toroid will also start this month. For a detailed procedure, see month 13.

Scheduling of the bridge cranes will be critical during this and the following month as the demand will be heavy from several ongoing activities.

The space allocation at the south end will also have to be scheduled as the space will be alternately occupied by the installation device or the coil instalation frame.



- INCLINED BLOCKS SUPPORTS REMOVED
- EXTERIOR BARREL COIL SEGMENTS BEING INSTALLED
- INTERIOR MUON CHAMBER RAILS BEING INSTALLED
- NORTH END FORWARD TOROID CONSTRUCTION STARTED

SDC SCINT CAL DETECTOR

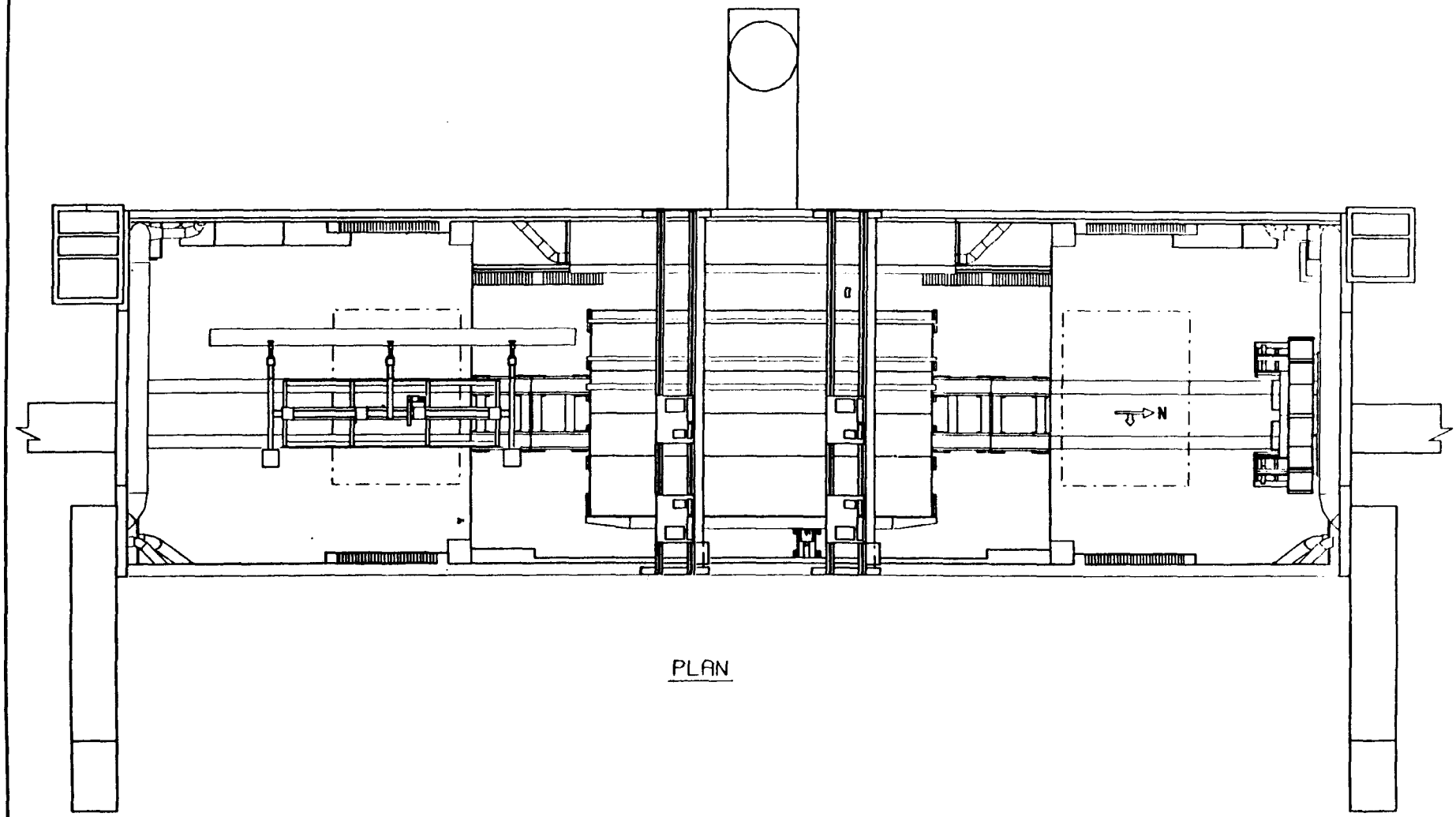
CONSTRUCTION PROGRESS

MONTH 11

ICF KAISER ENGINEERS 8-23-91 MODEL 523M0045.DGN MONTHILHIN

MANPOWER AND CRANE INSTALLATION ESTIMATE FOR THE ABOVE ITEMS

Manpower	4000 manhrs	
	SOUTH END	NORTH END
Shaft cranes usage	100 hrs	100 hrs
Bridge cranes usage	160 hrs	200 hrs
Large objects lowered from surface	14 exterior coil segments 3 sections of coil/rails installation device 16 bundles of muon chamber rails	4 sections of forward toroid cradle and assembly frame 24 forward toroid blocks 4 forward toroid coils
Large objects lifted to surface	8 inclined blocks support bents 4 walkway sections 4 muon barrel assembly frame 14 barrel coil support frames	8 inclined support bents 4 walkway sections 8 muon barrel assembly frame sections



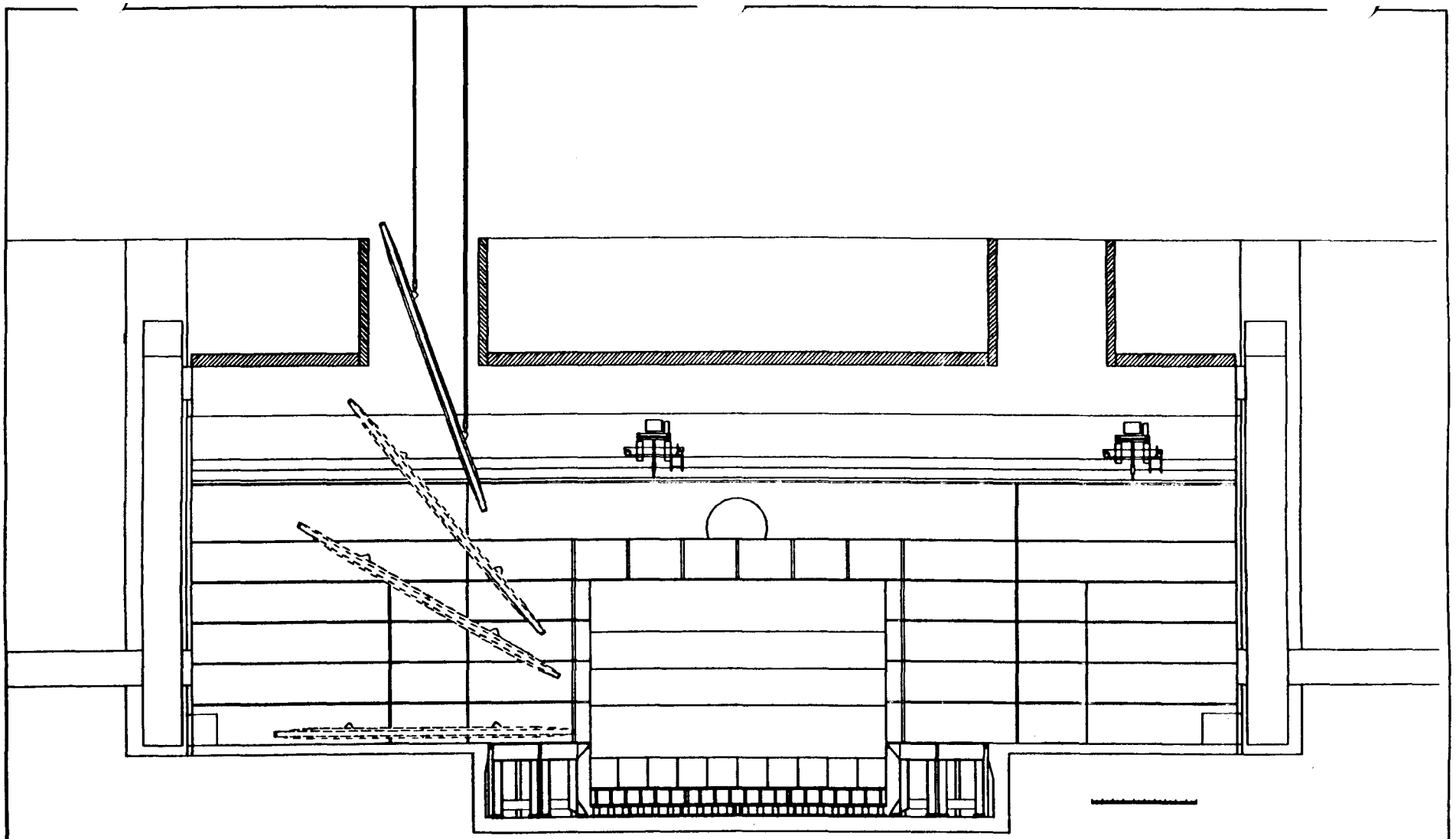
PLAN

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 11

ICF KAISH 9-19-91 523M46, MTH11



SDC SCINT CAL DETECTOR

COIL SEGMENT LOWERING TO HALL FLOOR

FIG 11.1

ICF KAISER ENGINEERS 9-26-91 MODEL 523M0041 41.HL21

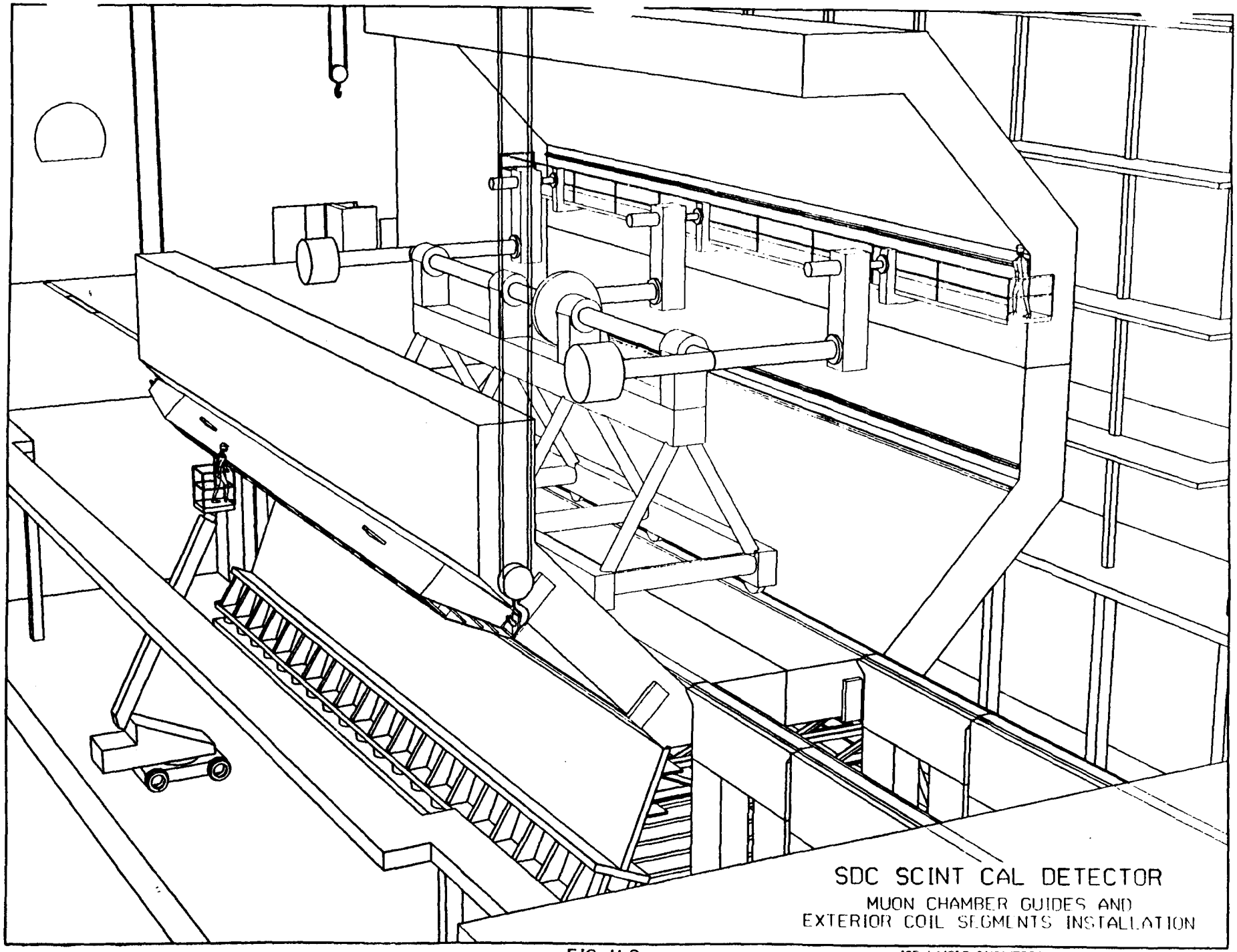


FIG. 11.2

ICF KAISER ENGINEERS 8-4-91 41,HL 7

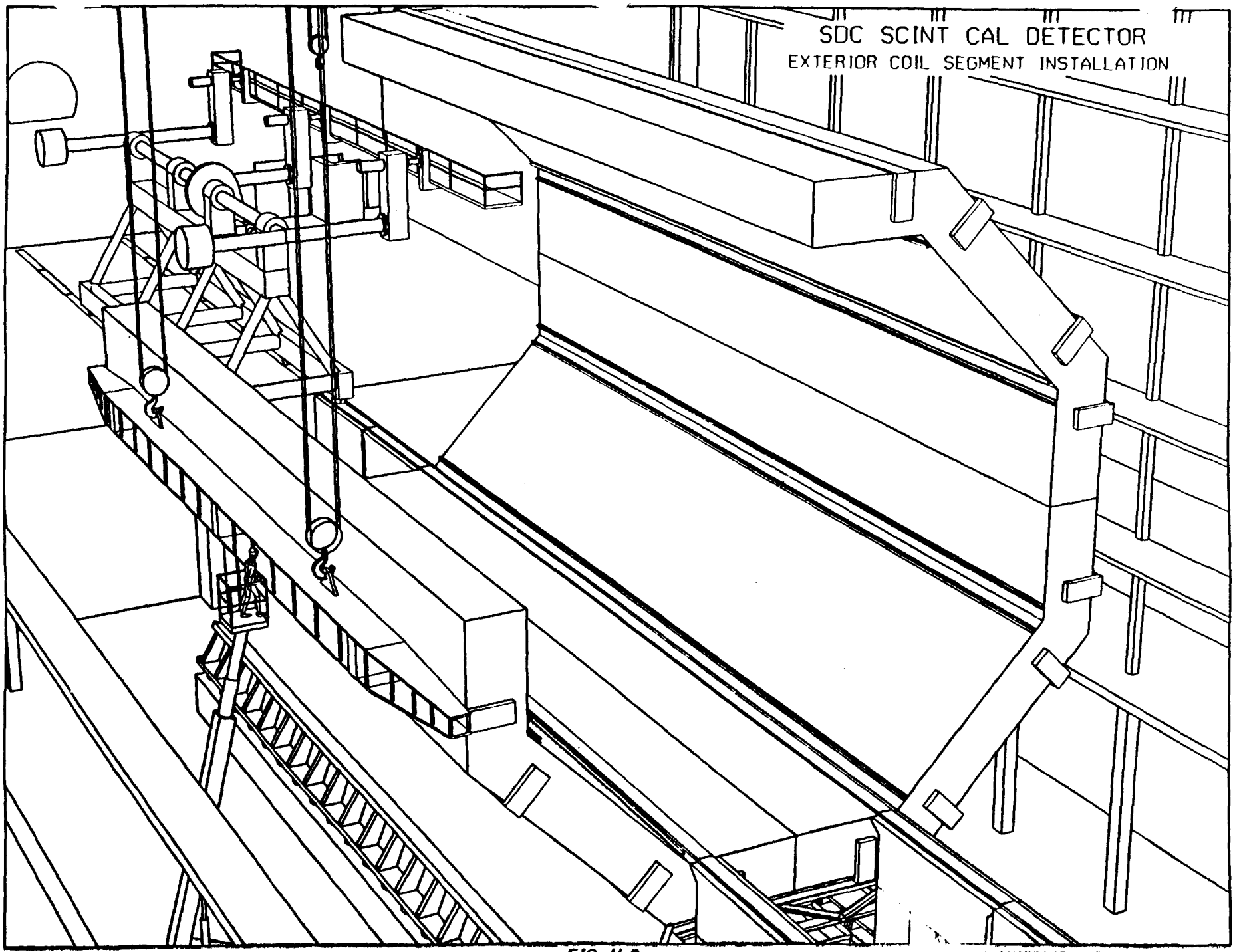


FIG. 11.3

ENGINEERS 8-5-91 41,HL8

MONTH 12

Installation of the first half of the south forward toroid has been completed and the second half started.

Electronic racks are shown as installed this month.

Installation of barrel coil segments on the barrel exterior will be completed this month and installation of interior coils will start.

The same installation device used to install the interior muon chamber rails, provided with different attachments, will be used for the coil segments installation on the interior of the muon barrel.

Figure 12.1 shows the surface crane lowering a coil segment and attaching it to the installation device. Figure 12.2 shows the installation device inside the barrel in the process of installing a coil segment. The installation device will be provided with hydraulic cylinders that retract or advance as necessary to install the coil segments. This operation has to somewhat precise as the interior coil segments need to interlace with the exterior coil fingers with rather tight tolerances.

In order to install the exterior muon chamber rails, the barrel will be affixed with temporary walkays. These walkways or narrow platforms will be also used for the installation of muon chamber gas pipes and cableways.

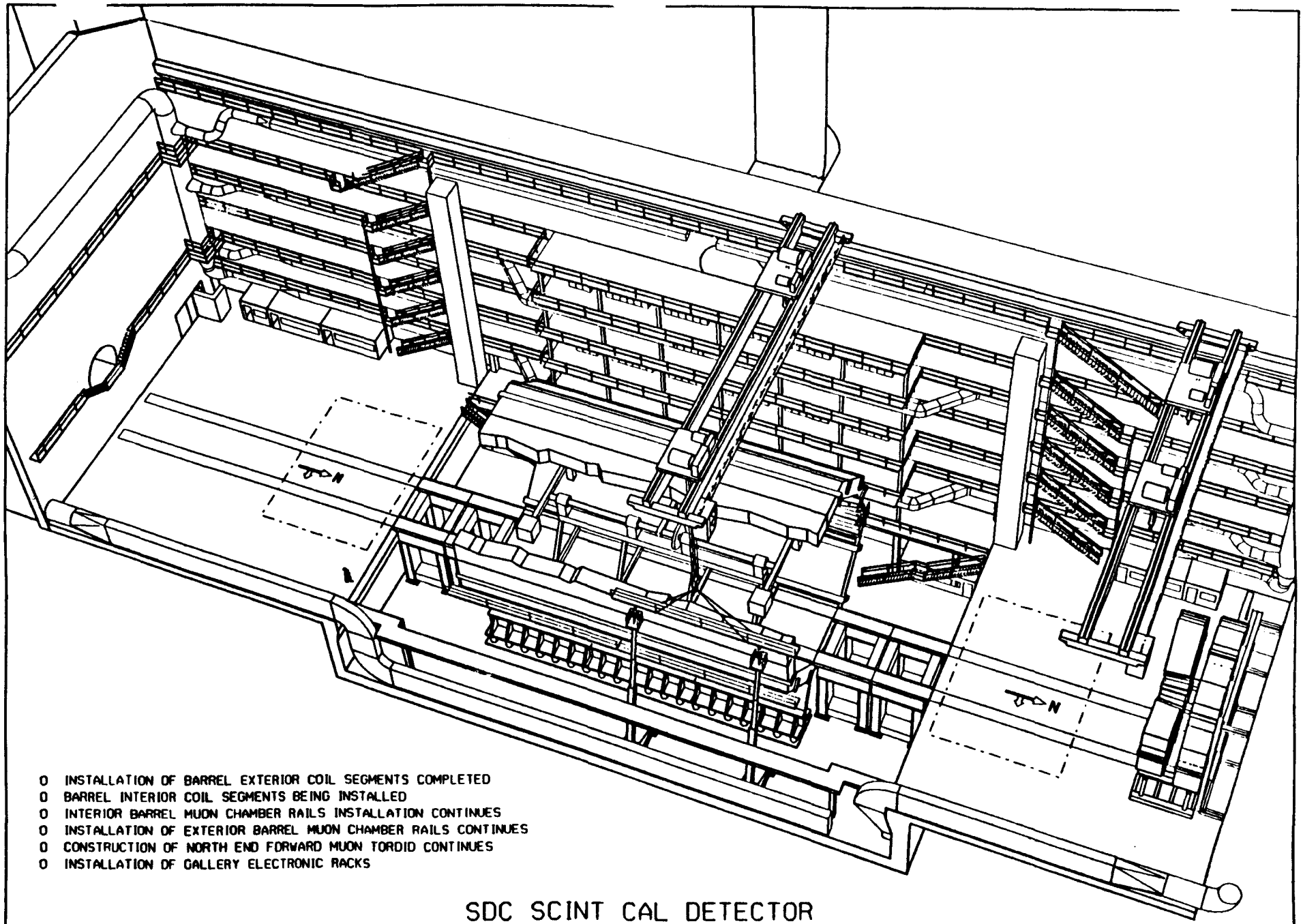
Figure 12.3 shows a crane holding a section of walkway being installed. Please note the tall cherry-pickers that will be required for operators to bolt the walkways in place. These cherry pickers will be later used for many other assembly operations.

Figure 12.3 also shows the installation device rotated 45 degrees for the installation of a coil segment on the top inclined blocks of the steel barrel.

Figure 12.4 shows a crane holding a muon chamber rail ready for bolting into position.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	4000 hrs



- INSTALLATION OF BARREL EXTERIOR COIL SEGMENTS COMPLETED
- BARREL INTERIOR COIL SEGMENTS BEING INSTALLED
- INTERIOR BARREL MUON CHAMBER RAILS INSTALLATION CONTINUES
- INSTALLATION OF EXTERIOR BARREL MUON CHAMBER RAILS CONTINUES
- CONSTRUCTION OF NORTH END FORWARD MUON TORDID CONTINUES
- INSTALLATION OF GALLERY ELECTRONIC RACKS

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 12

ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN MONTH12.HLN

	SOUTH END	NORTH END
Shaft crane usage	80 hrs	40 hrs
Bridge cranes usage	100 hrs	160 hrs
Large objects lowered from surface	16 interior coil segments 4 bundles of muon chamber rails	16 forward toroid blocks 4 crates for fwd toroid coils

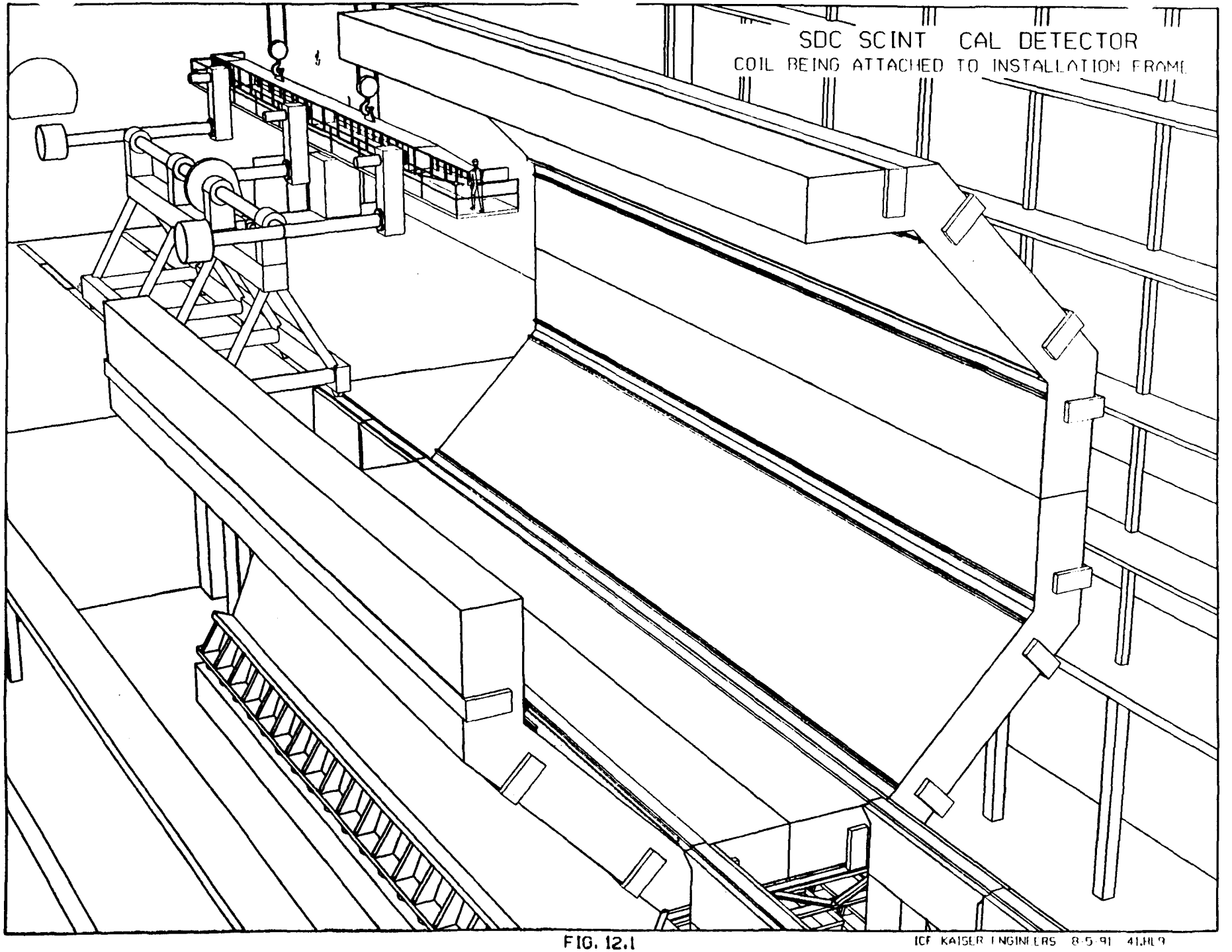

SDC SCINT CAL DETECTOR
COIL BEING ATTACHED TO INSTALLATION FRAME
ICF KAISER ENGINEERS 8-5-91 41.HL9

FIG. 12.1

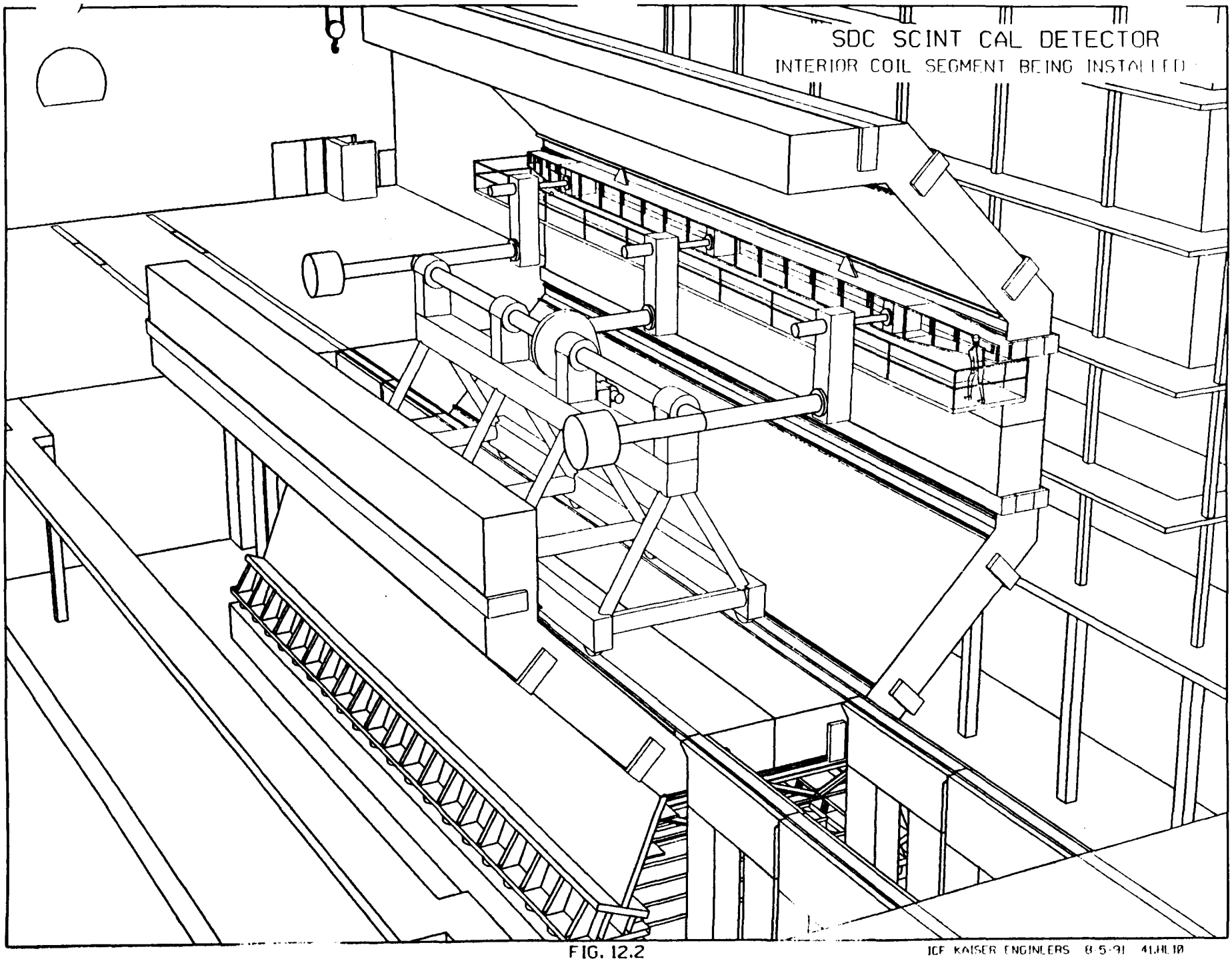

SDC SCINT CAL DETECTOR
INTERIOR COIL SEGMENT BEING INSTALLED
ICF KAISER ENGINEERS 8-5-91 41JHL10

FIG. 12.2

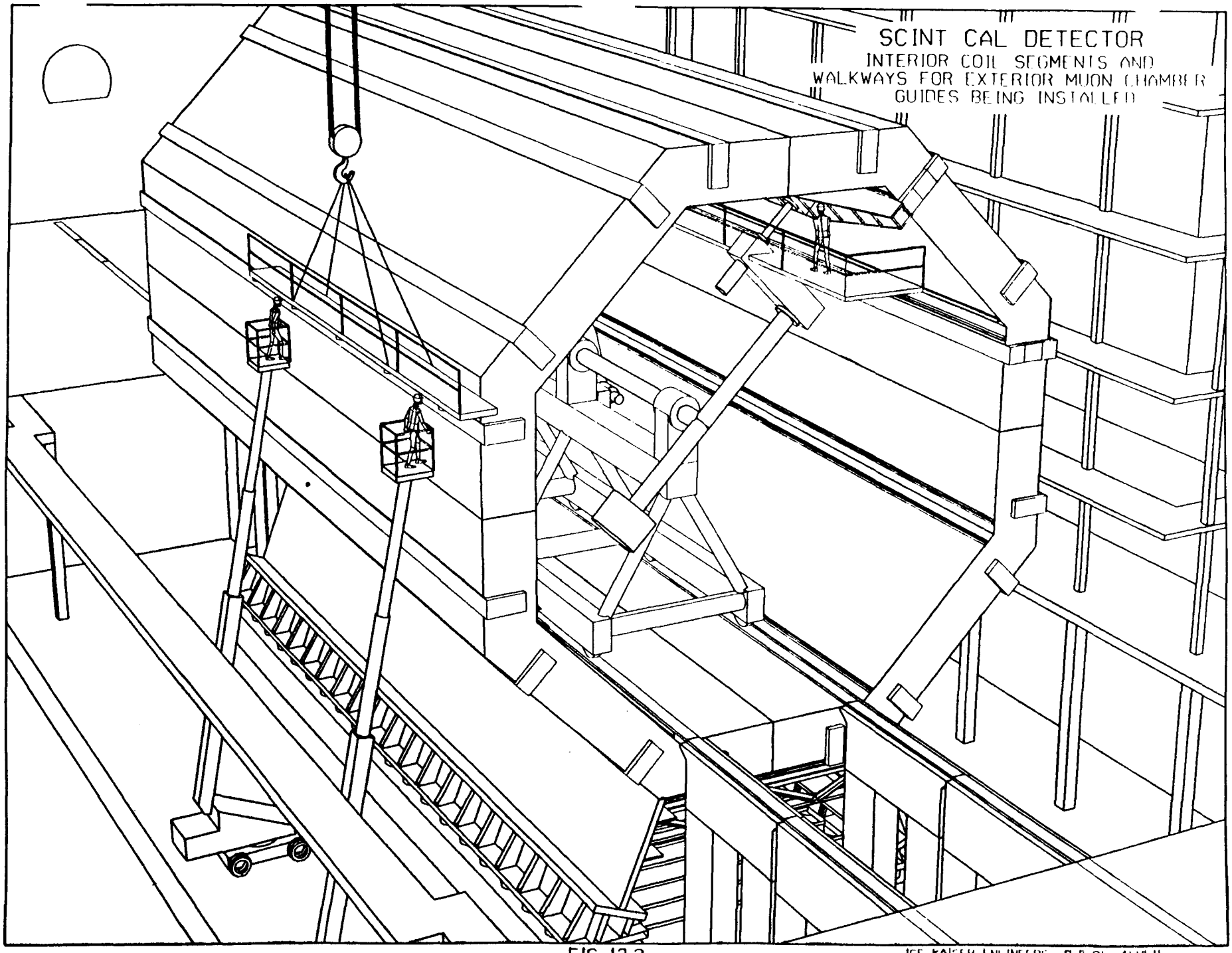


FIG. 12.3

ICF KAISER ENGINEERS 8 5 91 41.HL.11

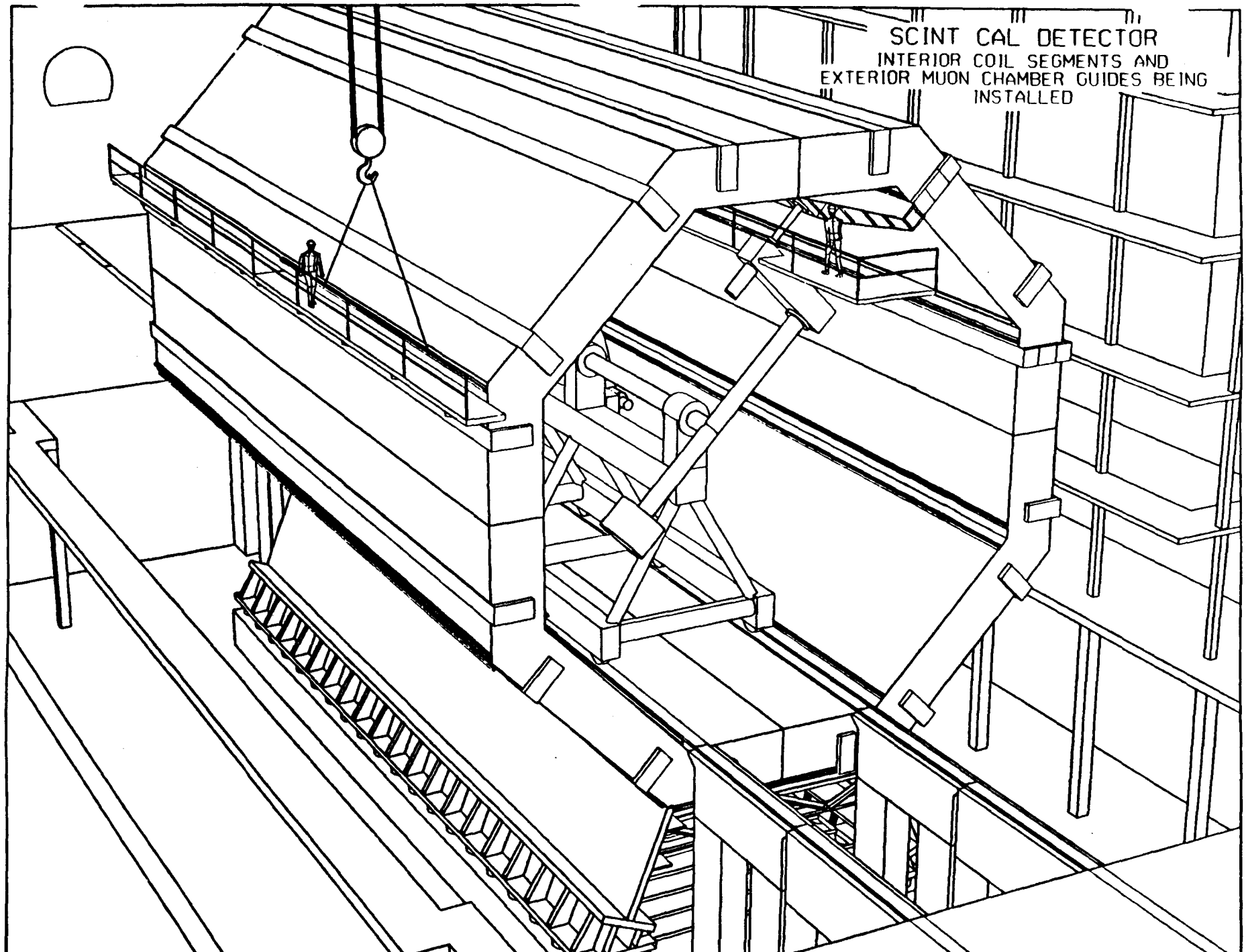


FIG. 12.4

ICF KAISER ENGINEERS 8-5-91 41.HL12

MONTH 13

Installation of the barrel coils should be completed during month 13.

Month 13 drawing shows the installation of muon chamber rails completed, however, this installation may continue for a longer period in parallel with the installation of the muon chamber gas lines and cabling, in which case the walkways attached to the barrel steel should be kept longer.

The first phase of the muon chamber installation has started. This consists of 4 towers installed on octant 8 and one on octant 7. The reason for the priority on these towers is that later they will be trapped by cable trays and will be much harder to align. Commencement of phase I chamber installation may be later than month 13 as rails and services installation may still be in progress.

The first half (FT2) of the south forward toroid has been started.

The second half (FT1) of the north end forward toroid has been completed, Muon chamber FW3 has been installed and the two toroid halves have been joined together and taken off the assembly frame.

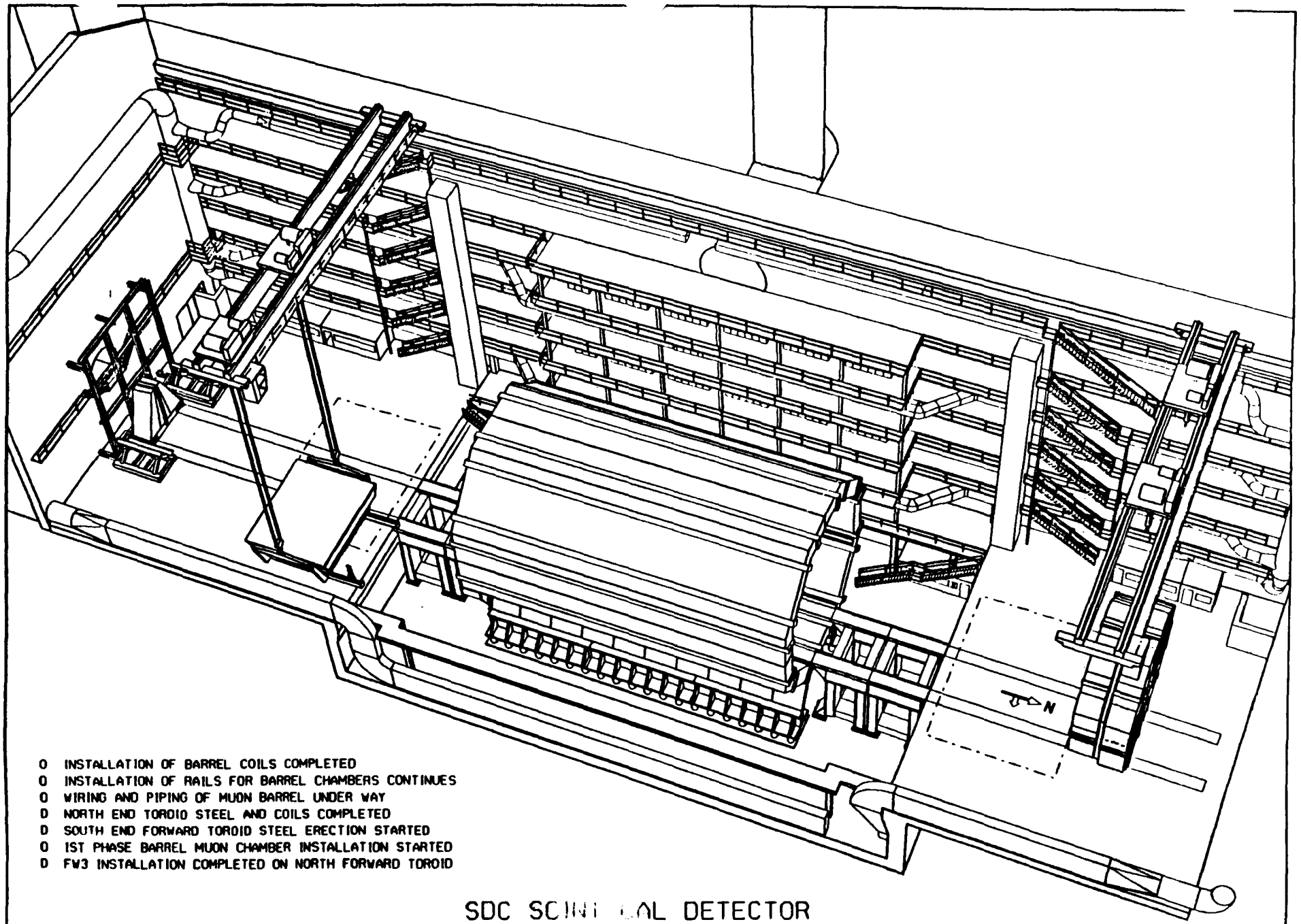
Figure 13.1 shows the vertical assembly frame in more detail. The bottom blocks are supported om temporary steel sleepers, and as more blocks are added, temporary ties to the assembly frame are installed. The coil packs are also installed during assembly of the blocks. After the second toroid (FT2) is completed (see fig. 13.5), the first toroid (FT1) is assembled about one meter away from the first in a similar manner.

Muon chamber FW3 is installed next, and the two toroids are moved together and tied to each other by bolting several plates into machined pockets on the outside the toroids.

As shown on fig. 13.2, each forward toroid half (FT1 & FT2) is assembled from twenty four 2000 mm thick blocks weighing about 82 metric tons each. Each block is built in the fabrication shop from vertical plates bolted together by high strength bolts. The outer plates of the blocks are thicker (about 200 mm) and the inner plates are thinner to ease flattening, and therefore to minimize any gaps betweeen plates. The outside plates have recessed holes for the longitudinal bolts.

The two radial surfaces of each block is machined for proper magnetic continuity and fit. There is a tapered stainless steel plate between the blocks for uniform flux distribution. Except for some local machined surfaces on the outside edge of the toroid, the plate may be flame cut with high speed torches.

The blocks are held together by four high strength recessed bolts in the outer plates near the corners of each block, as shown on Fig. 13.2.



- O INSTALLATION OF BARREL COILS COMPLETED
- O INSTALLATION OF RAILS FOR BARREL CHAMBERS CONTINUES
- O WIRING AND PIPING OF MUON BARREL UNDER WAY
- D NORTH END TOROID STEEL AND COILS COMPLETED
- D SOUTH END FORWARD TOROID STEEL ERECTION STARTED
- O 1ST PHASE BARREL MUON CHAMBER INSTALLATION STARTED
- D FW3 INSTALLATION COMPLETED ON NORTH FORWARD TOROID

SDC SCINTILLATOR DETECTOR

CONSTRUCTION PROGRESS

MONTH 13

ICF KAISER ENGINEERS 8-26-91 MODEL 523M0045.DGN MONTH13.HLN

Except when moved, the forward toroids are supported on the two thick vertical plates resting on the steel pads near the corners of the muon steel barrel, as shown in fig. 13.3. The supports are equipped with Hillman rollers to allow movement when opening the detector for repairs. The rollers may be rotated in any direction to move the toroids sideways should it become necessary to facilitate detector assembly or disassembly. For details of the roller system, see fig. 13.4.

MANPOWER AND EQUIPMENT INSTALLATION ESTIMATE FOR THE ABOVE ITEMS

Manpower	4000 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	40 hrs	30 hrs
Bridge cranes usage	100 hrs	80 hrs
Large objects lowered from surface	3 sections of forward toroid cradle and assembly frame 3 forward toroid blocks 1 crate of fwd toroid coils 1 muon chamber truss 1 muon chamber BW1	8 forward toroid blocks 4 crates of fwd toroid coils 2 sections of muon chamber FW3
Large objects lifted to the surface		3 sections of forward toroid assembly frame

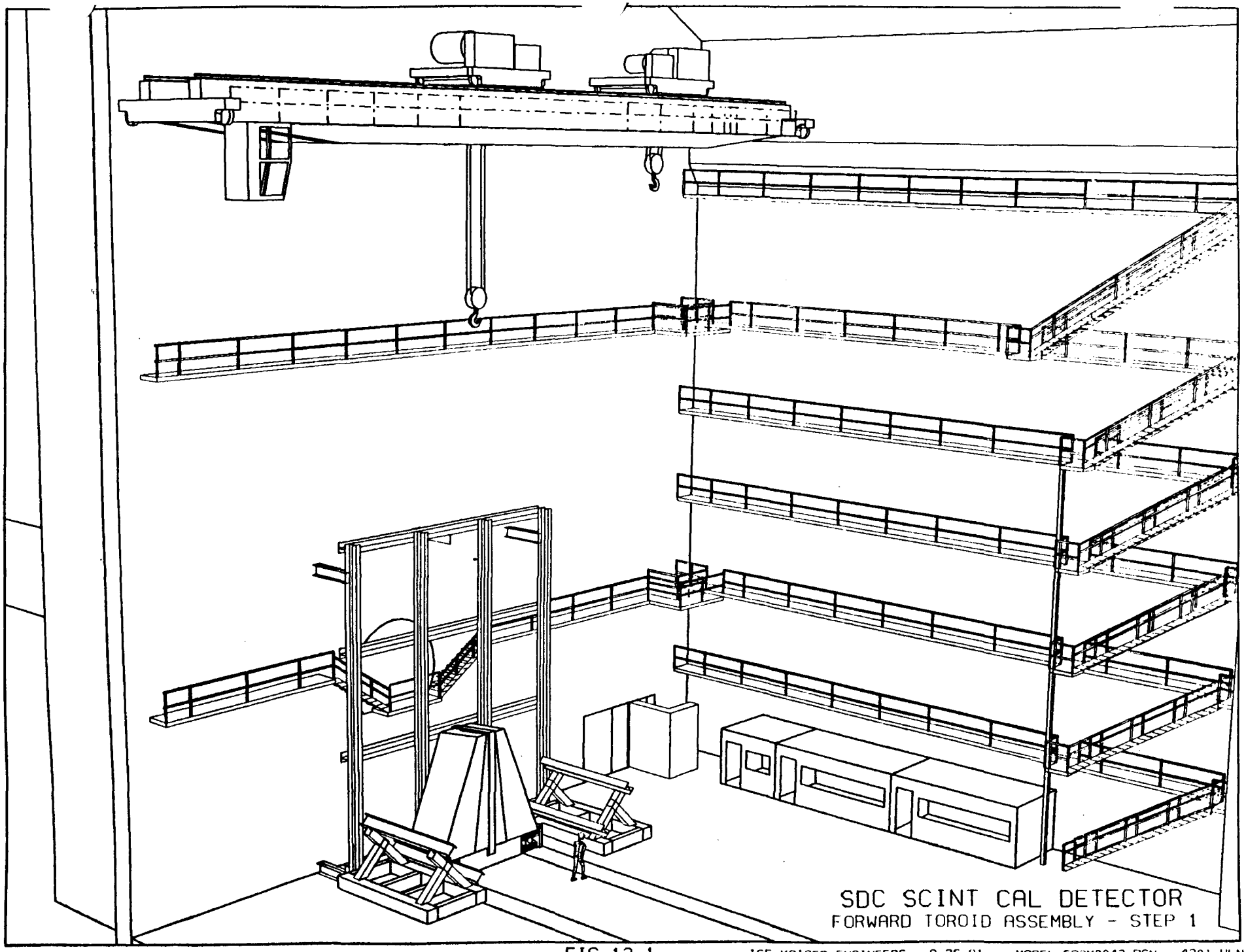
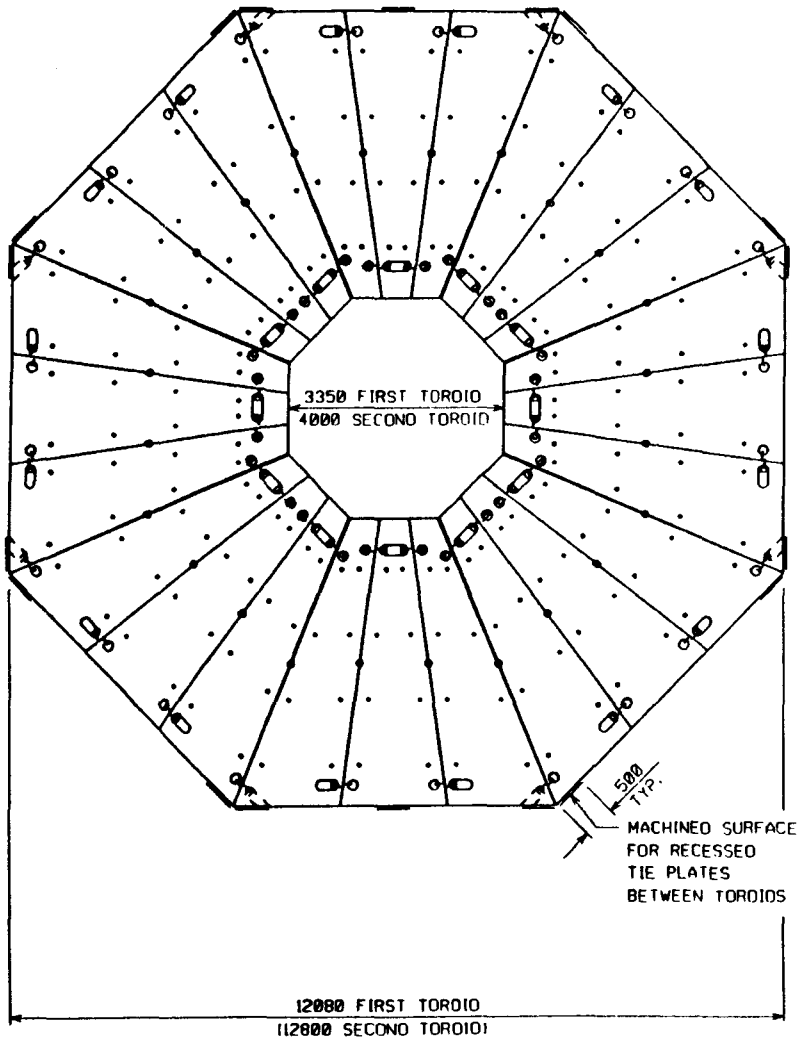
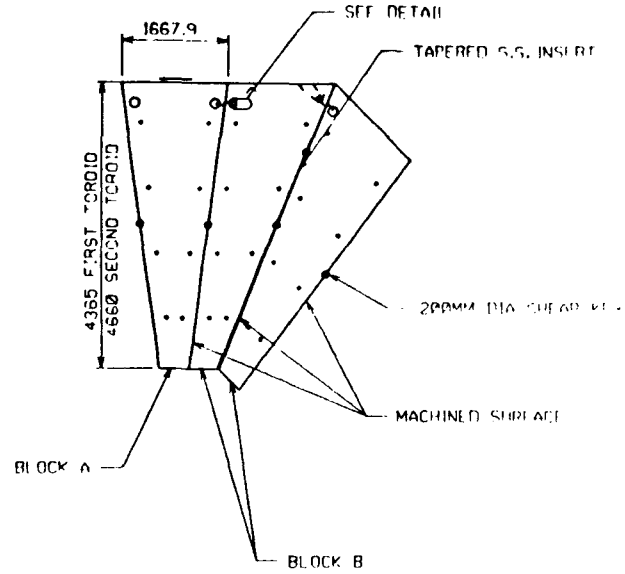
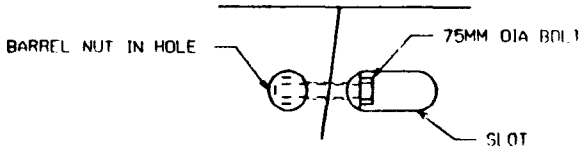


FIG 13.1 ICF KAISER ENGINEERS 9-26-91 MODEL 523M0042.DGN 4201.HLN





NOTE: ALL BLOCKS ARE 2000MM THICK, BUILT FROM VERTICAL PLATES BOLTED TOGETHER BY 50MM DIA RECESSED BOLTS. APPROX. BLOCK WEIGHT IS 82 TONS.



DETAIL OF BOLTING BETWEEN BLOCKS

(BOLTS IN OUTER PLATES ONLY)

SDC DETECTOR

FORWARD TOROID CONSTRUCTION

FIG. 13.2

ICF KAISER ENGINEERS 10 10 91 F1613.DGN

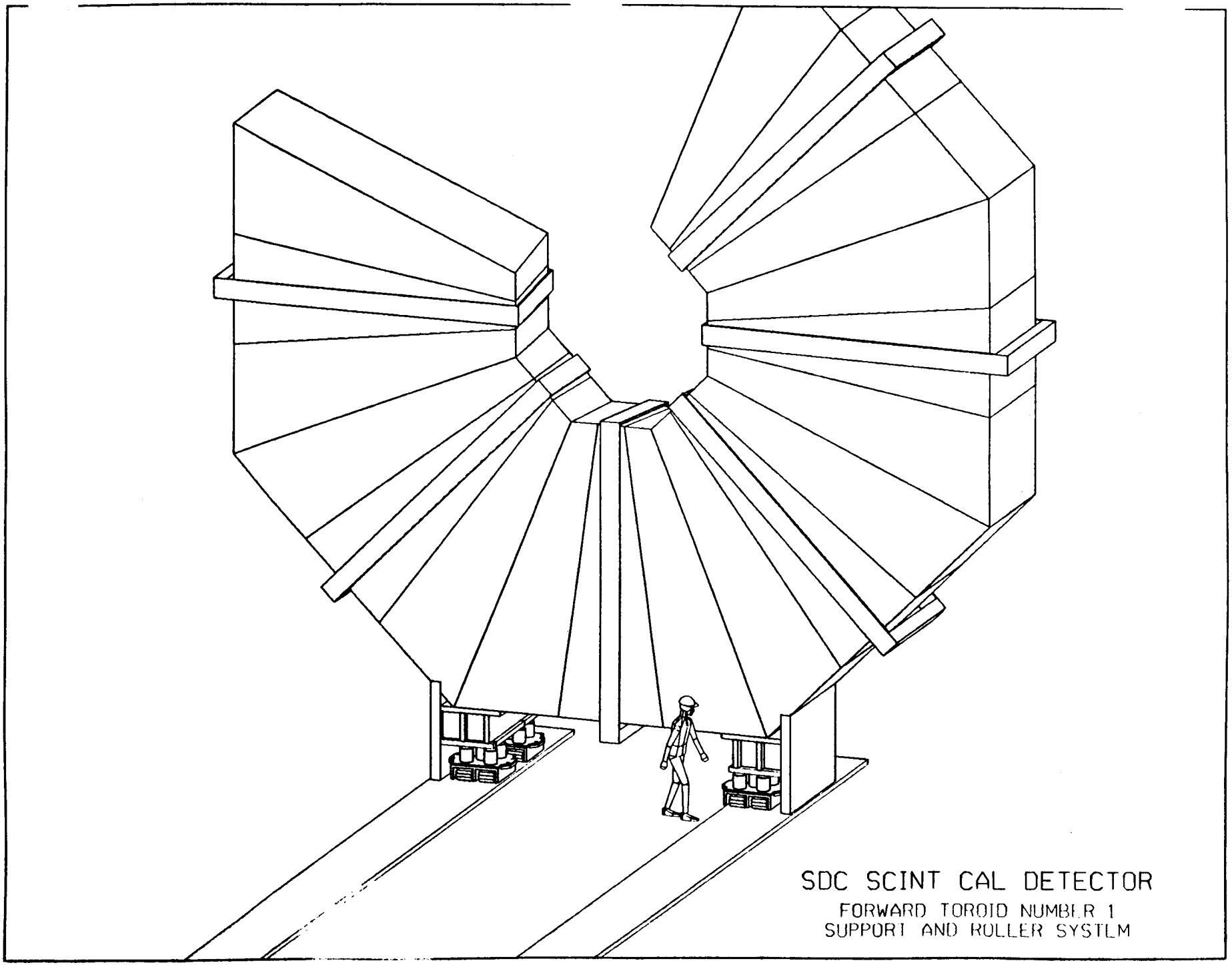


FIG. 13.3

ICF KAISER ENGINEERS 9-31-91 42,JHT

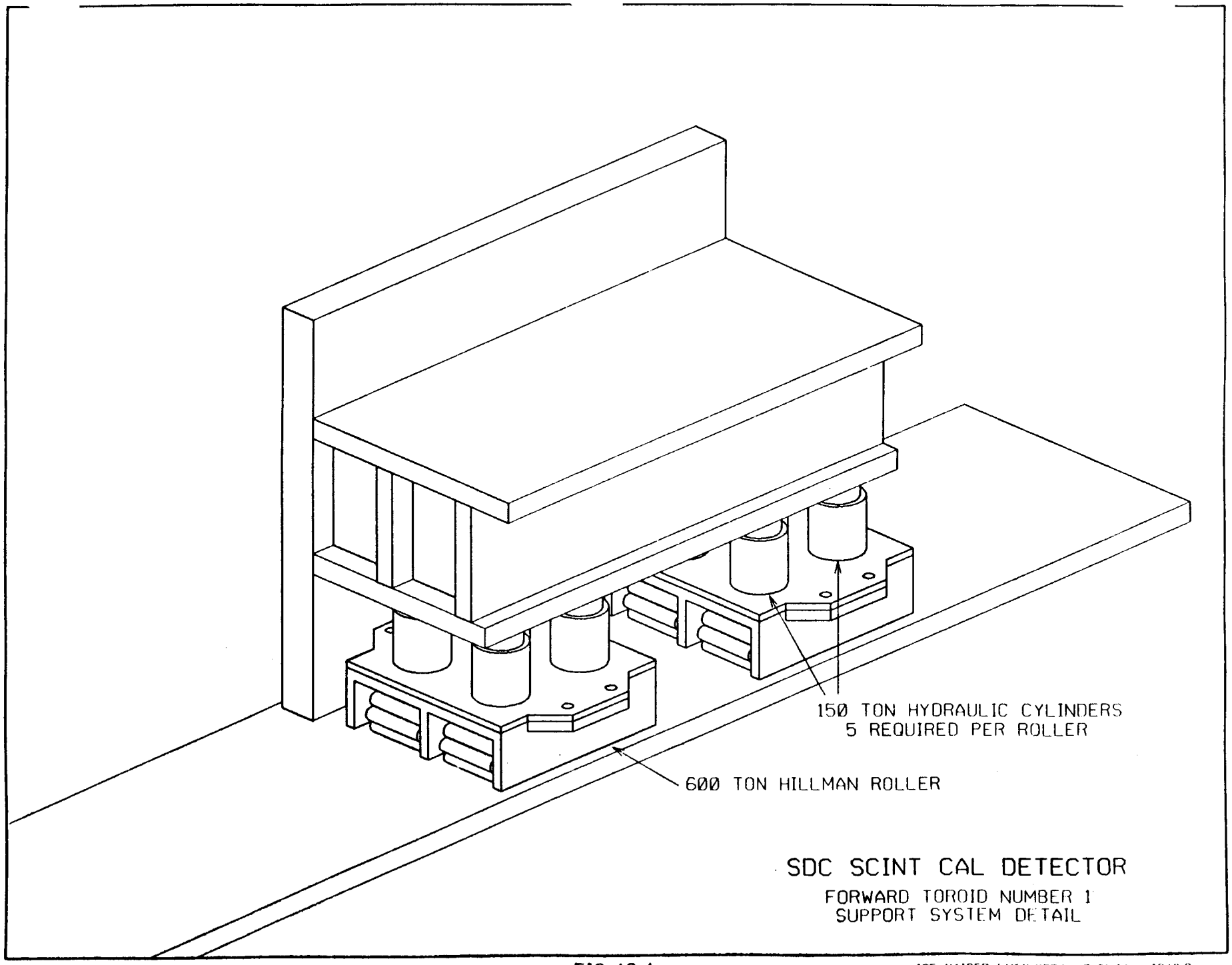


FIG. 13.4

ICF KAISER ENGINEERS 7-31-91 42JHL2

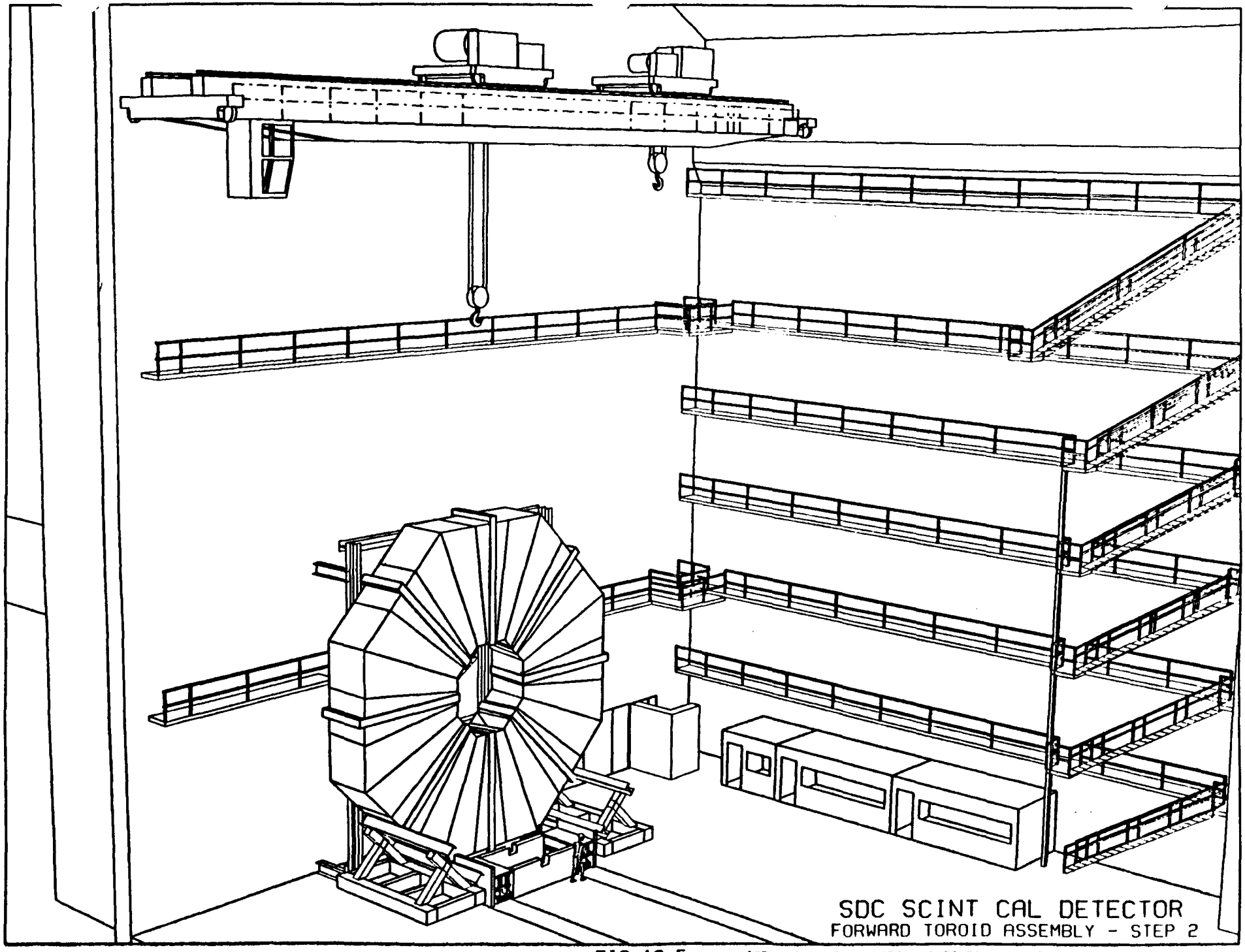


FIG 13.5 ICF KAISER ENGINEERS 9-26-91 MODEL 523M0042.DGN 4202.HLN

MONTH 14

The construction status drawing for month 14 shows two muon towers for octant 8 in place. These towers are part of the barrel phase I muon chambers installation. Each tower is composed of an external truss and an internal muon chamber. After installation each tower will be accurately aligned. The drawing also shows a muon truss in the process of being lifted for installation on octant 8.

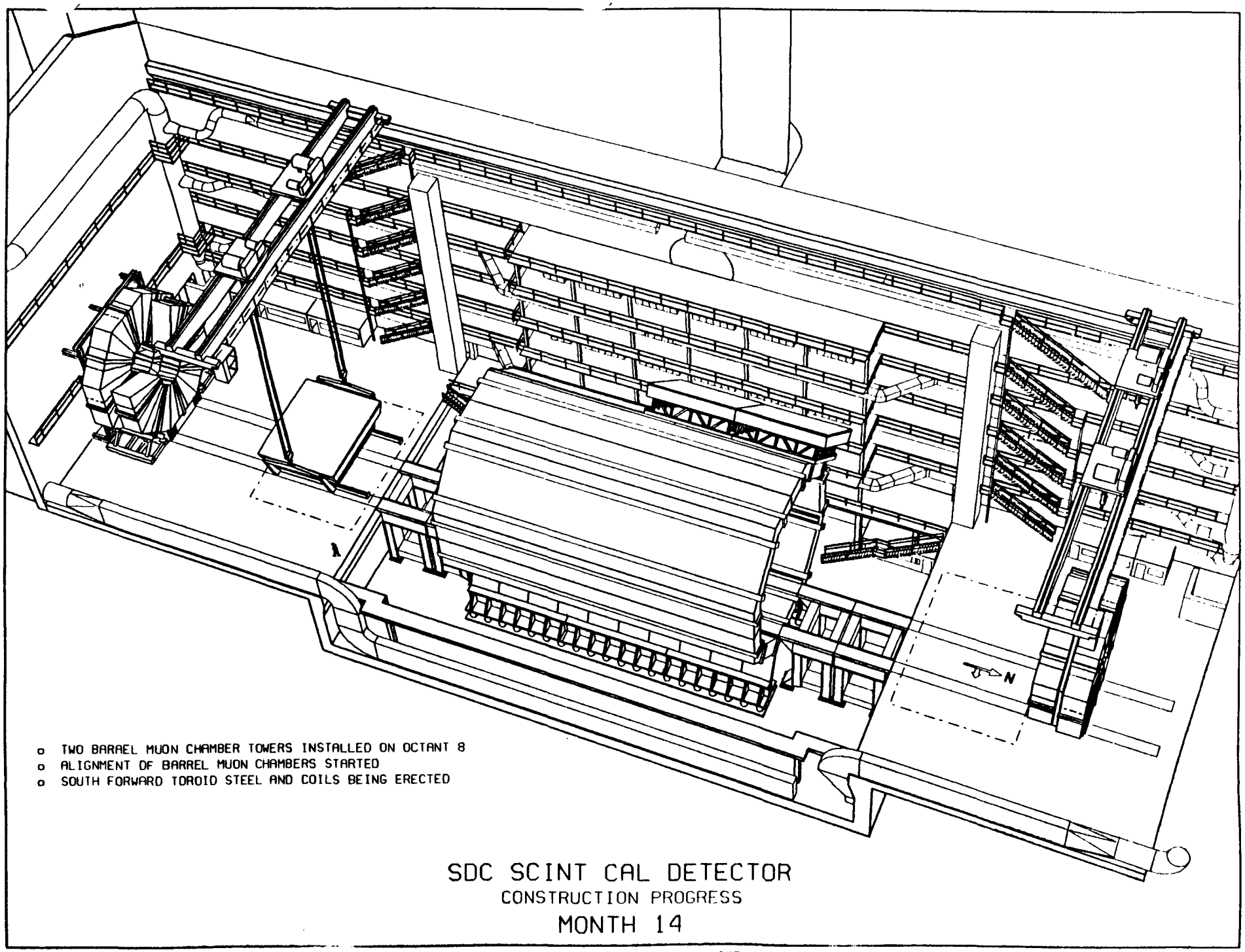
The drawing for month 14 also shows the south forward toroid under construction.

Figure 14.1 shows the south toroid halves completed and muon chamber FW3 being installed.

The forward toroid halves are constructed with a separation of one meter or more in order to facilitate bolting of the blocks, coil insertion, and the installation of interleaving muon chambers. Once these operations are completed, The two halves will be pulled together and rigidly fastened to make one unit.

MANPOWER AND EQUIPMENT ESTIMATE FOR THE ABOVE ITEMS

Manpower	3000 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	100 hrs	25 hrs
Bridge cranes usage	150 hrs	50 hrs
Large objects lowered from the surface	39 forward toroid blocks 7 crates of forward toroid coils	3 muon chamber trusses 3 muon chambers BW1
Large objects lifted to the surface		6 muon chamber cradles



- TWO BARREL MUON CHAMBER TOWERS INSTALLED ON OCTANT 8
- ALIGNMENT OF BARREL MUON CHAMBERS STARTED
- SOUTH FORWARD TOROID STEEL AND COILS BEING ERECTED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 14

ICF KAISER ENGINEERS 8-27-91 MODEL 523M0045.DGN MONTH14.HLN

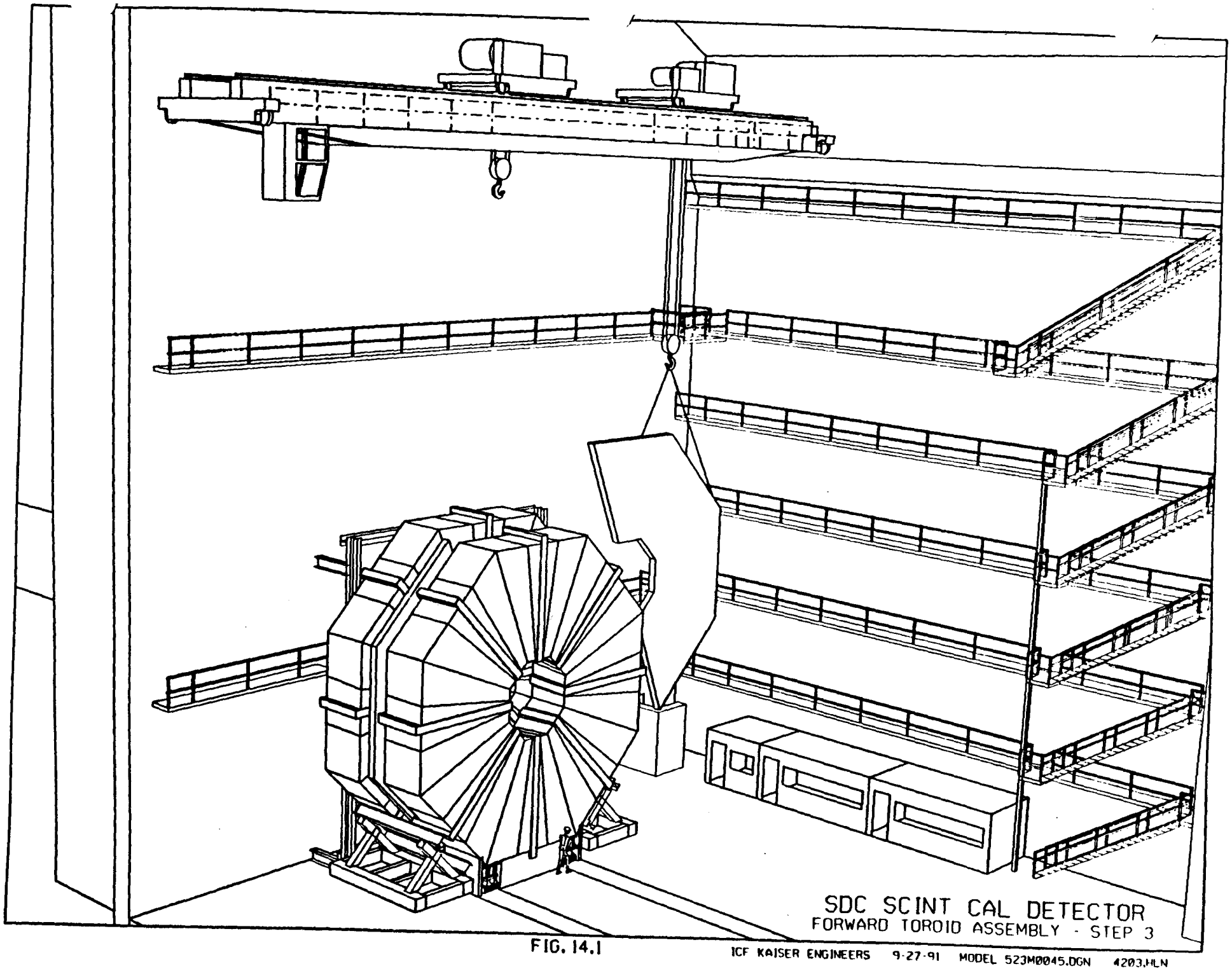

SDC SCINT CAL DETECTOR
FORWARD TOROID ASSEMBLY - STEP 3
ICF KAISER ENGINEERS 9-27-91 MODEL 523M0045.DGN 4203.HLN

FIG. 14.1

MONTH 15

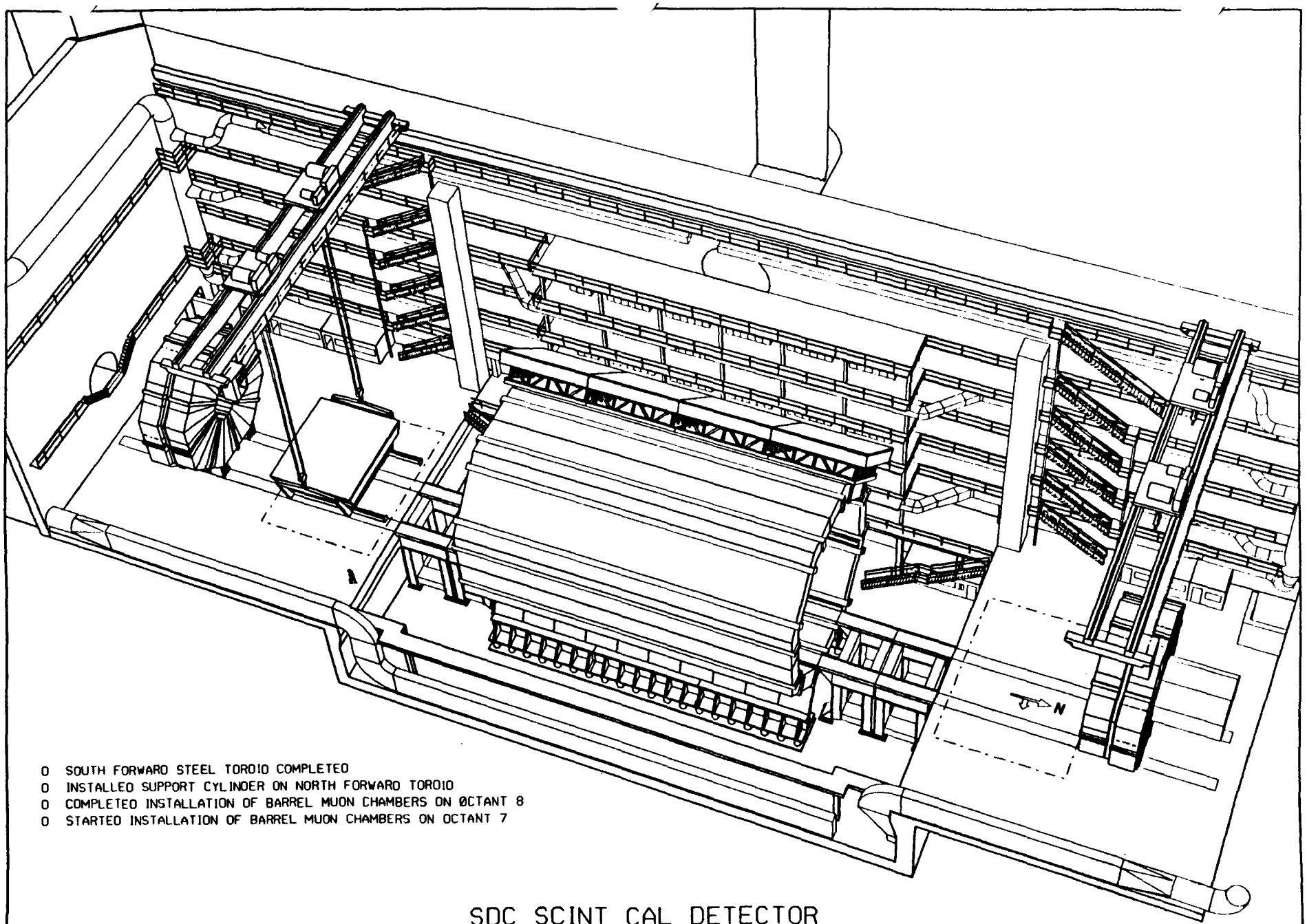
The south forward toroid is completed this month and the fixtures used to assemble it are removed to the surface.

The north forward toroid was moved forward to be able to install the support cylinder for the muon chambers and cerenkov counter mounted on the rear of the toroid see fig. 15.1.

By the end of this month all muon chamber towers on octant 8 will have been installed and aligned. The crane is shown ready to lift a muon chamber truss to be installed in octant 7.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS.

Manpower	1200 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	40 hrs	20 hrs
Bridge cranes usage	80 hrs	30 hrs
Large objects lowered from surface	21 forward toroid blocks	3 muon chamber towers 3 muon chambers BW1
Large objects lifted to the surface	3 sections of forward toroid cradle and assembly frame	6 muon chamber cradles



- SOUTH FORWARD STEEL TOROID COMPLETED
- INSTALLED SUPPORT CYLINDER ON NORTH FORWARD TOROID
- COMPLETED INSTALLATION OF BARREL MUON CHAMBERS ON ØCTANT 8
- STARTED INSTALLATION OF BARREL MUON CHAMBERS ON OCTANT 7

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 15

ICF KAISER ENGINEERS 10-13-91 MODEL 523MØØ45.DGN MONTH15.HLN

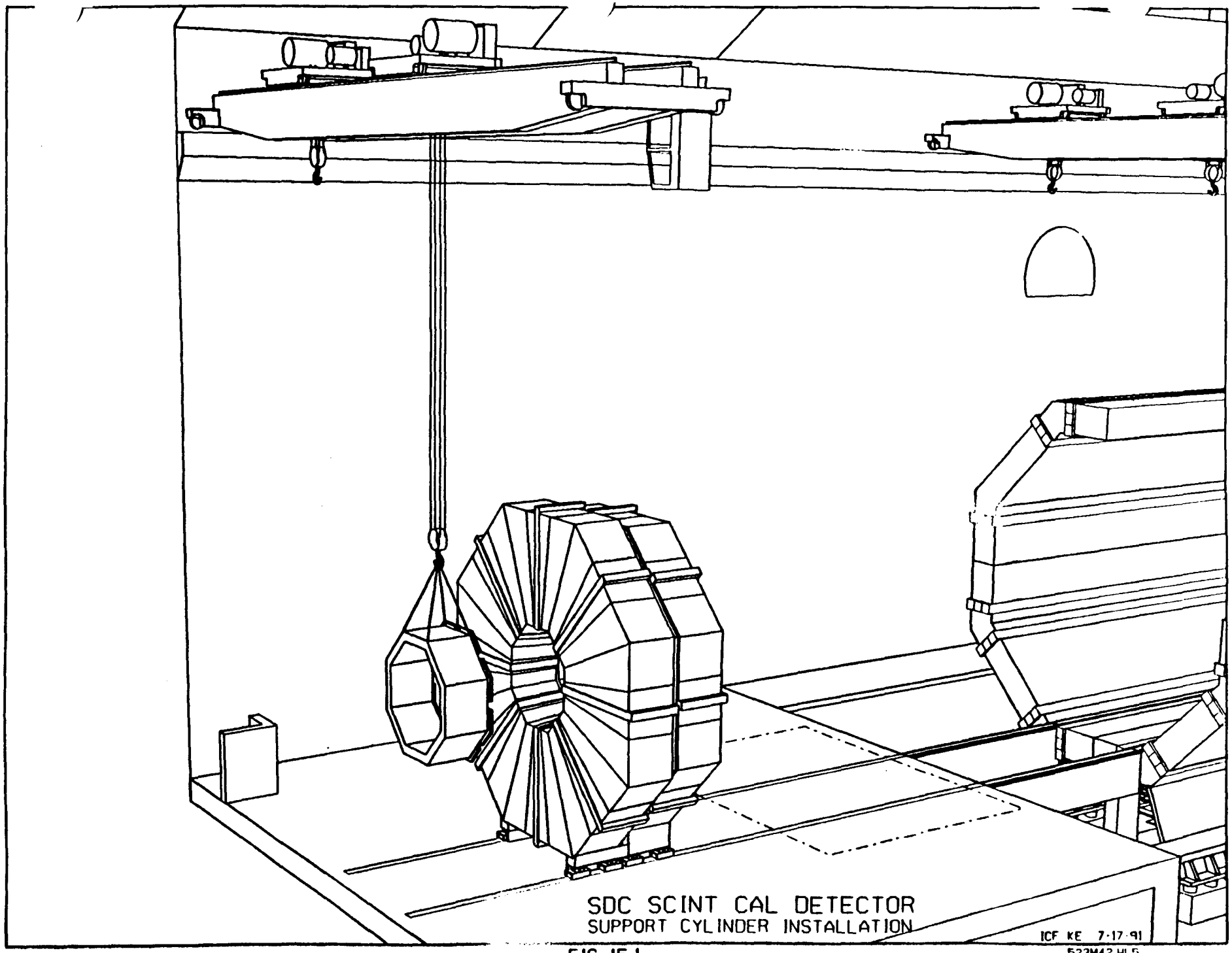

SDC SCINT CAL DETECTOR
SUPPORT CYLINDER INSTALLATION
ICF KE 7-17-91
523M42.HL5

FIG. 15.1

MONTH 16

The support cylinder for the south end forward toroid has been installed.

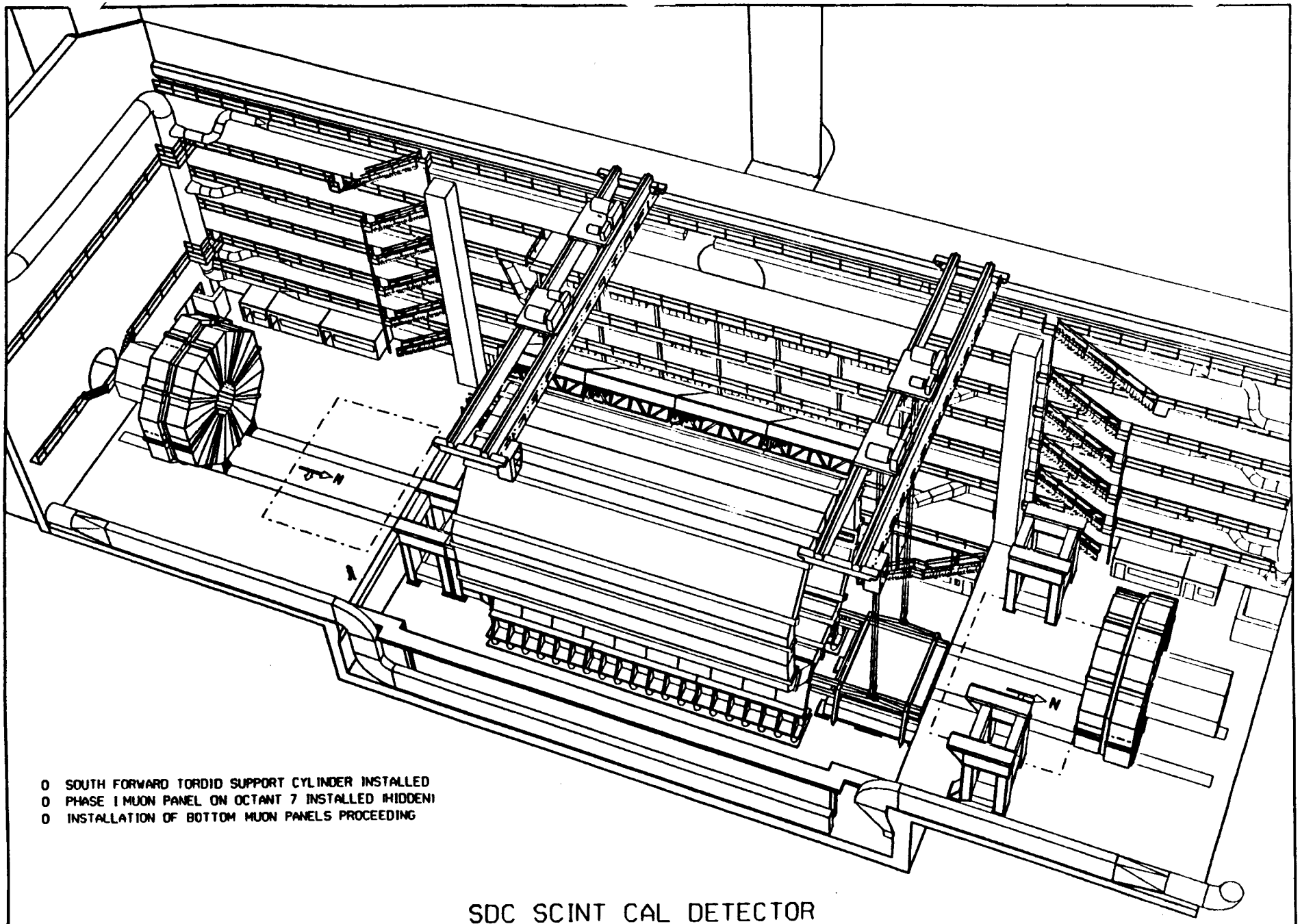
One muon chamber tower has been installed on octant 7.

The north bridge has been removed to allow the installation of the bottom (octant 5) chambers. The bridge has been constructed in two pieces to allow for its removal after the intermediate muon chambers (except on octant 5) are installed as it is then trapped. To remove both halves, the one closest to the hall floor gets lifted by the crane; the next one is rolled backward until it is freed from the intermediate muon chambers and then also lifted by the crane and transported to a storage area. There is not enough room inside the pit to move the bridges sideway, which could have been done with rollers, hence they must be stored temporarily on the operating floor.

The drawing for month 16 shows a crane with two trolleys handling the device to insert the bottom muon chambers. Since trusses cannot be used on the bottom of the detector, the chambers have to be inserted individually. The insertion device has been furnished in this case with two sets of rails, one for muon chamber BW2 and the other set for muon chamber BW3.

MANPOWER AND EQUIPMENT UTILIZATION REQUIRED FOR THE ABOVE ITEMS

Manpower	1000 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	20 hrs	25 hrs
Bridge cranes usage	40 hrs	50 hrs
Large objects lowered from the surface	Forward toroid support cylinder	4 muon chambers BW3
Large objects lifted to the surface	9 sections of coil/rails installation device	4 muon chamber cradles



- SOUTH FORWARD TORDID SUPPORT CYLINDER INSTALLED
- PHASE I MUON PANEL ON OCTANT 7 INSTALLED (HIDDEN)
- INSTALLATION OF BOTTOM MUON PANELS PROCEEDING

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 16

ICF KAISER ENGINEERS 8-29-91 MODEL 523M0045.DGN MONTH16.HLN

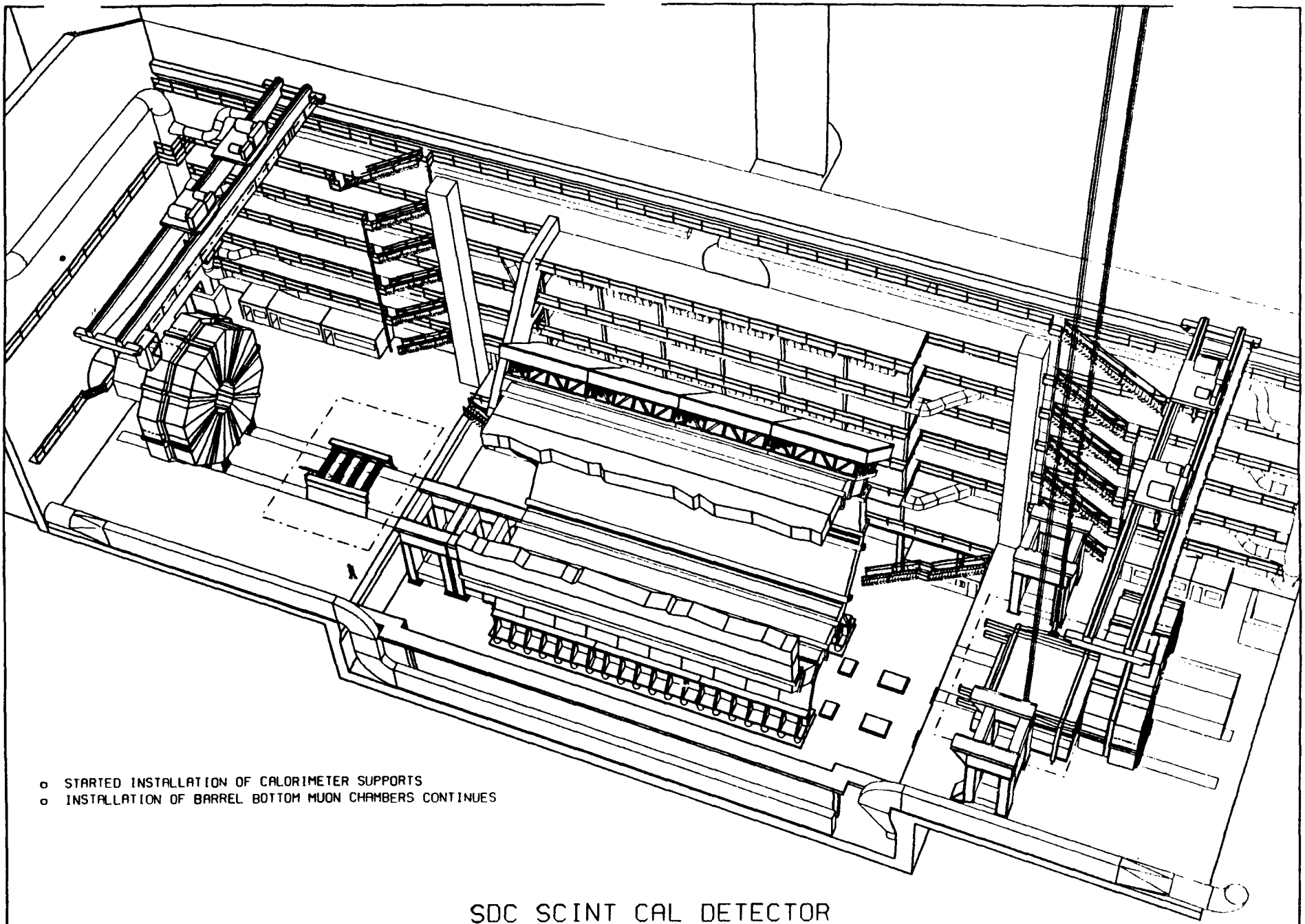
MONTH 17

Installation and alignment of the bottom octant muon chambers continues this month with the installation of two more towers. The drawing show the last set of bottom chambers ready to be lifted into insertion position. Please note the tight space on this area of the operating floor when performing this operation.

Installation of the calorimeter supports starts this month. The drawing shows a section of the support, preassembled on the surface, ready to be picked up by the bridge crane. The calorimeter support was divided into three sections in order not to exceed the weight limitation of the bridge crane.

MANPOWER AND EQUIPMENT UTILIZATION REQUIRED FOR THE ABOVE ITEMS

Manpower	600 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	10 hrs	30 hrs
Bridge cranes usage	10 hrs	50 hrs
Large objects lowered from the surface	1 calorimeter support assembly	4 muon chambers BW2
Large objects lifted to the surface		4 muon chamber cradles



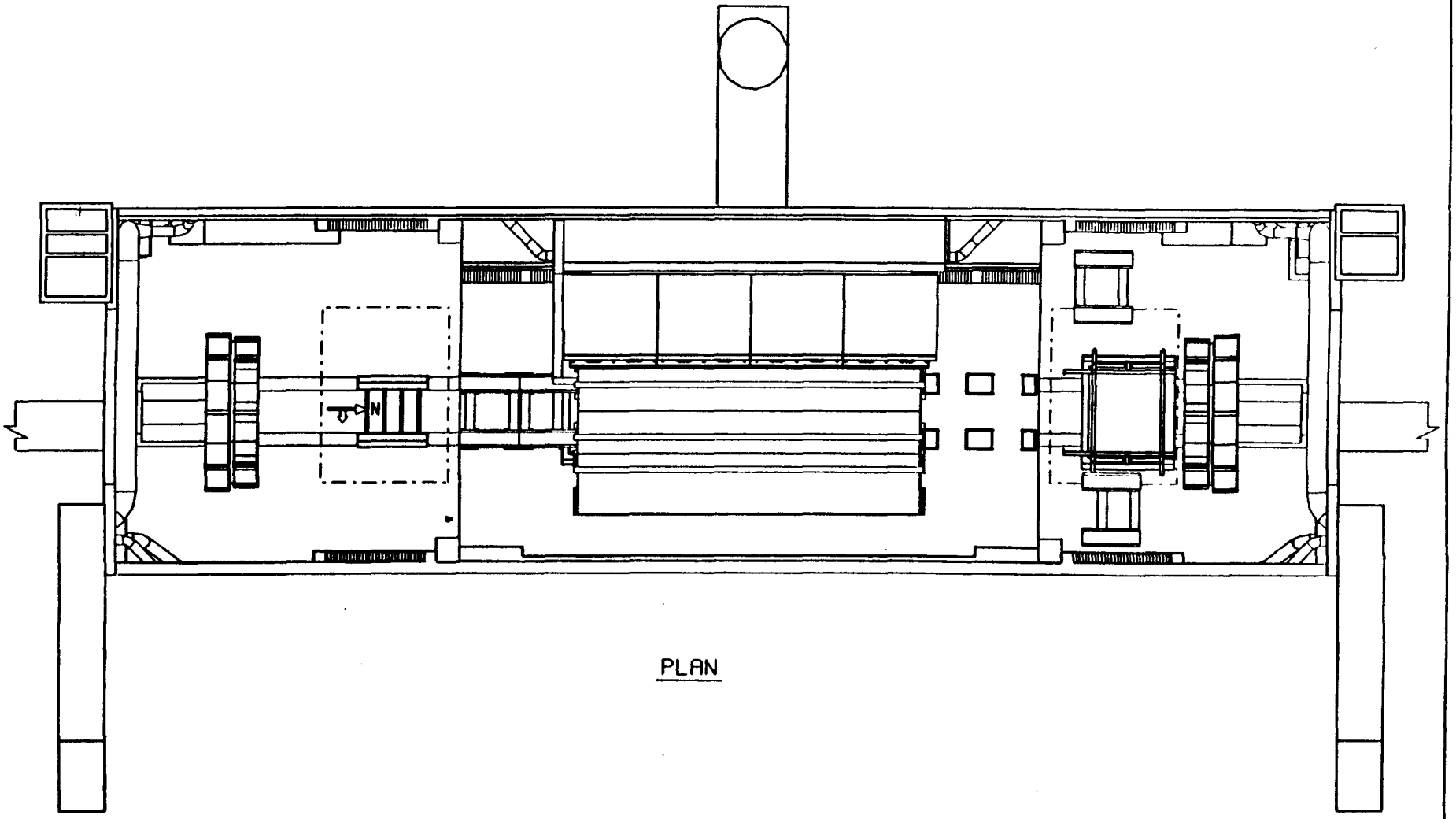
- STARTED INSTALLATION OF CALORIMETER SUPPORTS
- INSTALLATION OF BARREL BOTTOM MUON CHAMBERS CONTINUES

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 17

ICF KAISER ENGINEERS 8-29-91 MODEL 523M0045.DGN MONTH17.HLN



PLAN

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 17

MONTH 18

This picture has more detail than the others to get a better feeling of space requirements in a high floor utilization situation.

By this month, the bottom muon chambers have been installed and aligned.

During this month, the barrel calorimeter is lowered to the operating floor. Since this is a major operation (it is estimated that the barrel calorimeter weighs on the order of 3200 metric tons), it has been studied in some detail.

It is assumed that the calorimeters will be assembled on the surface, in close proximity to the construction shaft. Figure 18.1 shows the barrel calorimeter rolled onto the lowering device.

The lowering device consists of a holding frame suspended by four sets of wire ropes as shown in figure 18.2. Each set of wire ropes is held by a 950 metric ton capacity hollow hydraulic jack. The figure shows just one wire rope in each corner. In reality there are many wire ropes threaded through each jack.

Figures 18.3, 18.4 and 18.5 show different views of the calorimeter and the jacking frame at the surface with the calorimeter ready to be lowered.

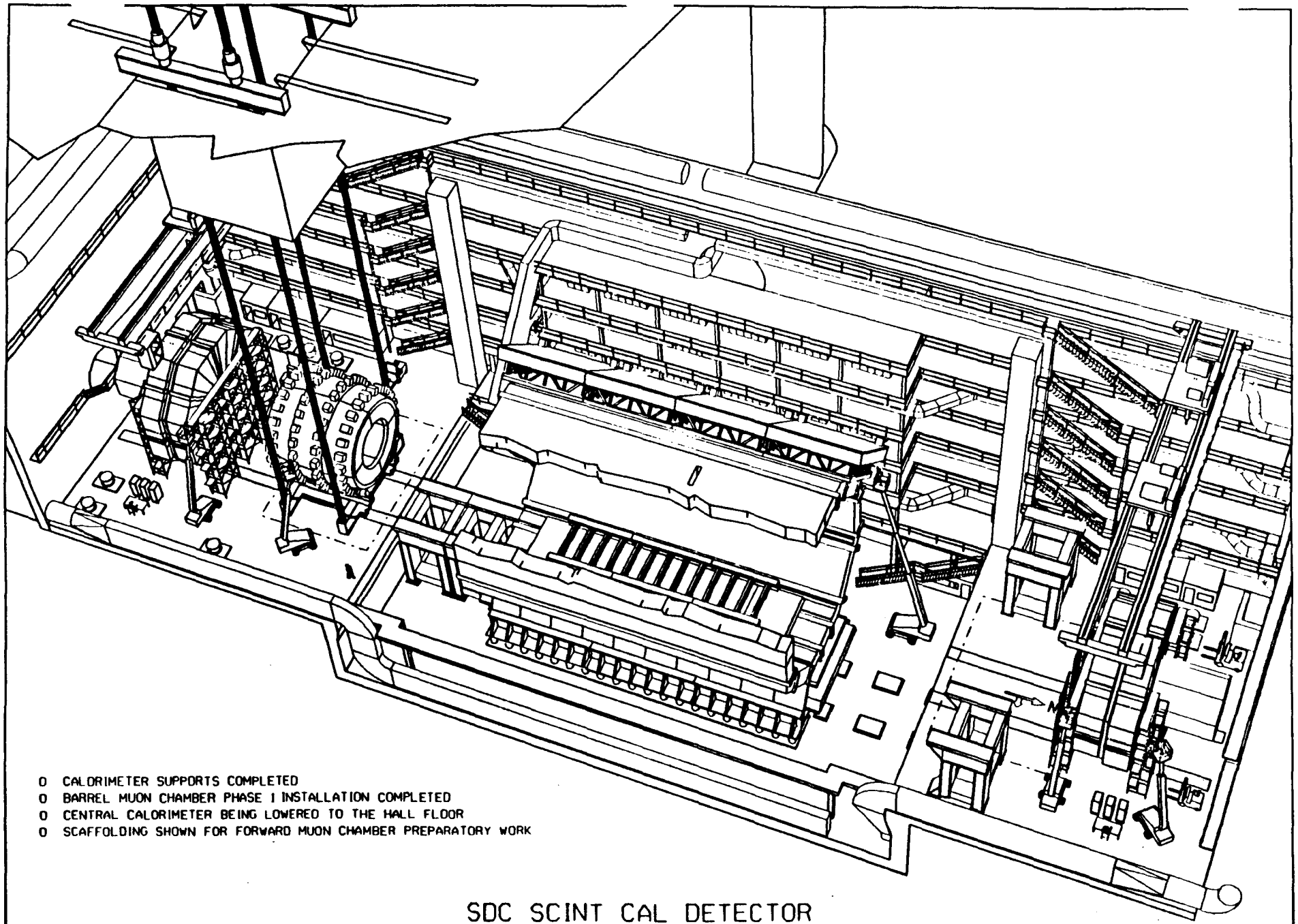
Figure 18.6 shows the barrel calorimeter lowered to the hall floor and figure 18.7 shows how the the holding frame is unbolted from the hoisting cables and travels to meet and match the calorimeter support guides previously installed. The detector is rolled into its operating position by means of horizontal hydraulic jacks (not shown) temporarily attached to the support guides.

The drawing for month 18 also shows the scaffolding used for mounting chamber supports, cables, and gas piping for the forward muon chambers.

A desk is shown with an operator sitting at a desk with a computer and several electronic racks nearby to test the equipment installed on the forward toroids.

Several cherry pickers are shown serving 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.

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 area appears to very highly occupied. Vehicles need room to maneuver and laydown areas for fixtures and tools need to be allocated for



- CALORIMETER SUPPORTS COMPLETED
- BARREL MUON CHAMBER PHASE I INSTALLATION COMPLETED
- CENTRAL CALORIMETER BEING LOWERED TO THE HALL FLOOR
- SCAFFOLDING SHOWN FOR FORWARD MUON CHAMBER PREPARATORY WORK

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

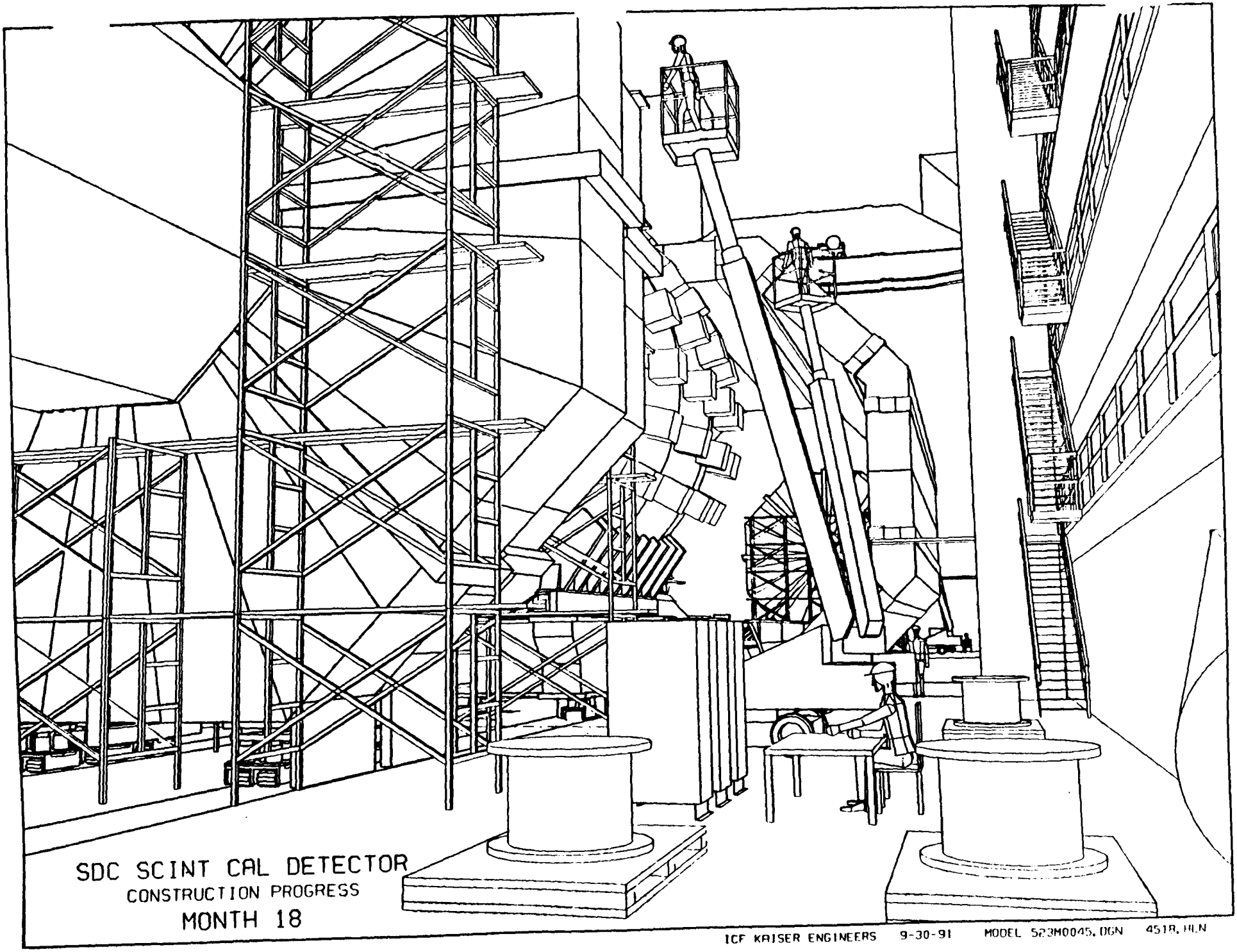
MONTH 18

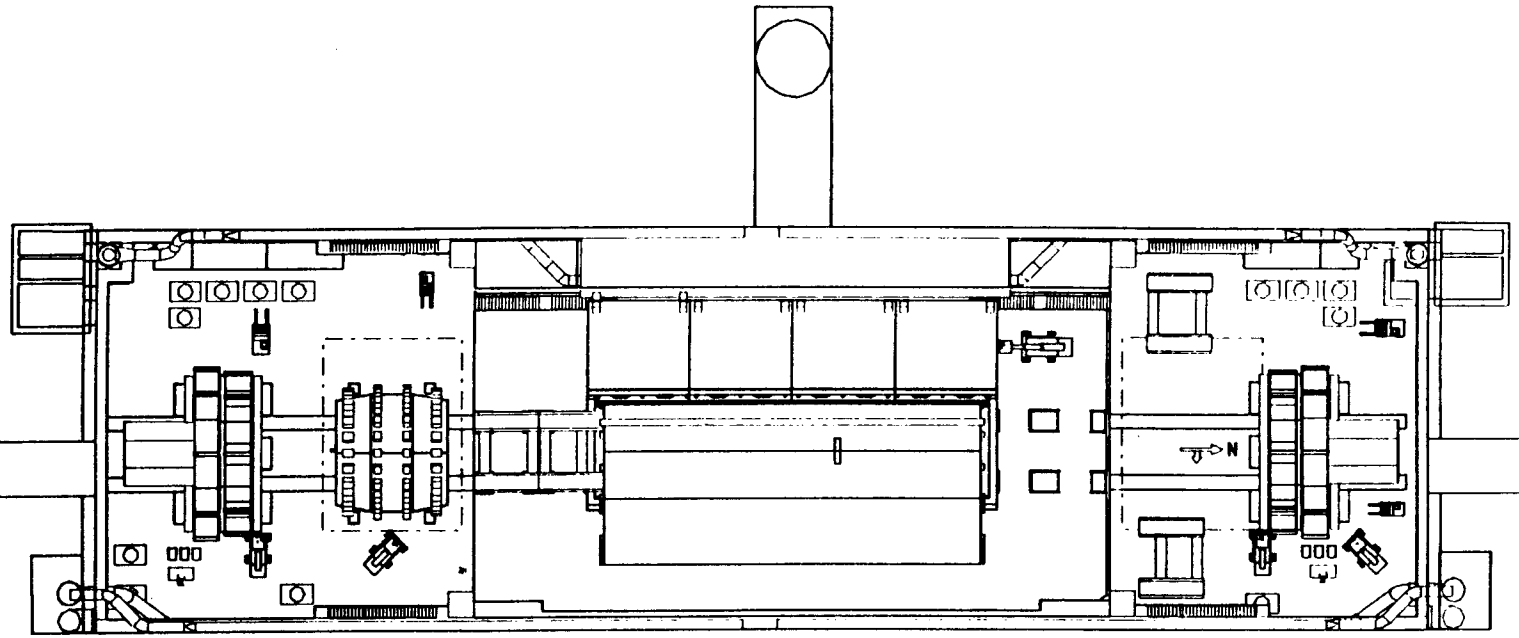
ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN MONTH18.HLN

an efficient construction operation.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	4000 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	100 hrs	40 hrs
Bridge cranes usage	50 hrs	80 hrs
Large objects lowered from the surface	1 barrel calorimeter/cradle 12 bundles of scaffolding	3 muon chamber trusses 3 muon chambers BW1
Large objects lifted to the surface		6 muon chamber cradles


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



PLAN VIEW

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 18

ICF KAISER ENGINEERS 10-6-91 MODEL 523M0046.DGN 523m46.mth18

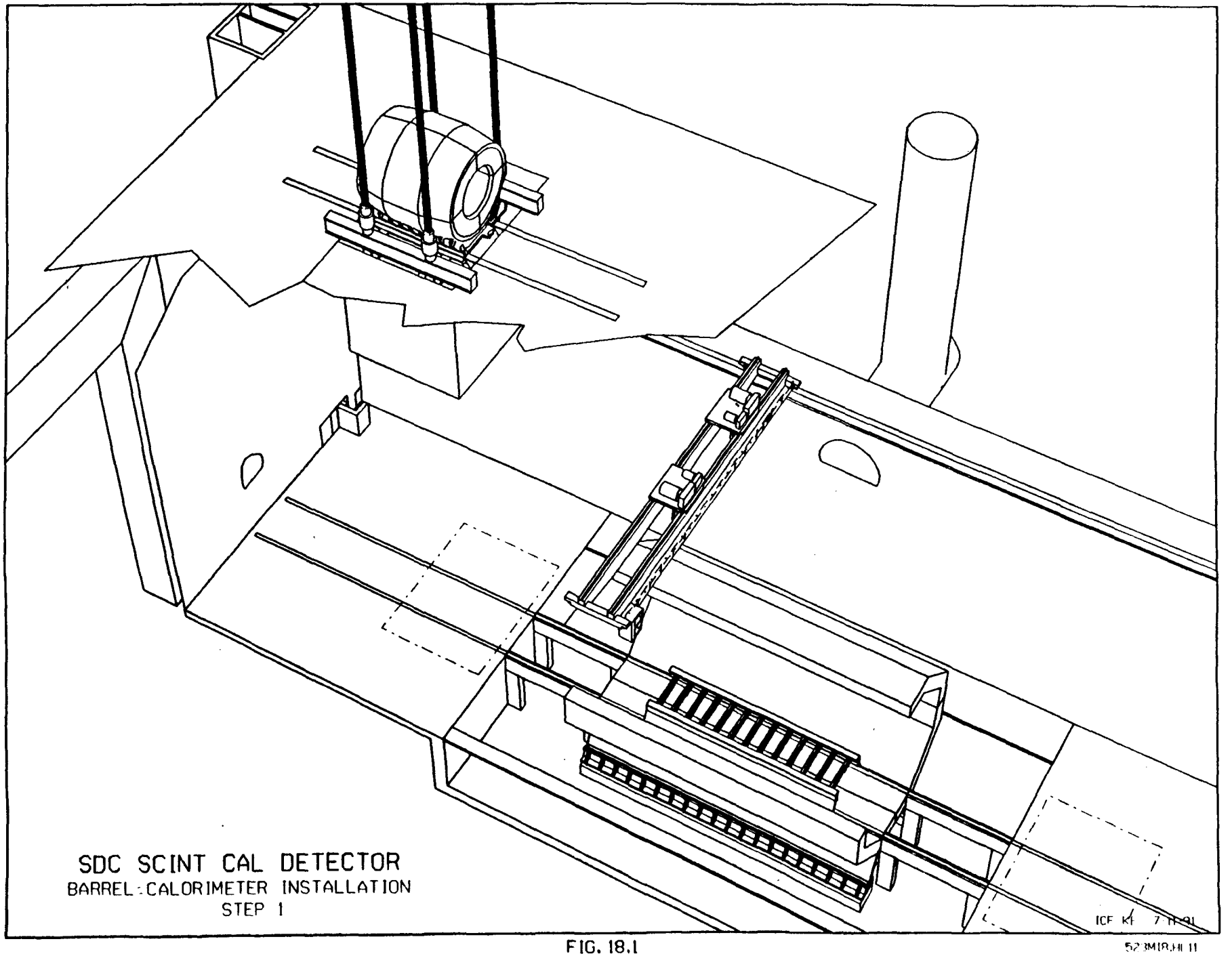
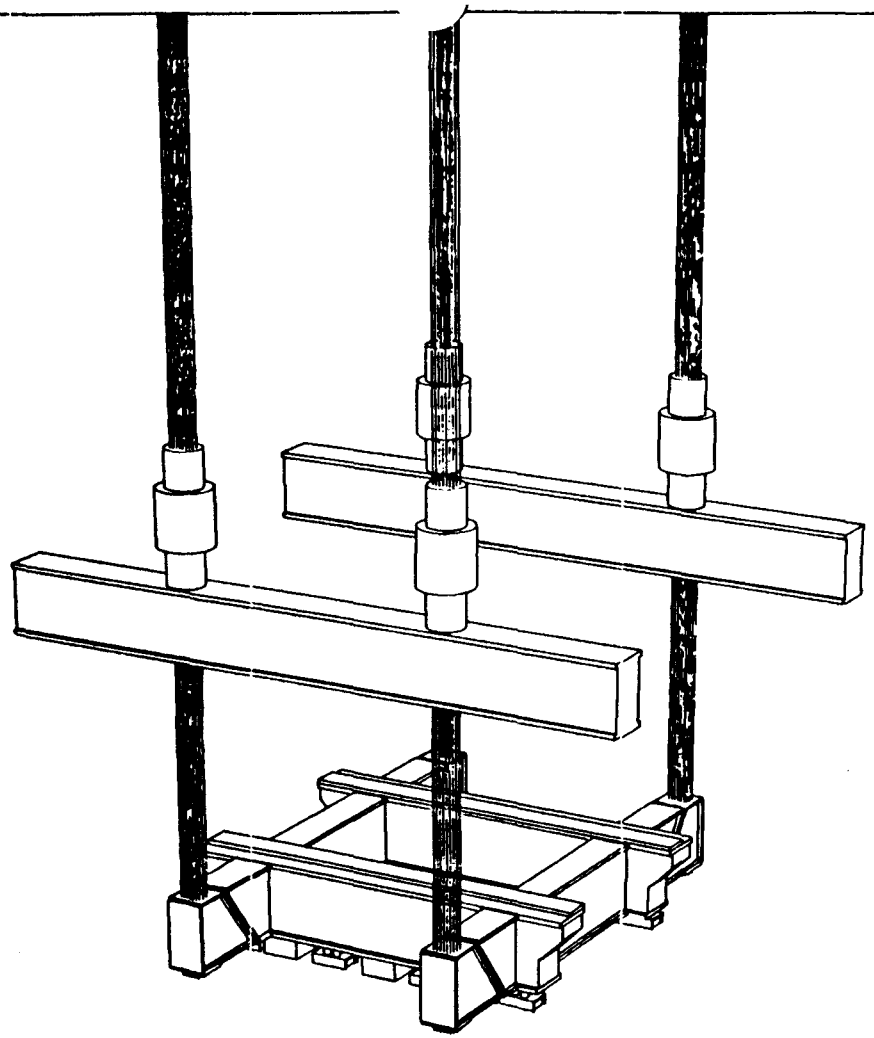


FIG. 18.1

52 3M18.HI 11



SDC SCINT CAL DETECTOR

HYDRAULIC JACKING SYSTEM
3800 METRIC TONS CAPACITY

FIG. 18.2

ICF KAISER ENGINEERS 10 10 91 MODEL 523M0018.DGN 18,HL11

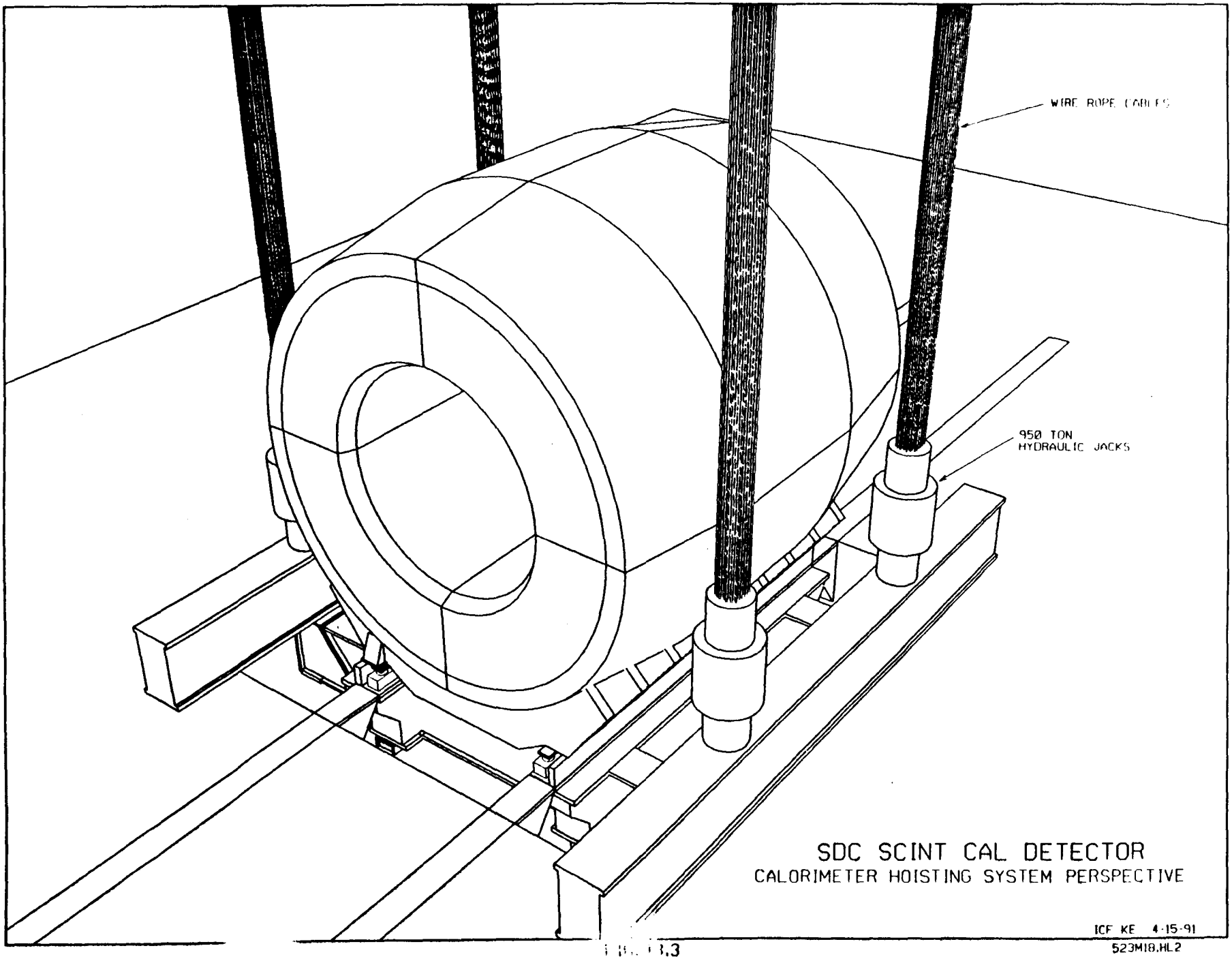

WIRE ROPE CABLES
950 TON
HYDRAULIC JACKS
SDC SCINT CAL DETECTOR
CALORIMETER HOISTING SYSTEM PERSPECTIVE
ICF KE 4-15-91
523M18.HL2

FIG. 13.3

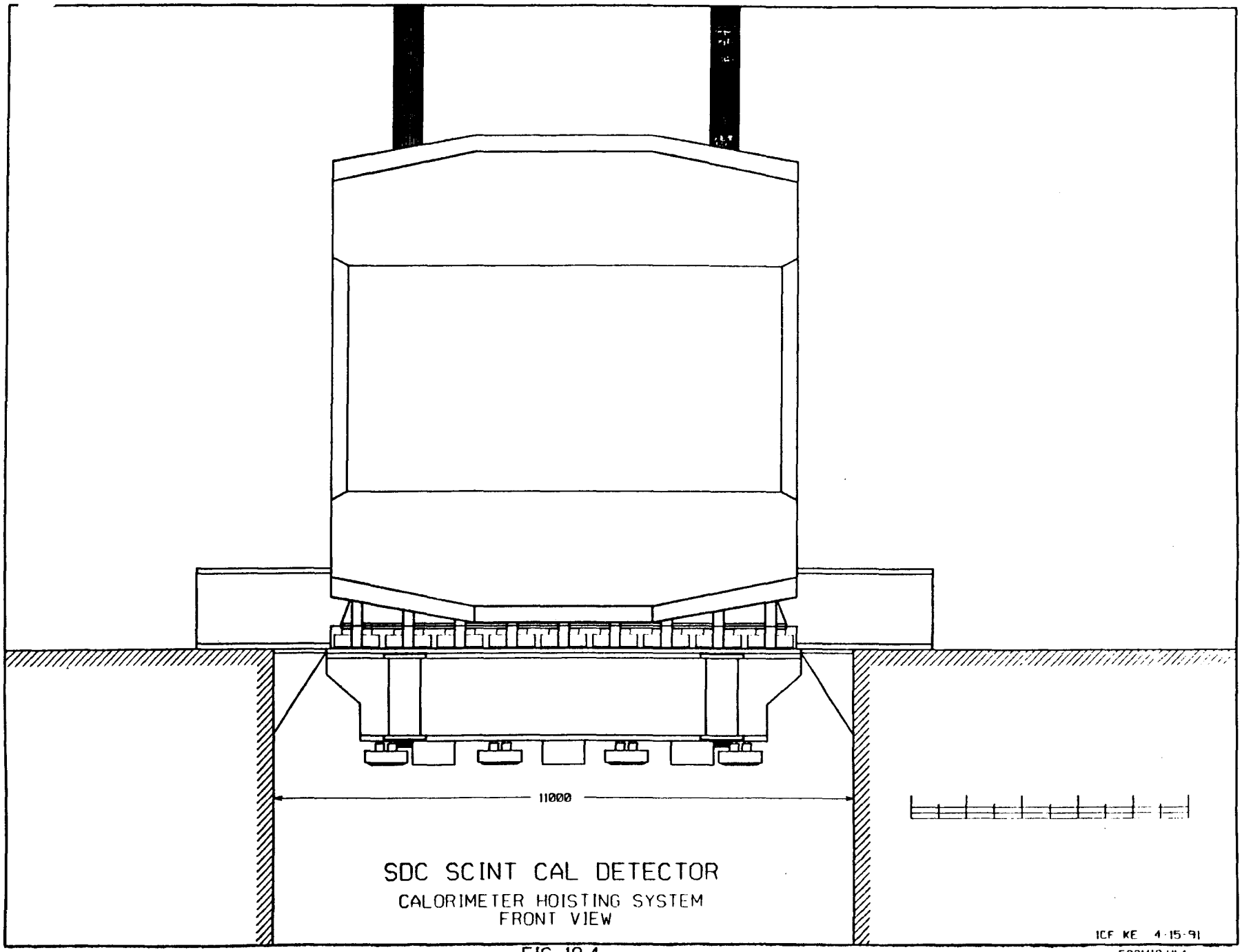

11000
SDC SCINT CAL DETECTOR
CALORIMETER HOISTING SYSTEM
FRONT VIEW
ICF KE 4-15-91
523M10.HL4

FIG. 18.4

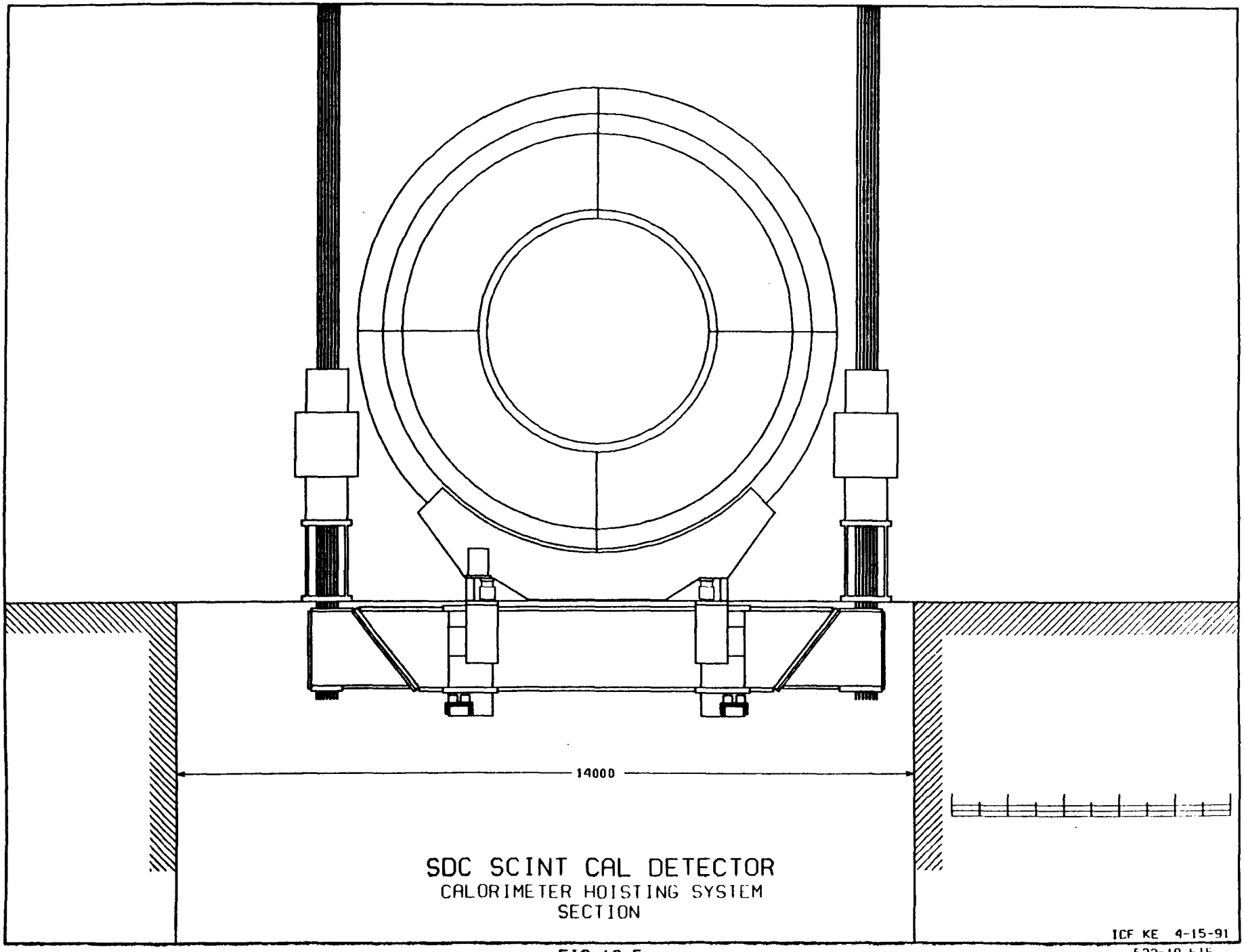

14000
SDC SCINT CAL DETECTOR
CALORIMETER HOISTING SYSTEM
SECTION
ICF KE 4-15-91
523m18.h15

FIG 18.5

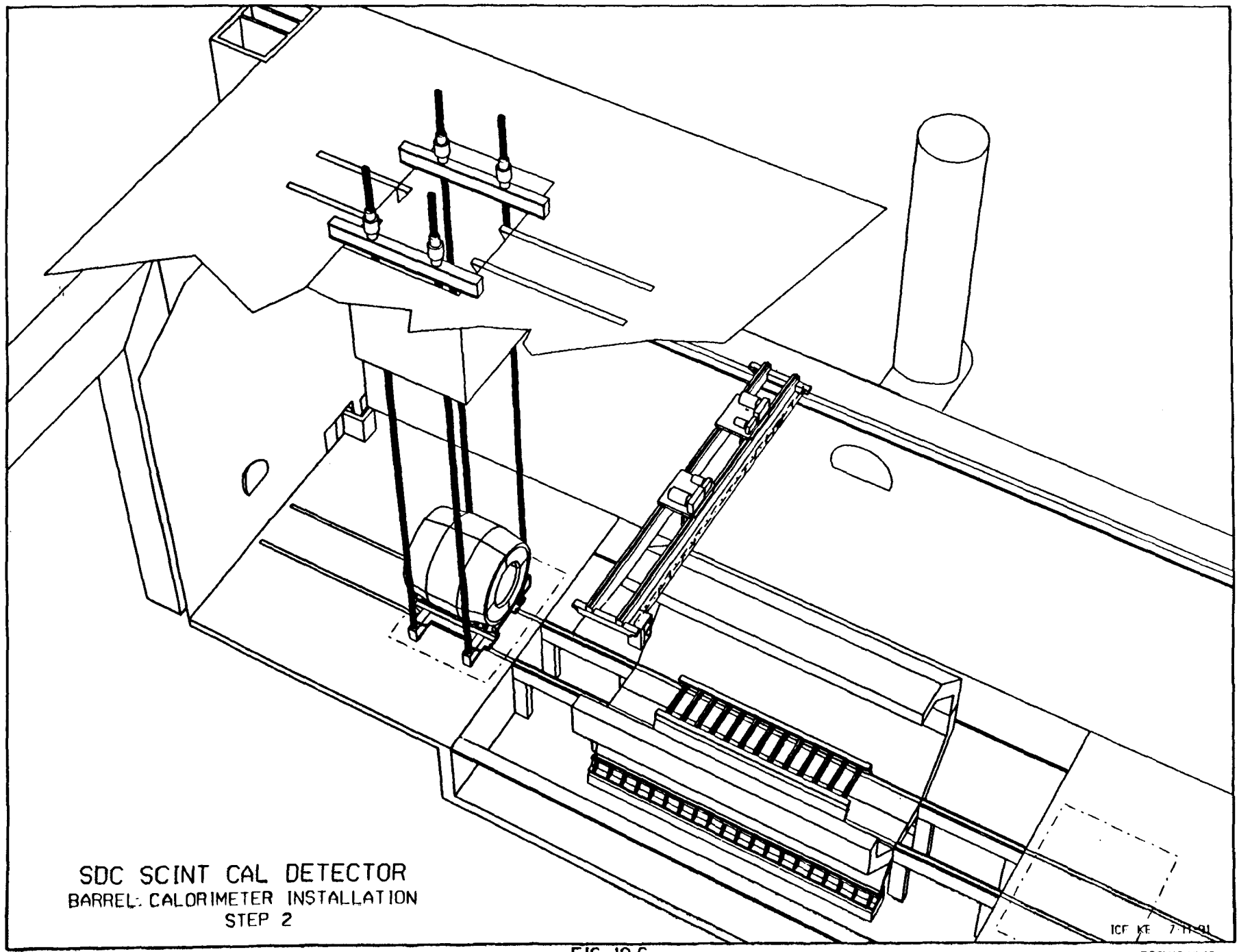


FIG. 18.6

523M18.HL12

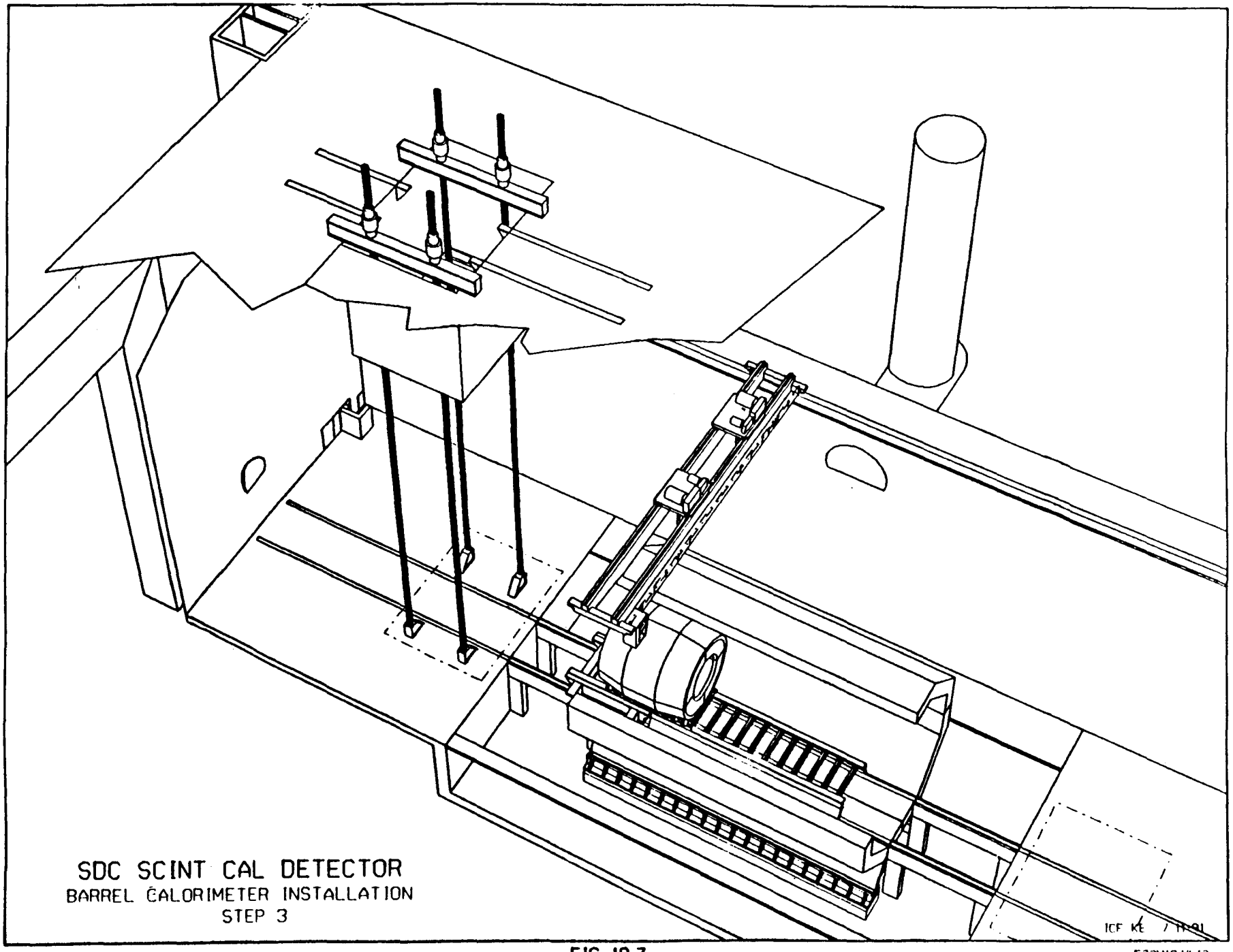


FIG. 18.7

523M18.HI 13

MONTH 19

The barrel calorimeter will be in its operating postition by the end of this month.

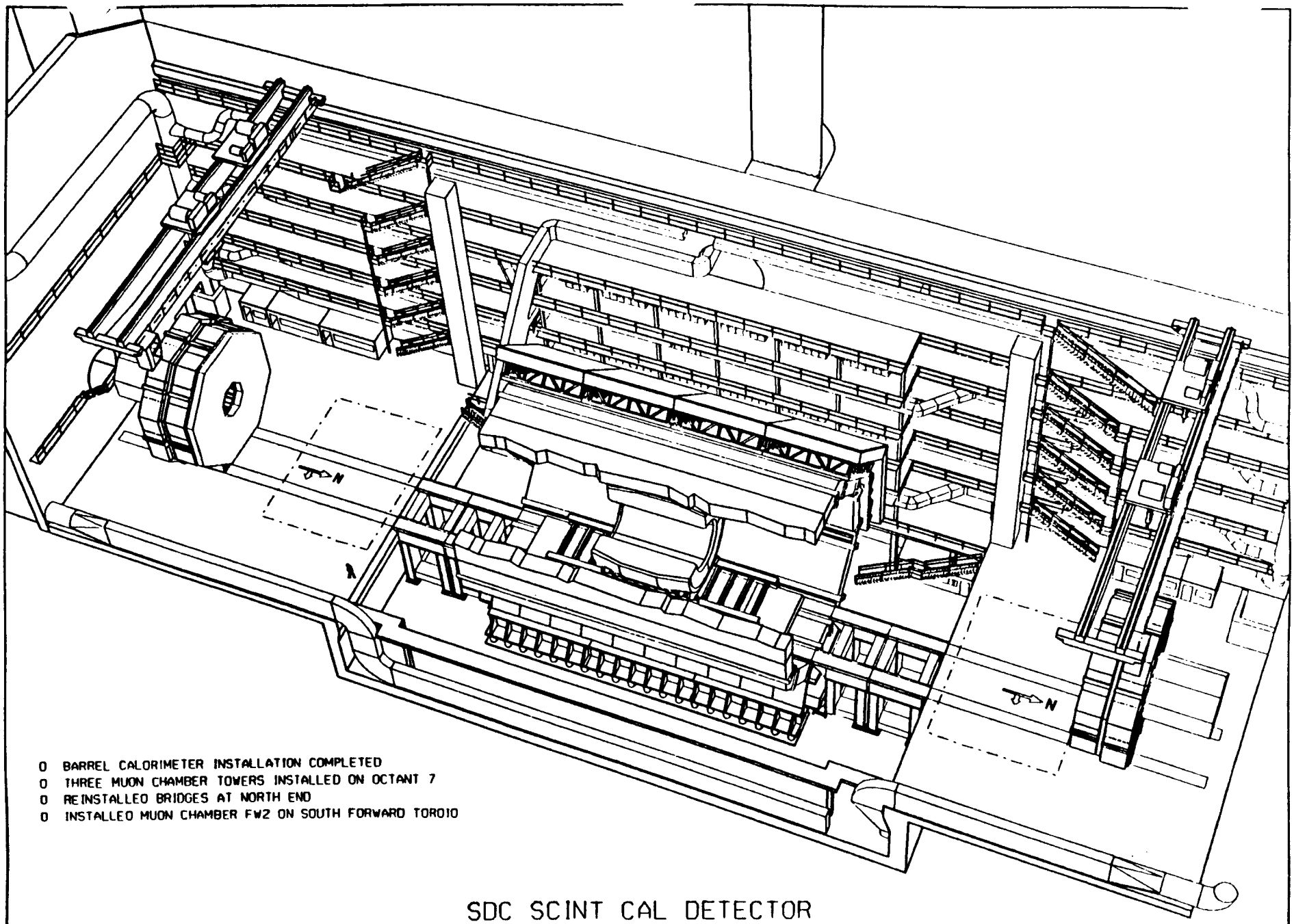
Phase II for the installation of barrel muon chamber towers has begun this month with the installation of three towers on octant 7.

The bridge sections at the north end of the building have been reinstalled.

Muon chamber FW2 has been installed on the south forward toroid.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	2100 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	10 hrs	40 hrs
Bridge cranes usage	20 hrs	80 hrs
Large objects lowered from the surface	2 muon chamber FW2 sections	3 muon chamber trusses 3 muon chambers BW1
Large objects lifted to the surface	1 barrel calorimeter cradle	6 muon chamber cradles



- BARREL CALORIMETER INSTALLATION COMPLETED
- THREE MUON CHAMBER TOWERS INSTALLED ON OCTANT 7
- REINSTALLED BRIDGES AT NORTH END
- INSTALLED MUON CHAMBER FW2 ON SOUTH FORWARD TOROID

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 19

ICF KAISER ENGINEE[illegible] MODEL 523M0045.DGN MONTH19.HLN

MONTH 20

Three muon towers are installed and aligned on octant 6 this month.

Muon chamber FW2 was installed on the north forward toroid.

The muon chambers (FW4 & FW5) and Cerenkov counter system are lowered to the hall floor by the surface crane (for more explanation on the installation of these systems, see write up on month 22).

The superconducting solenoidal coil is installed this month. Figures 20.1 through 20.5 show the different steps assumed for its installation.

The solenoid will be mounted on a mandrel which in turn will be mounted on a cradle. The whole assembly will be lowered to the hall floor by the surface crane.

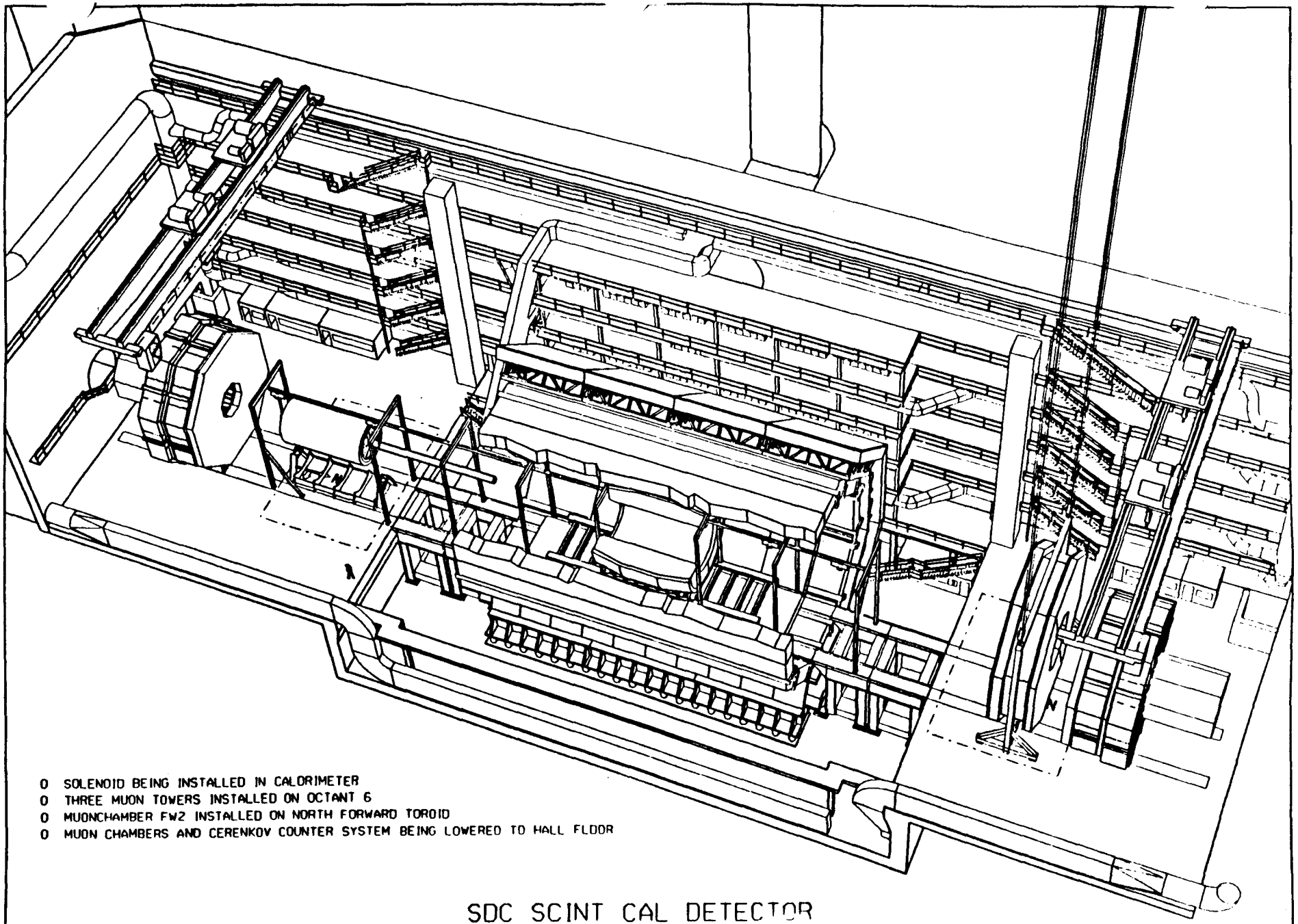
A monorail system is be constructed temporarily inside the detector for purposes of this installation. This monorail system will later be used to install other items inside the calorimeter.

In fig 20.2, an extension has been added to the mandrel. Later a beam will be added above the coil and the monorail hoists will be rolled into position and hoist the coil as shown in Figure 20.3.

The hoists will carry the coil until the mandrel extension is within reach of a third hoist which will take over from the second hoist so that travel can continue (see figure 20.4). At this point the second hoist will be dismantled. The coil can now penetrate into the central calorimeter and be secured in place.

MANPOWER AND EQUIPMAENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	3000 hrs



- SOLENOID BEING INSTALLED IN CALORIMETER
- THREE MUON TOWERS INSTALLED ON OCTANT 6
- MUONCHAMBER FW2 INSTALLED ON NORTH FORWARD TOROID
- MUON CHAMBERS AND CERENKOV COUNTER SYSTEM BEING LOWERED TO HALL FLOOR

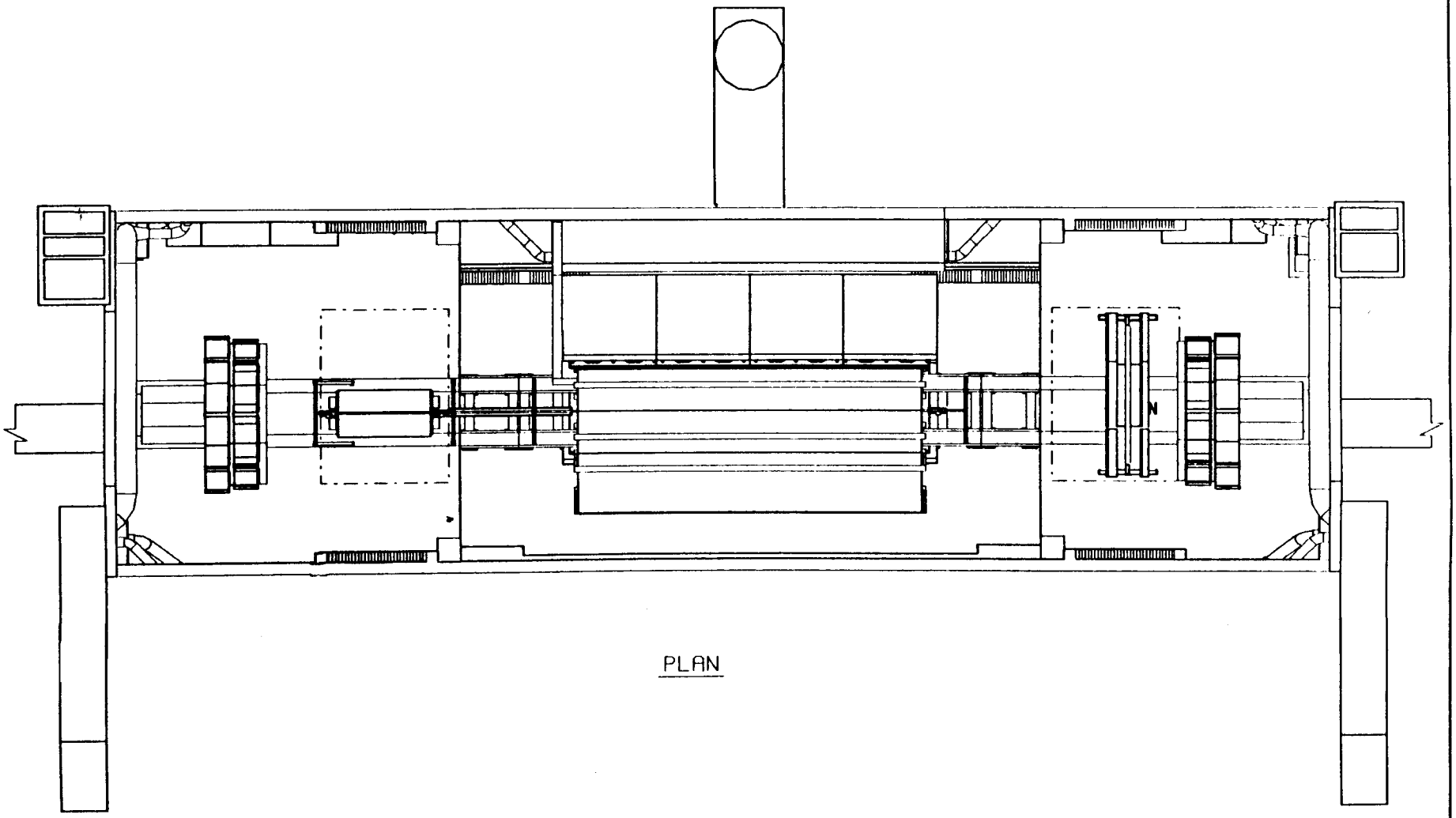
SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 20

JF KAISER ENGINEERS 9-3-91 MODEL 523M0045.DGN MONTH20.HLN

	SOUTH END	NORTH END
Shaft cranes usage	40 hrs	50 hrs
Bridge cranes usage	80 hrs	80 hrs
Large objects lowered from the surface	5 bundles of steel monorail 1 solenoid in cradle 2 muon chamber trusses 2 muon chambers BW1	2 muon chambers FW2 sections 3 bundles of steel monorail 1 muon chamber truss 1 chambers/Cerenkov counter system 1 muon chamber BW1
Large objects lifted to the surface	4 muon chamber cradles	2 muon chamber cradles



PLAN

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 20

ICF KAISER ENGINEERS 9-19-91 523M46.MTH20

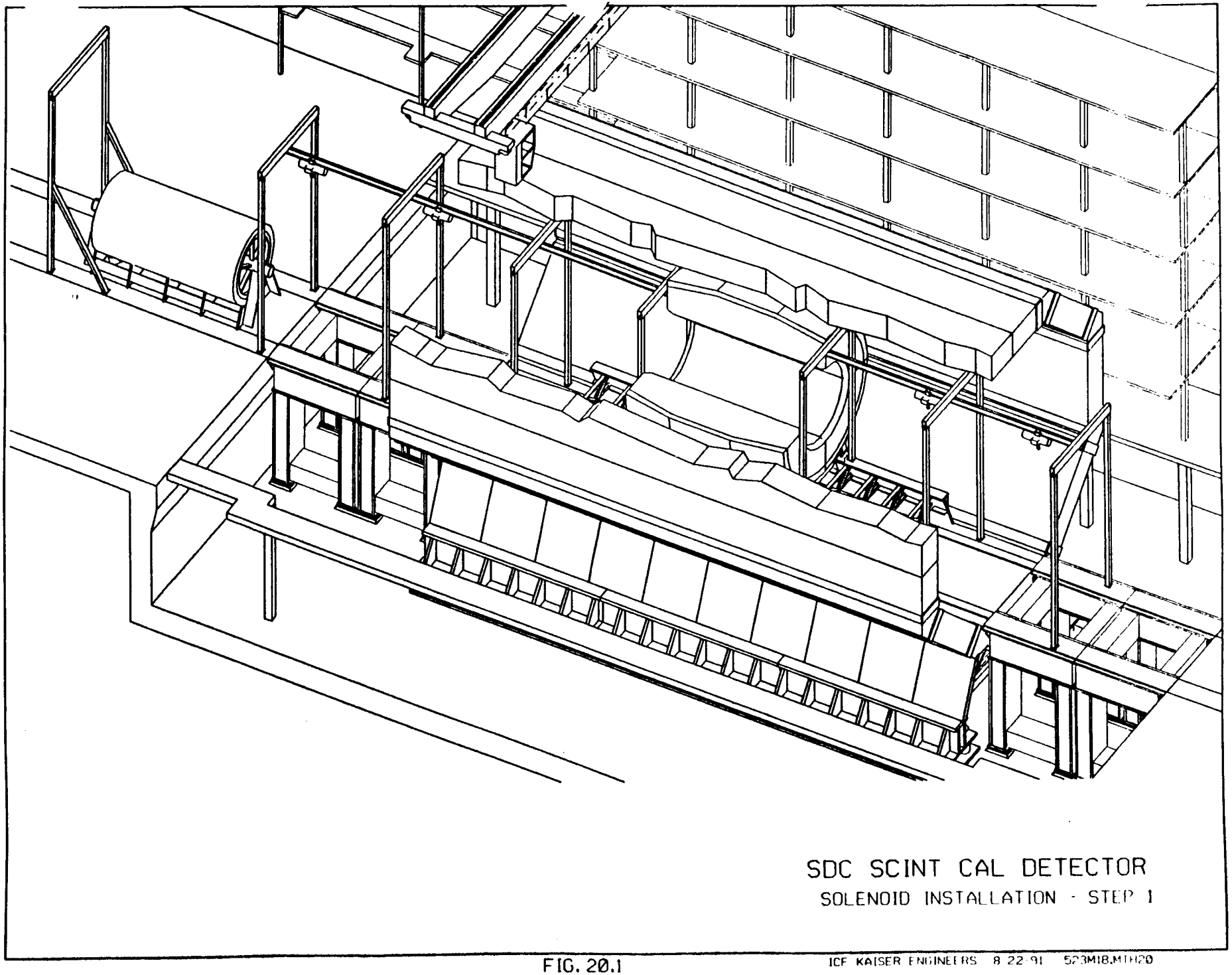

SDC SCINT CAL DETECTOR
SOLENOID INSTALLATION - STEP 1
ICF KAISER ENGINEERS 8 22 91 523M18.MTH20

FIG. 20.1

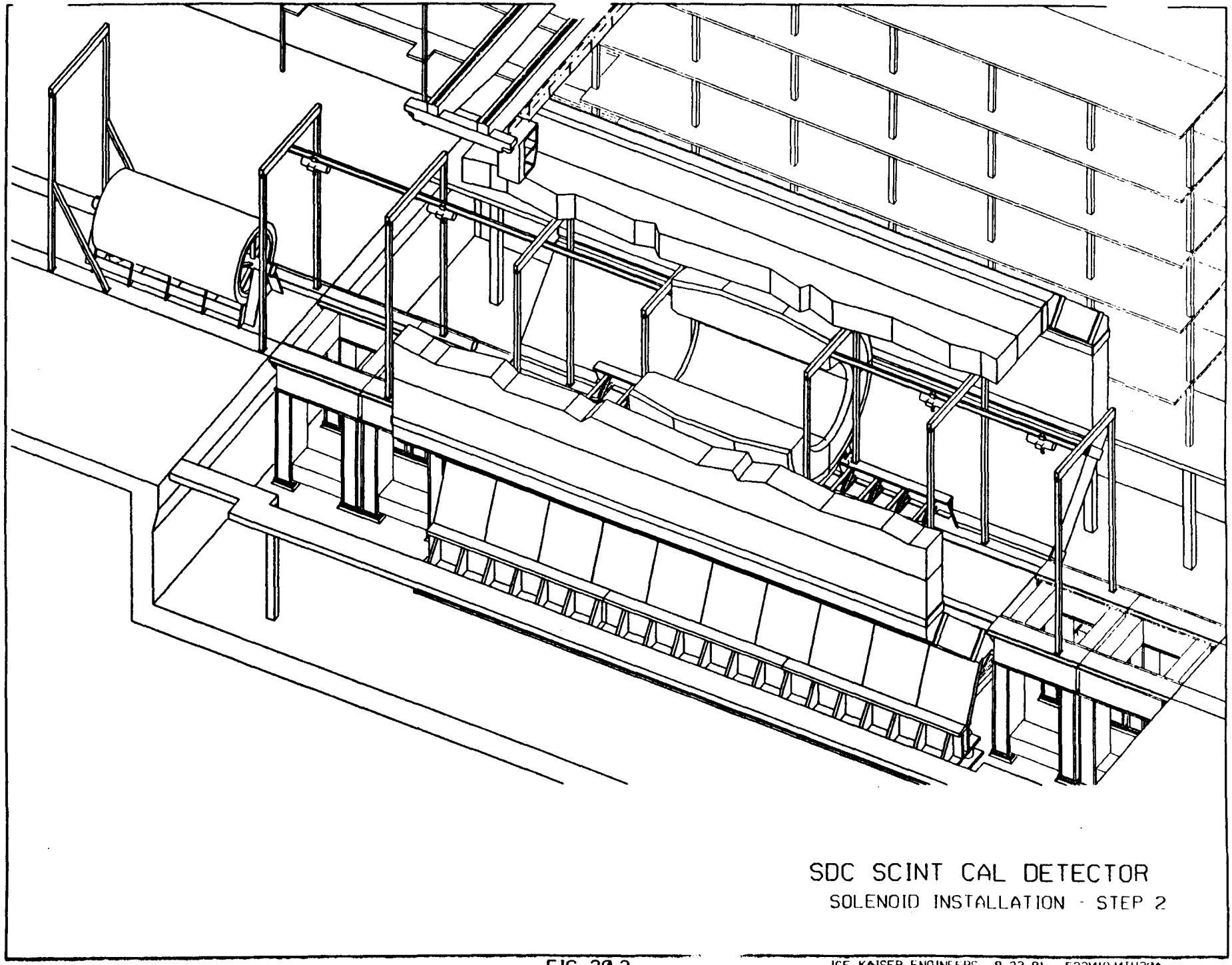

SDC SCINT CAL DETECTOR
SOLENOID INSTALLATION - STEP 2
ICF KAISER ENGINEERS 8-22-91 523MIB.MTI120A

FIG. 20.2

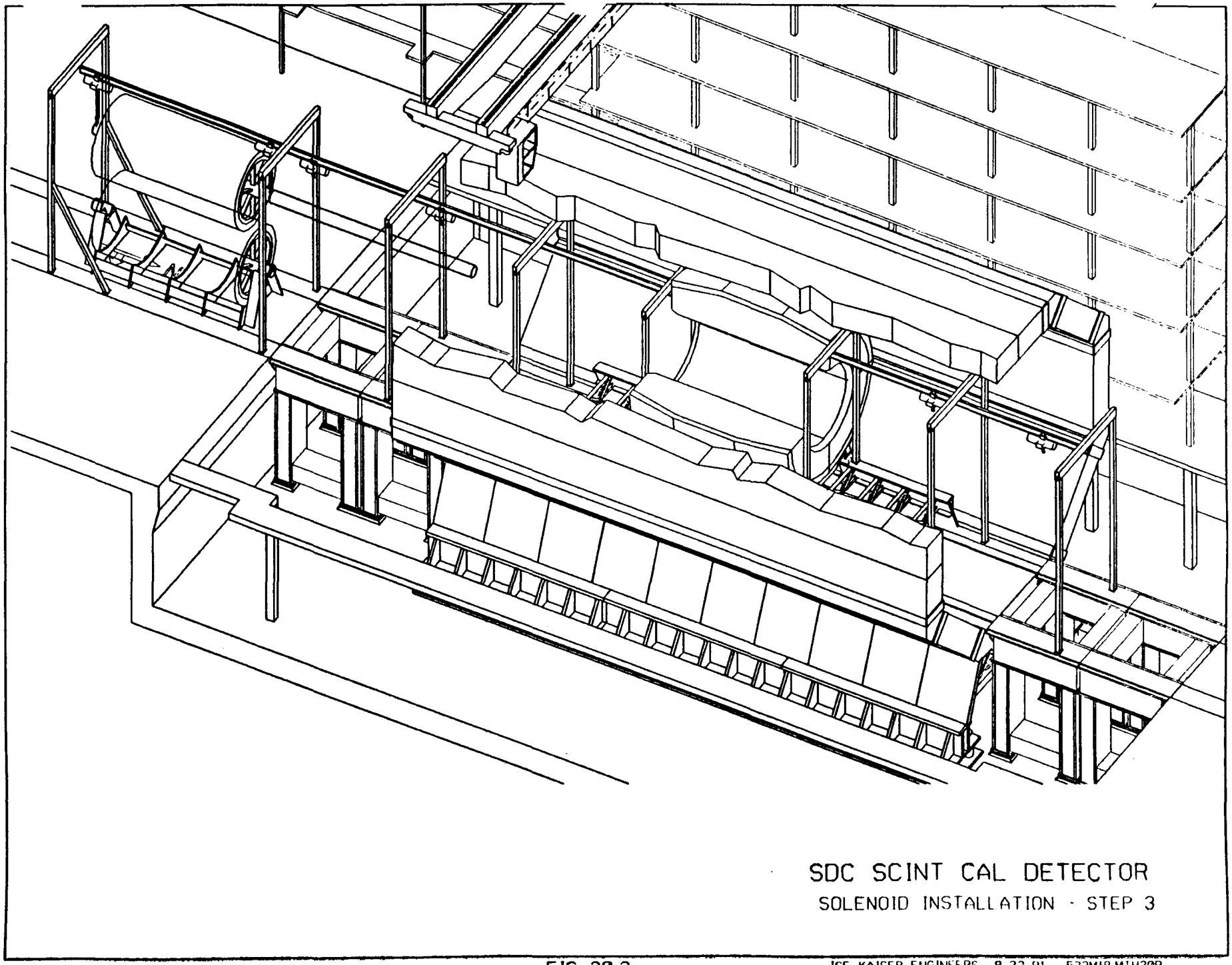
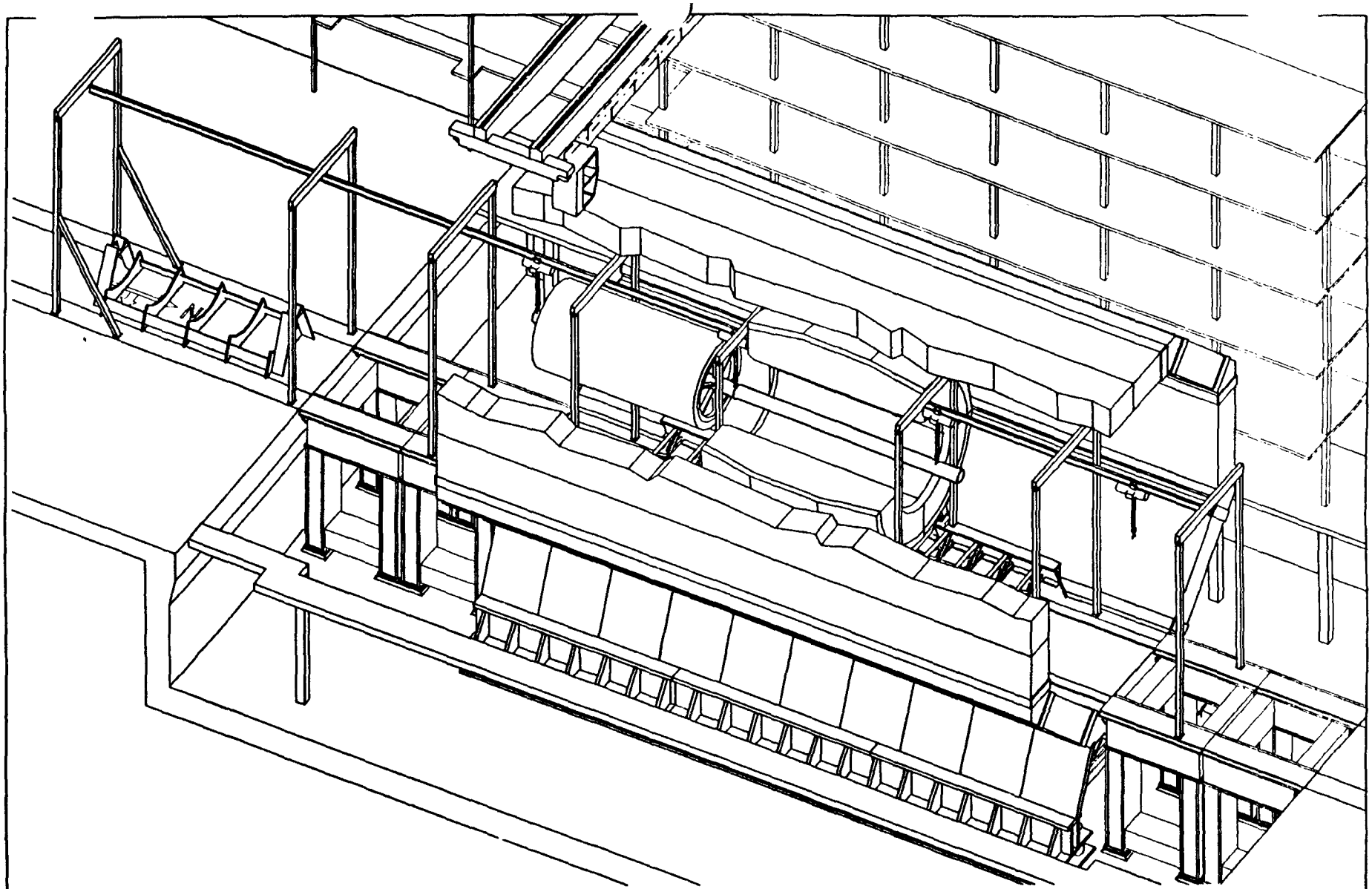


FIG. 20.3

ICF KAISER ENGINEERS 8 22 91 523MIB.MTH20B



SDC SCINT CAL DETECTOR

SOLENDOID INSTALLATION - STEP 4

FIG. 20.1

ICF KAISER ENGINEERS 8-22-91 523MIB.M1H20C

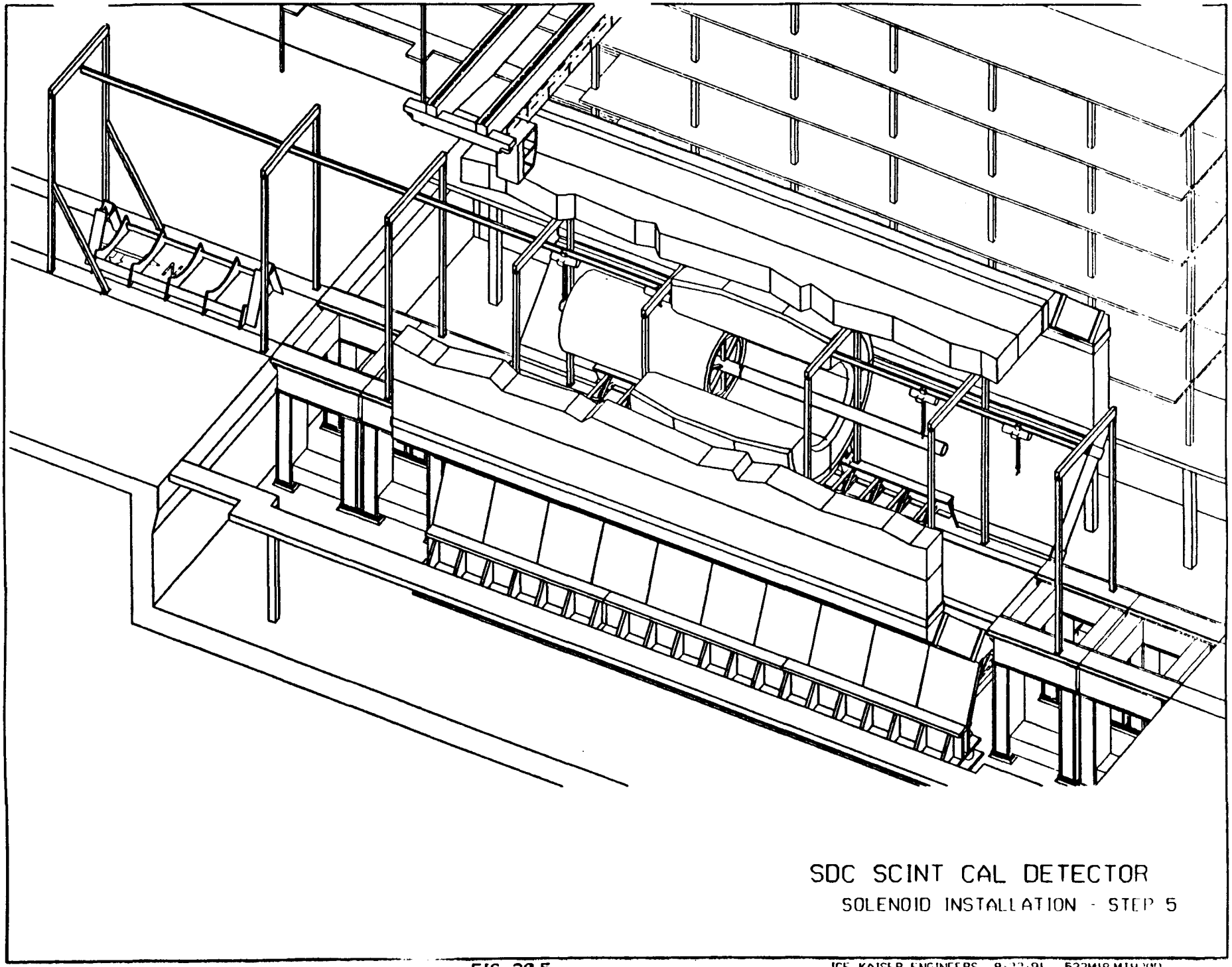


FIG. 20.5

ICF KAISER ENGINEERS 8-22-91 523M18.MTH.00

MONTH 21

There are two drawings from different perspective angles for month 21. The first drawing was done in more detail than others in order to investigate whether there is enough room on the hall floor to perform all the activities scheduled for this month. Further investigation will be required in the future which would include laydown space for loads and parking space for all the vehicles that will operate on the floor. On the basis of the present drawing there does not seem to be a problem. The other drawing shows month 21 from a different perspective.

The cryogenic platform and the solenoid chimney is installed.

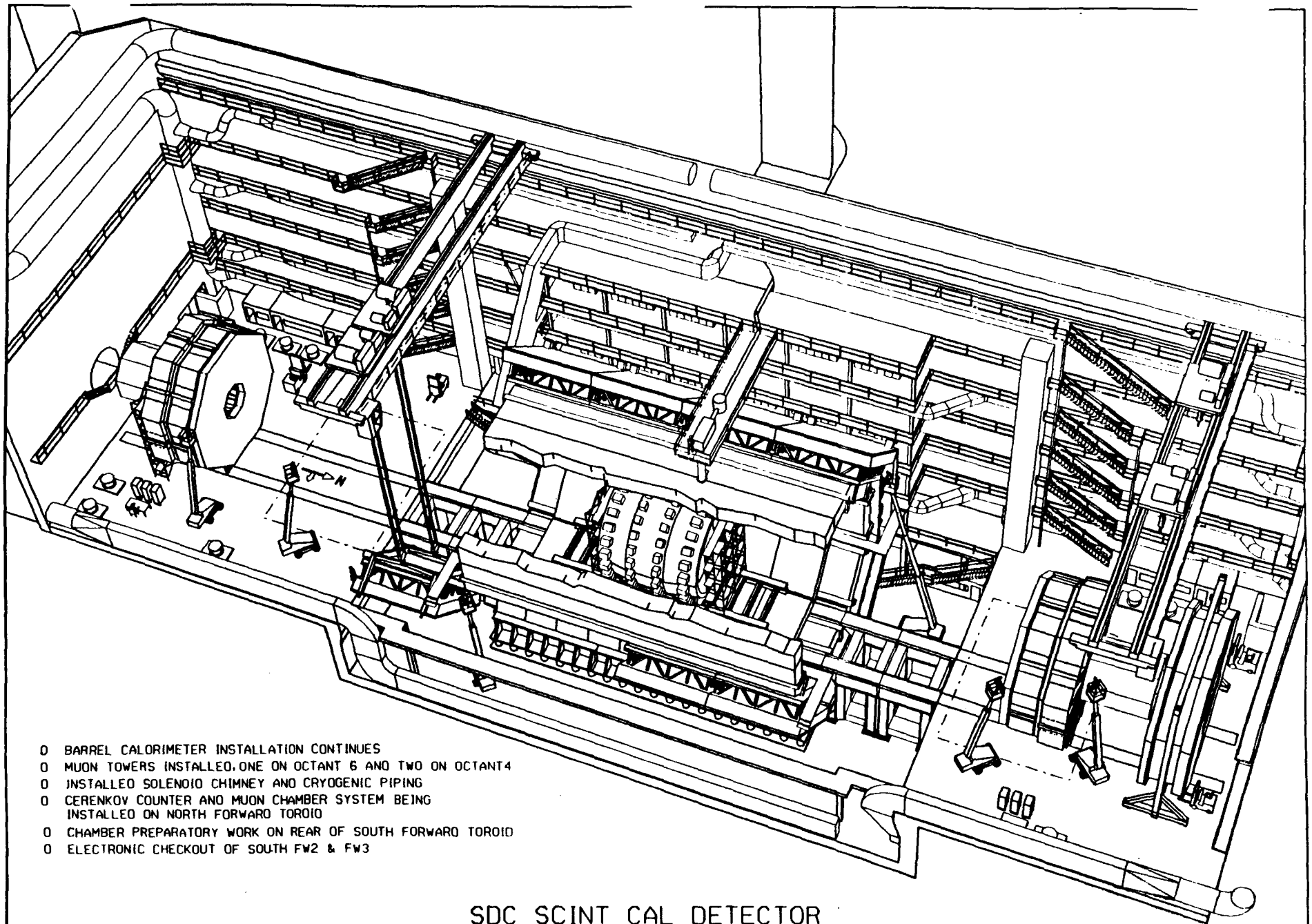
During this month the electronic checkout, piping and cabling of the barrel calorimeter will continue. The connection of the coil to the cryogenics system will be made.

The north forward muon chamber/cerenkov counter system is rolled around the north forward toroid, while the toroid is moved south to make room. Once the two items are aligned they will be rolled together and the muon chamber/ Cerenkov counter assembly installed.

Two more towers will be installed on octant 4 and one on octant 6.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	2000 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	50 hrs	10 hrs
Bridge cranes usage	100 hrs	10 hrs
Large objects lowered from the surface	3 muon chamber trusses 3 muon chambers BW1 4 sections of cryogenic platform	
Large objects lifted to the surface	6 muon chamber cradles	



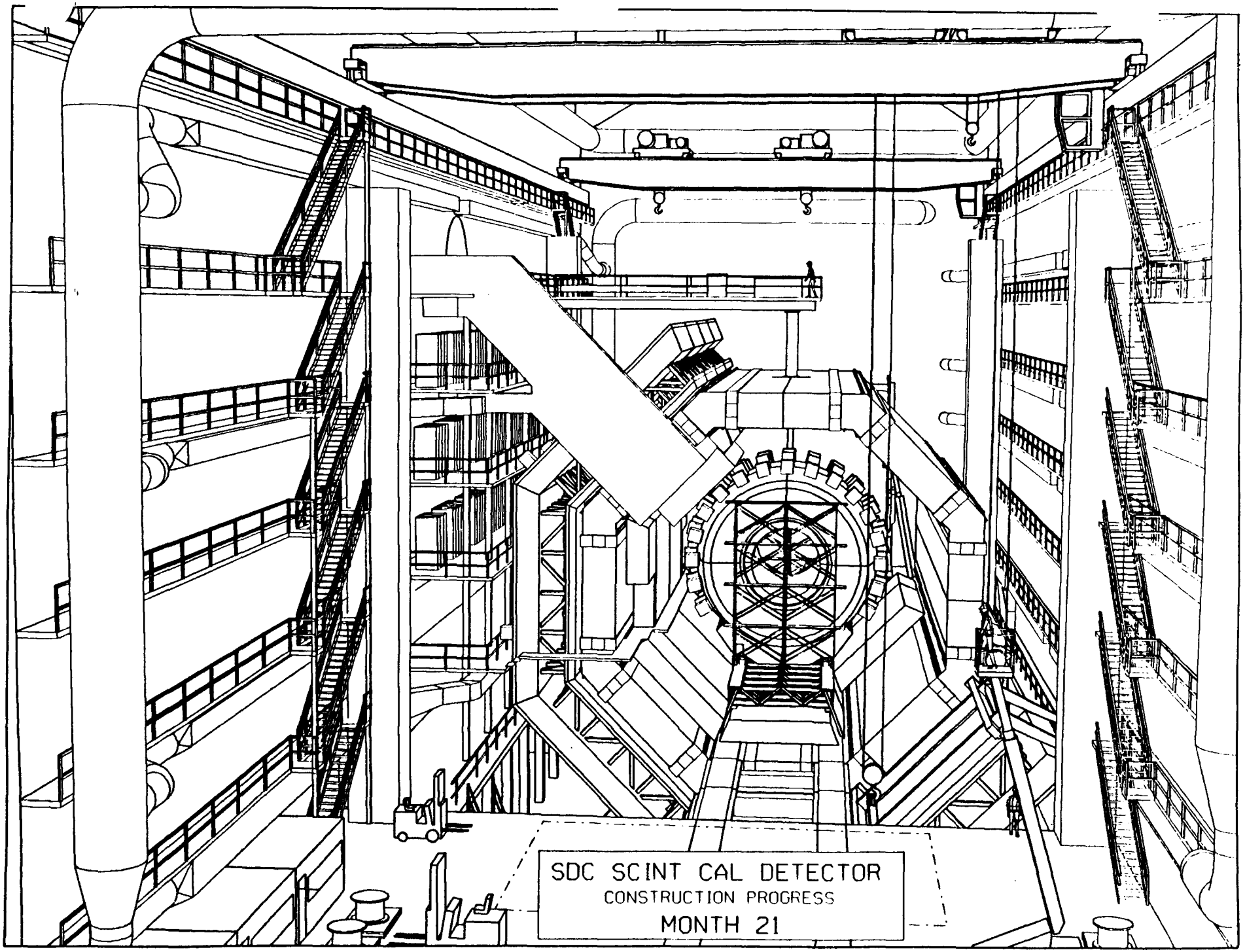
- 0 BARREL CALORIMETER INSTALLATION CONTINUES
- 0 MUON TOWERS INSTALLED, ONE ON OCTANT 6 AND TWO ON OCTANT4
- 0 INSTALLED SOLENOID CHIMNEY AND CRYOGENIC PIPING
- 0 CERENKOV COUNTER AND MUON CHAMBER SYSTEM BEING INSTALLED ON NORTH FORWARD TOROID
- 0 CHAMBER PREPARATORY WORK ON REAR OF SOUTH FORWARD TOROID
- 0 ELECTRONIC CHECKOUT OF SOUTH FW2 & FW3

SDC SCINT CAL DETECTOR

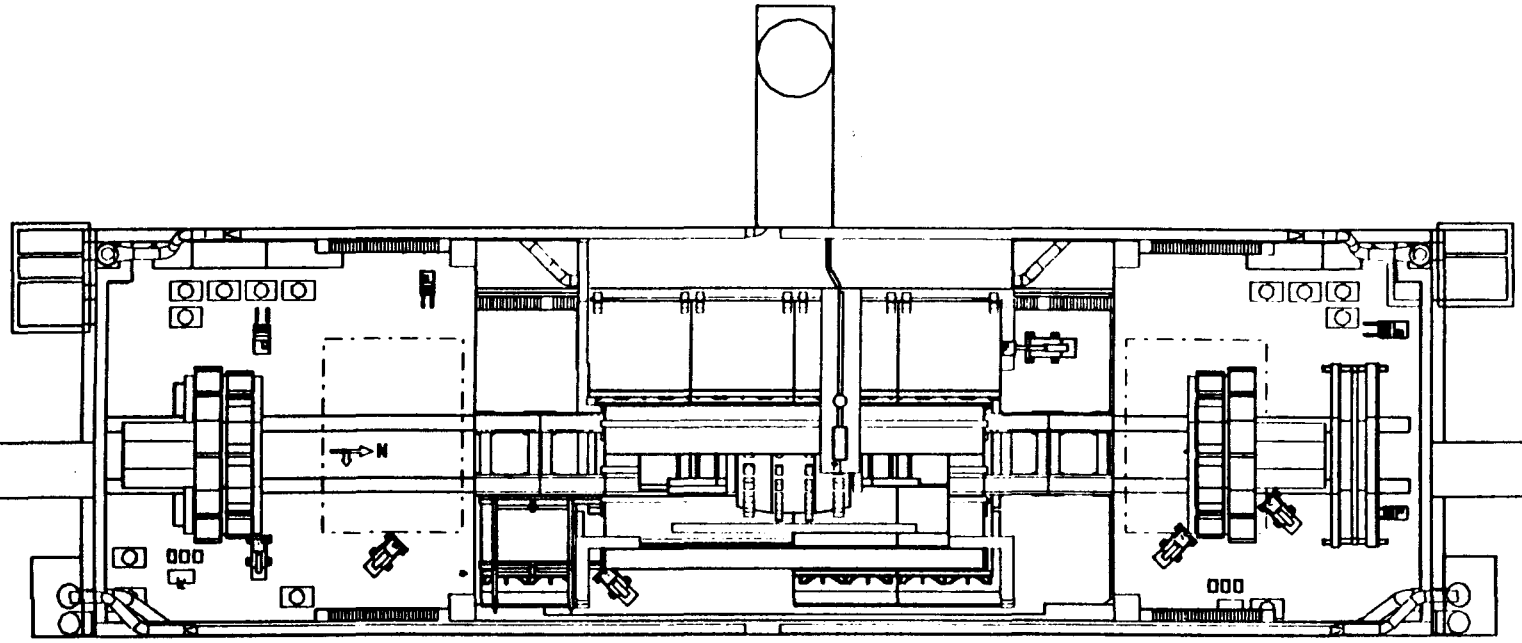
CONSTRUCTION PROGRESS

MONTH 21

ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN MONTH21.HLN



ICF KAISER ENGINEERS 10-16-91 MODEL 523M0045.DGN 4521.HL2



PLAN VIEW

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 21

ICF KAISER ENGINEERS 10-6-91 MODEL 523M0046.DGN 523m46.mth21

MONTH 22

The installation work on the barrel calorimeter continues and the solenoid cooldown begins.

Two muon towers on octant 4 and one on octant 3 are installed and aligned.

Figure 22.1 shows a muon truss being installed on octant 3 and the positioning of the installation frame cross members. The auxiliary hook of one trolley will be used to tilt the frame to its proper angle and then the frame temporarily bolted to the muon steel, while the muon truss is pushed onto the matching rails (Hall details not shown for clarity).

The installation of FW4, FW5 and the Cerenkov counter on the north forward toroid is completed.

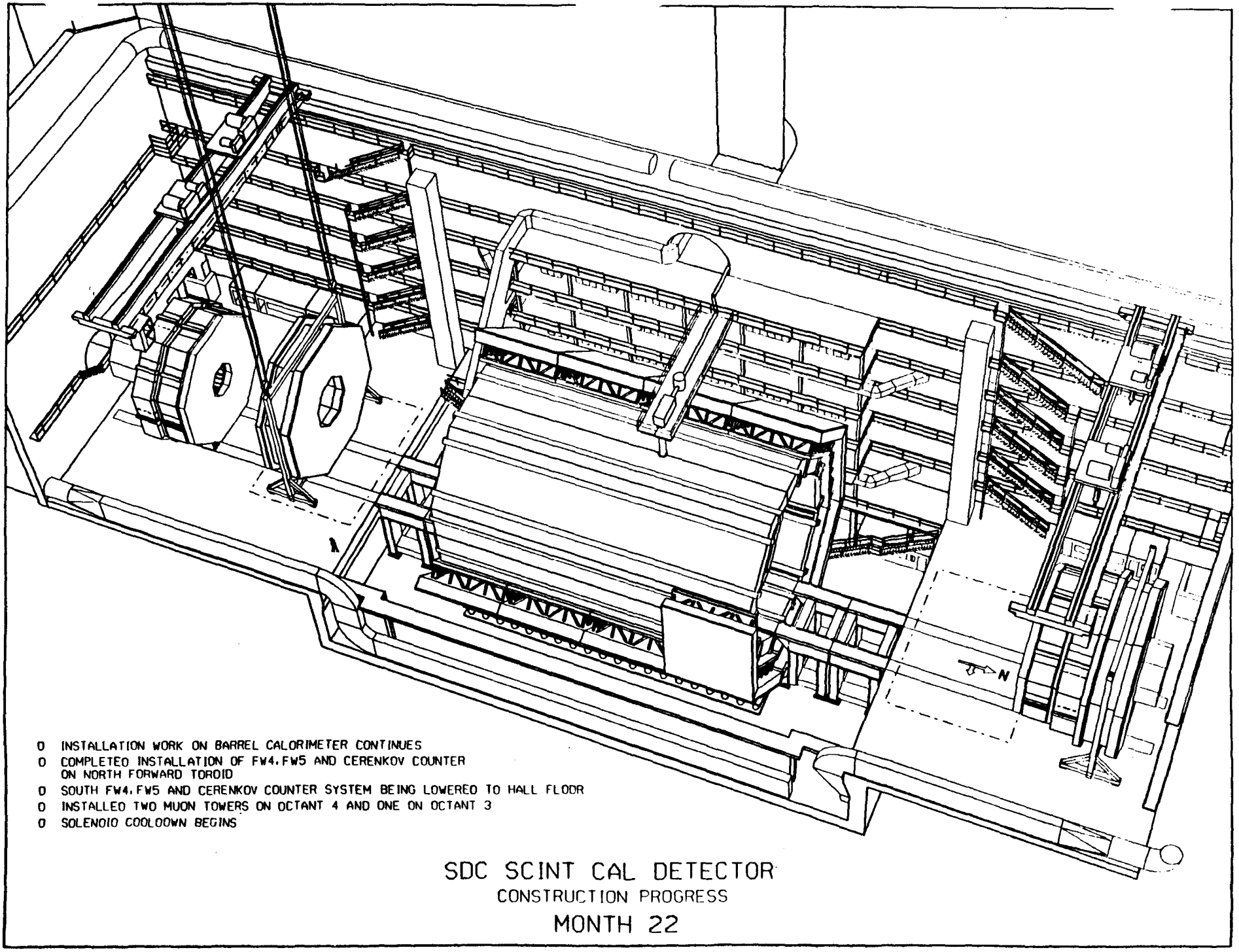
The drawing shows the south forward muon chambers FW4, FW5 and the Cerenkov counter being lowered by two hooks or trolleys. This could also be done with one hook and a sling.

At the time this report was written, a decision had not been made as to whether to assemble the forward muon chambers and Cerenkov counters on the surface and lower the whole system as a complete ring or whether to assemble these items on the hall floor from segments.

Figure 22.2 and 22.3 shows an alternate method for the installation of the forward muon chambers and Cerenkov counters using chamber and Cerenkov counter segments.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	1000 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	30 hrs	20 hrs
Bridge cranes usage	60 hrs	40 hrs
Large objects lowered from the surface	1 muon chamber truss 1 muon chamber BW1 1 chambers/Cerenkov counter system	2 muon chamber trusses 2 muon chambers BW1



- INSTALLATION WORK ON BARREL CALORIMETER CONTINUES
- COMPLETED INSTALLATION OF FW4, FW5 AND CERENKOV COUNTER ON NORTH FORWARD TOROID
- SOUTH FW4, FW5 AND CERENKOV COUNTER SYSTEM BEING LOWERED TO HALL FLOOR
- INSTALLED TWO MUON TOWERS ON OCTANT 4 AND ONE ON OCTANT 3
- SOLENOID COOLDOWN BEGINS

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 22

ICF KAISER ENGINEERS 9-6-91 MODEL 523M0045.DGN MONTH22.JHN

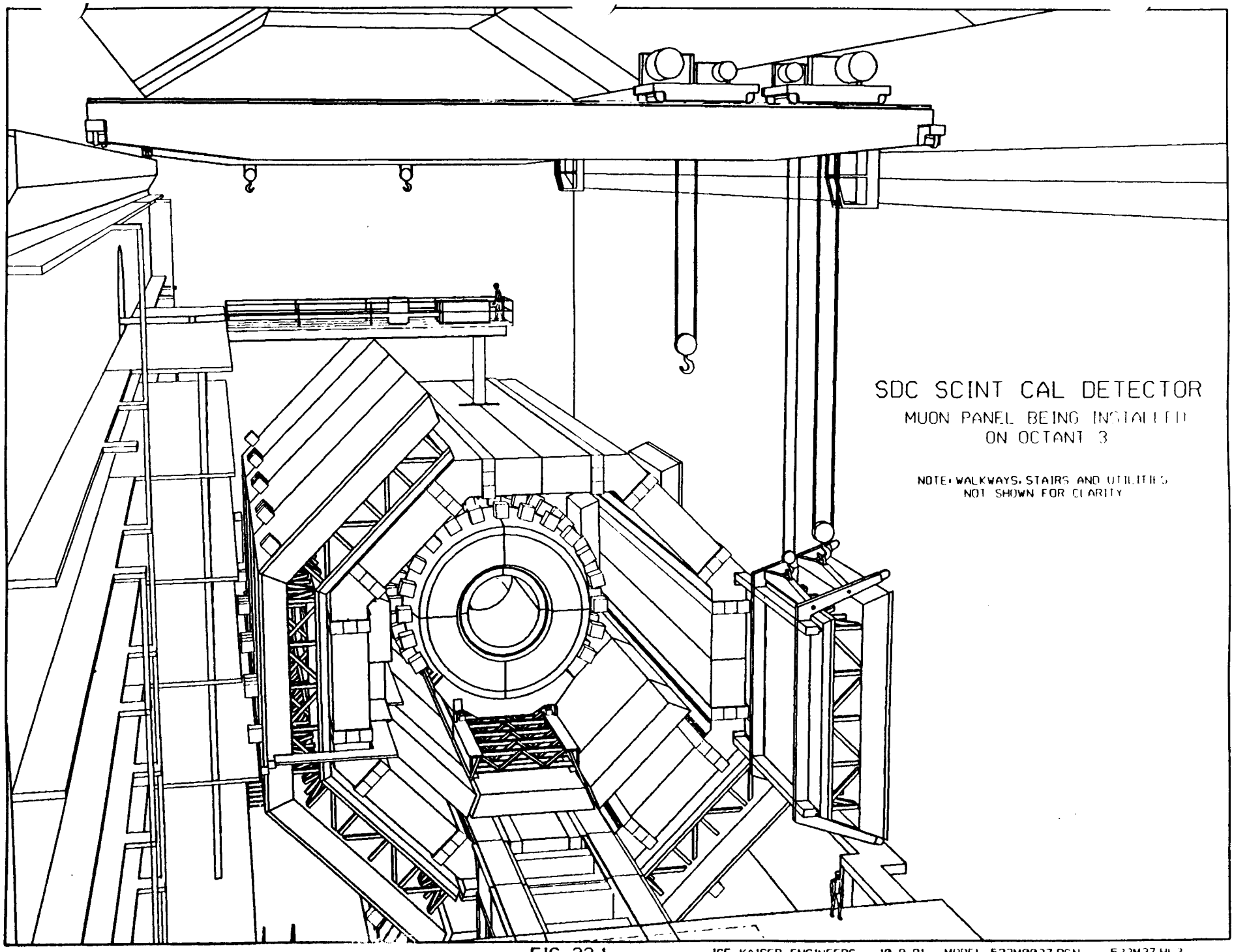


FIG. 22.1

ICF KAISER ENGINEERS 10 9-91 MODEL 523M0037.DGN 523M37.HL2

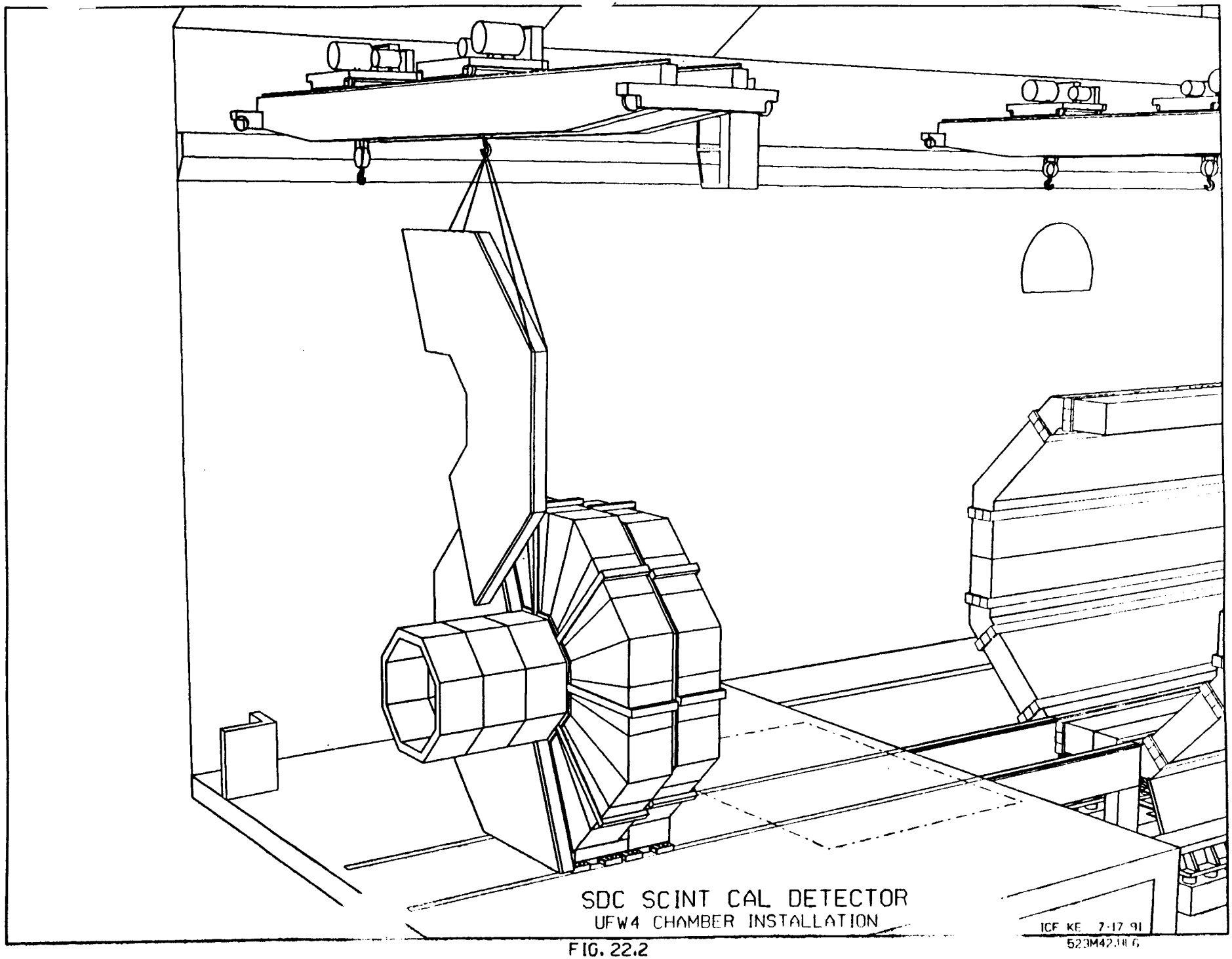

SDC SCINT CAL DETECTOR
UFW4 CHAMBER INSTALLATION
ICF KE 7-17-91
523M42.HG

FIG. 22.2

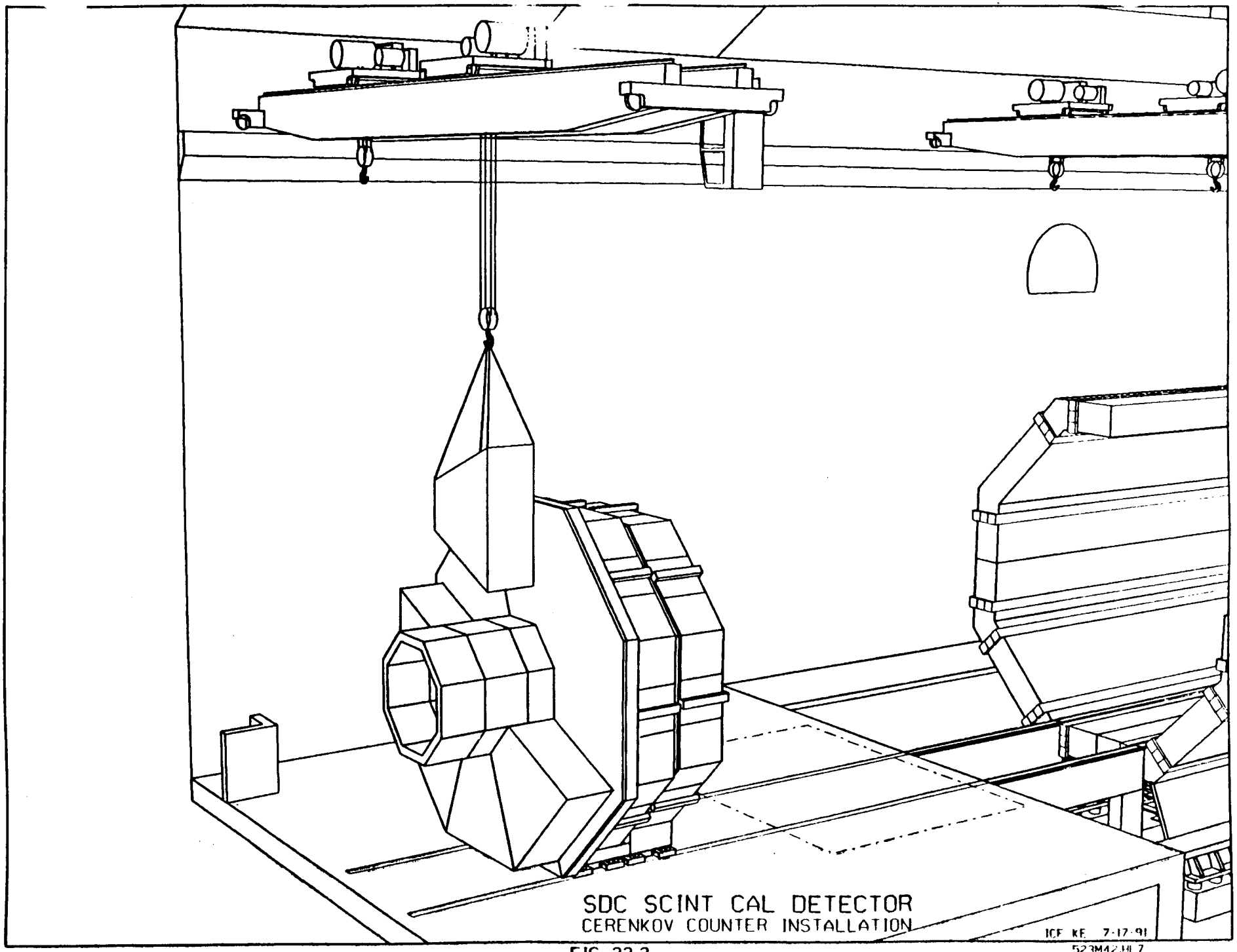

SDC SCINT CAL DETECTOR
CERENKOV COUNTER INSTALLATION
ICF KE 7-17-91
523M4234L7

FIG. 22.3

MONTH 23

The installation work on the barrel calorimeter and the cooldown of the solenoid continues.

The Cerenkov counter/muon chamber system is installed on the south forward toroid.

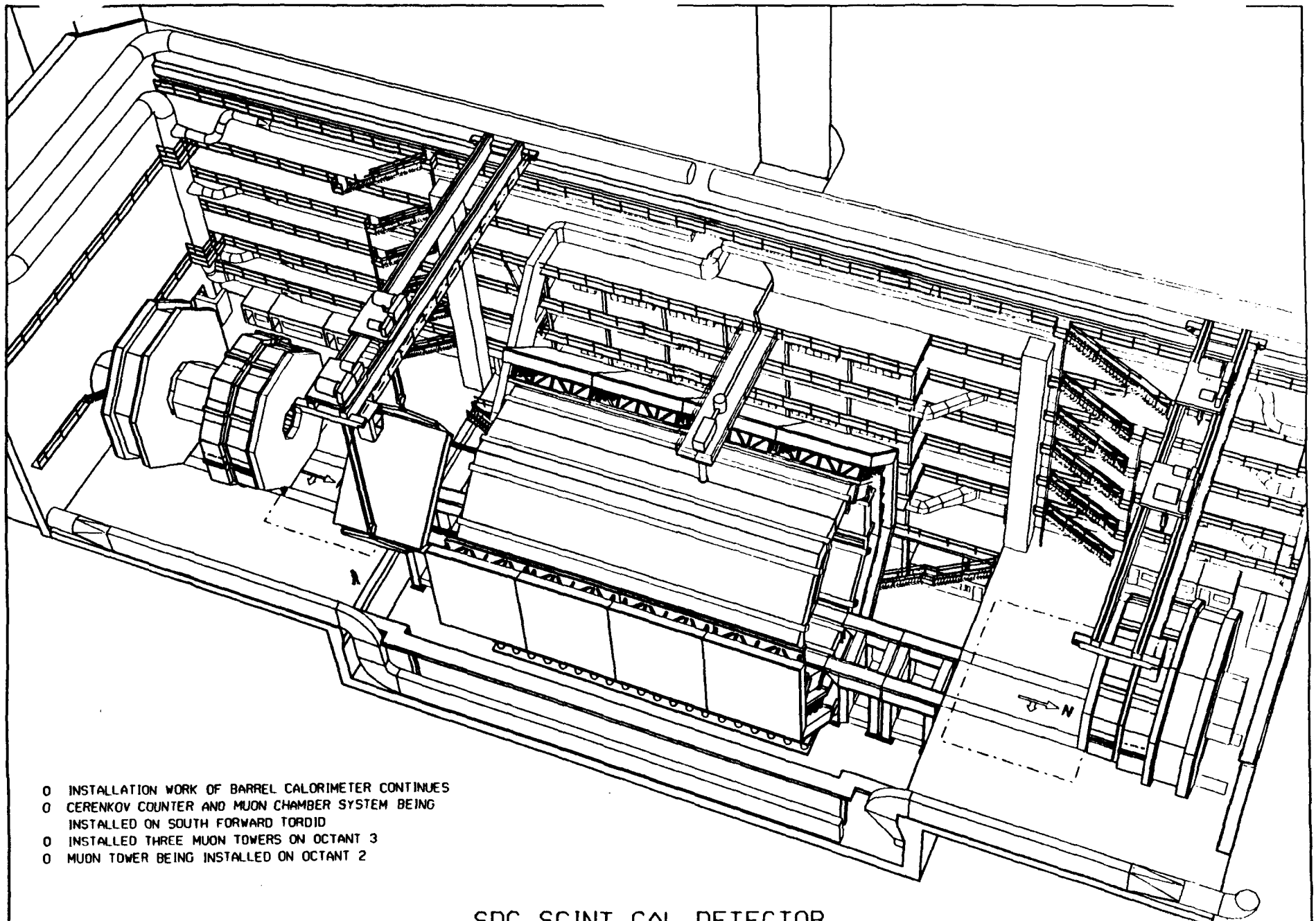
Three muon towers will be installed this month on octant 3 and one muon tower on octant 2.

Figure 23.1 shows an octant 3 muon truss being installed. Please note the use of two trolleys to control the positioning of the installation frame.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	900 hrs

	SOUTH END	NORTH END
Shaft cranes usage	20 hrs	30 hrs
Bridge cranes usage	40 hrs	60 hrs
Large objects lowered from the surface	1 muon chamber truss 1 muon chamber BW1	2 muon chamber trusses 2 muon chambers BW1
Large objects lifted to the surface	2 muon chamber cradles	4 muon chamber cradles



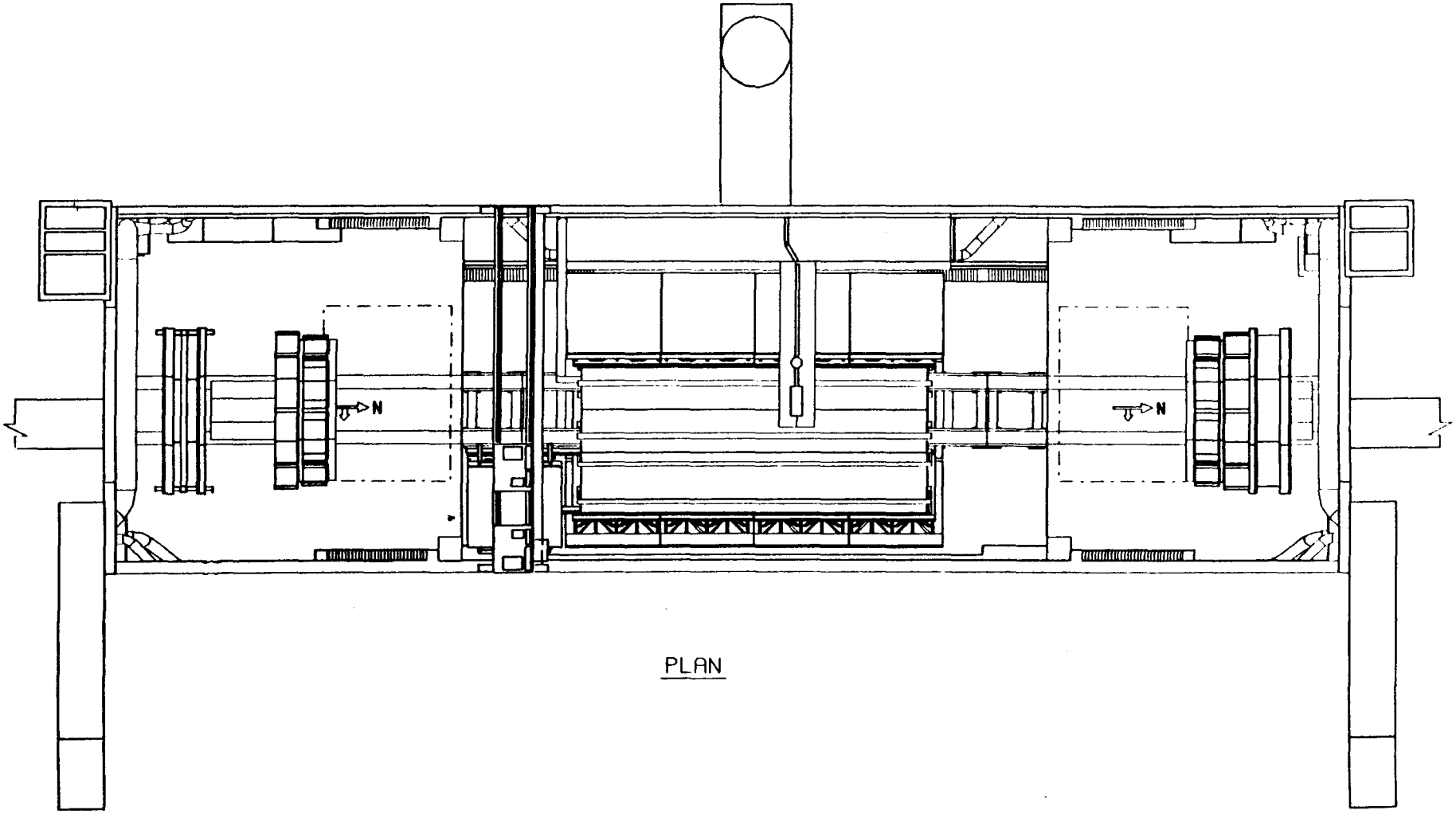
- INSTALLATION WORK OF BARREL CALORIMETER CONTINUES
- CERENKOV COUNTER AND MUON CHAMBER SYSTEM BEING INSTALLED ON SOUTH FORWARD TORDID
- INSTALLED THREE MUON TOWERS ON OCTANT 3
- MUON TOWER BEING INSTALLED ON OCTANT 2

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

ICF KAISER ENGINEERS 9-19-91 523M46, MT1123

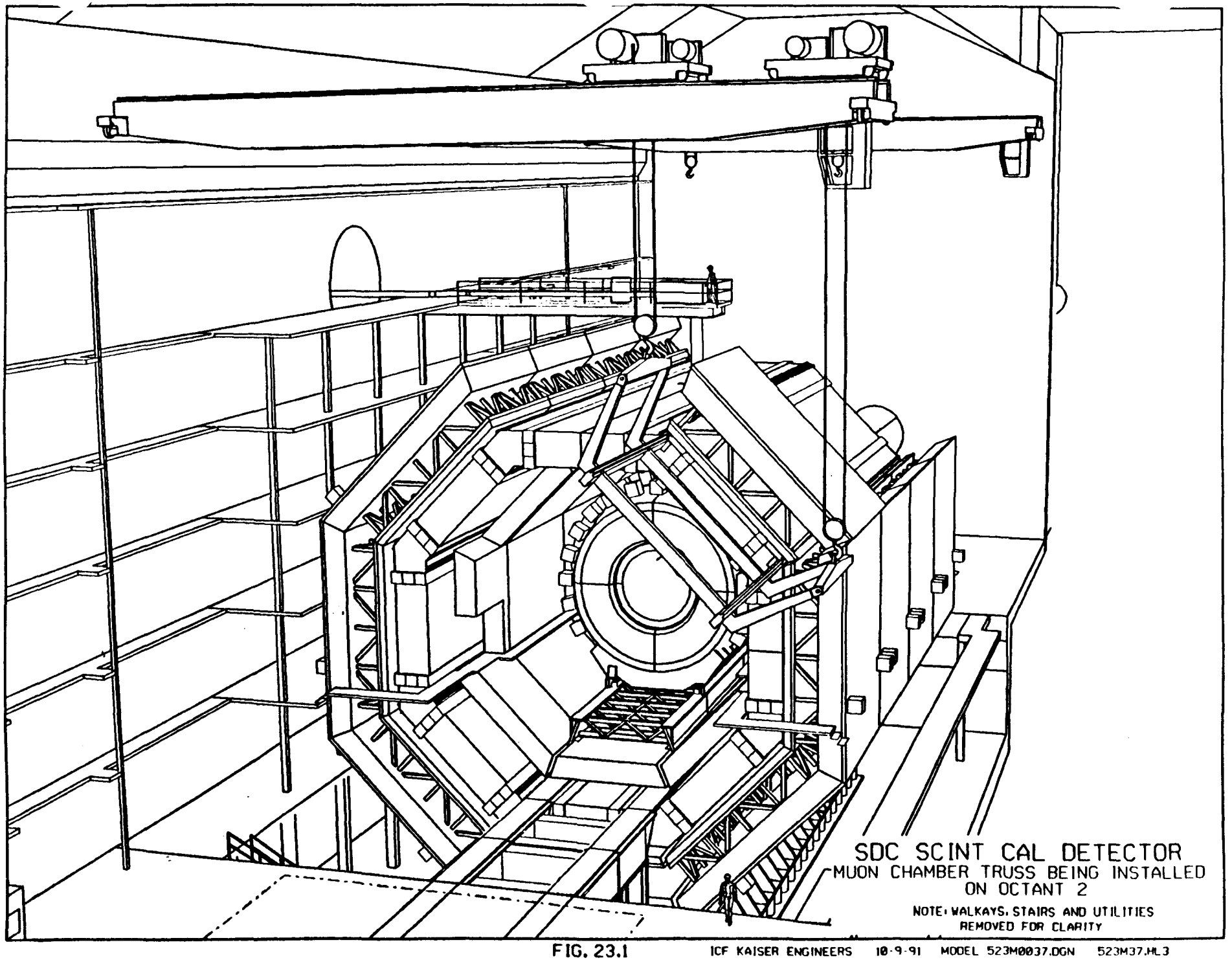


FIG. 23.1 ICF KAISER ENGINEERS 10-9-91 MODEL 523M0037.DGN 523M37.HL3

MONTH 24

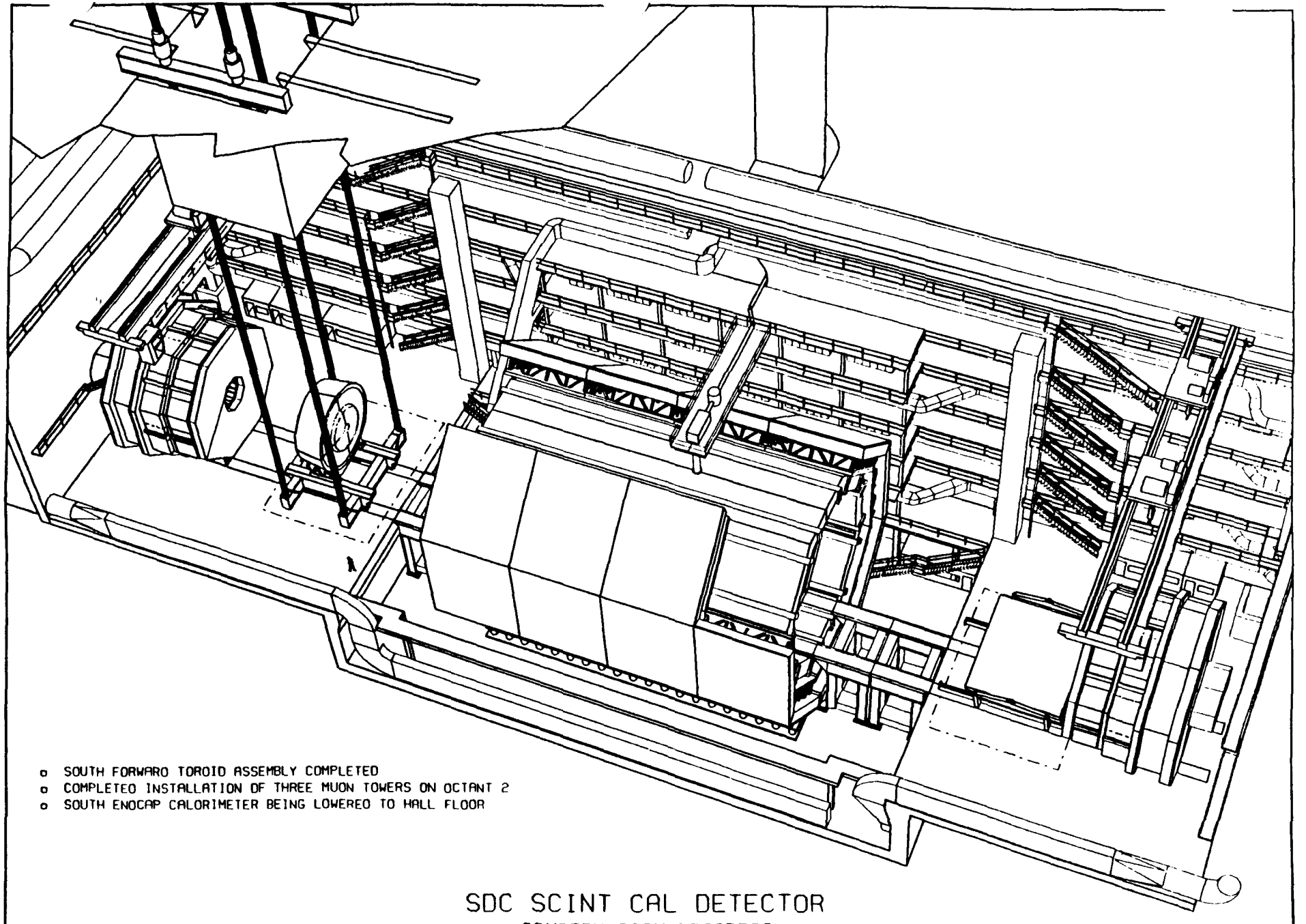
By month 24 the assembly of the south forward toroid is completed.

Three muon towers will be installed on octant 2.

The south endcap calorimeter is shown in the process of being lowered to the hall floor. It is proposed to use the same system that was used to lower the barrel calorimeter. If the hollow hydraulic jacks that were used for lowering the barrel calorimeter were rented, lighter jacks may be used for this operation. Lighter jacks use less cables and a smaller power supply saving time in the rigging.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	3500 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	60 hrs	40 hrs
Bridge cranes usage	20 hrs	80 hrs
Large objects lowered from the surface	1 endcap calorimeter	3 muon chamber trusses 3 muon chambers BW1
Large objects lifted to the surface	1 forward toroid chambers lifting rig 1 endcap calorimeter cradle	6 muon chamber cradles



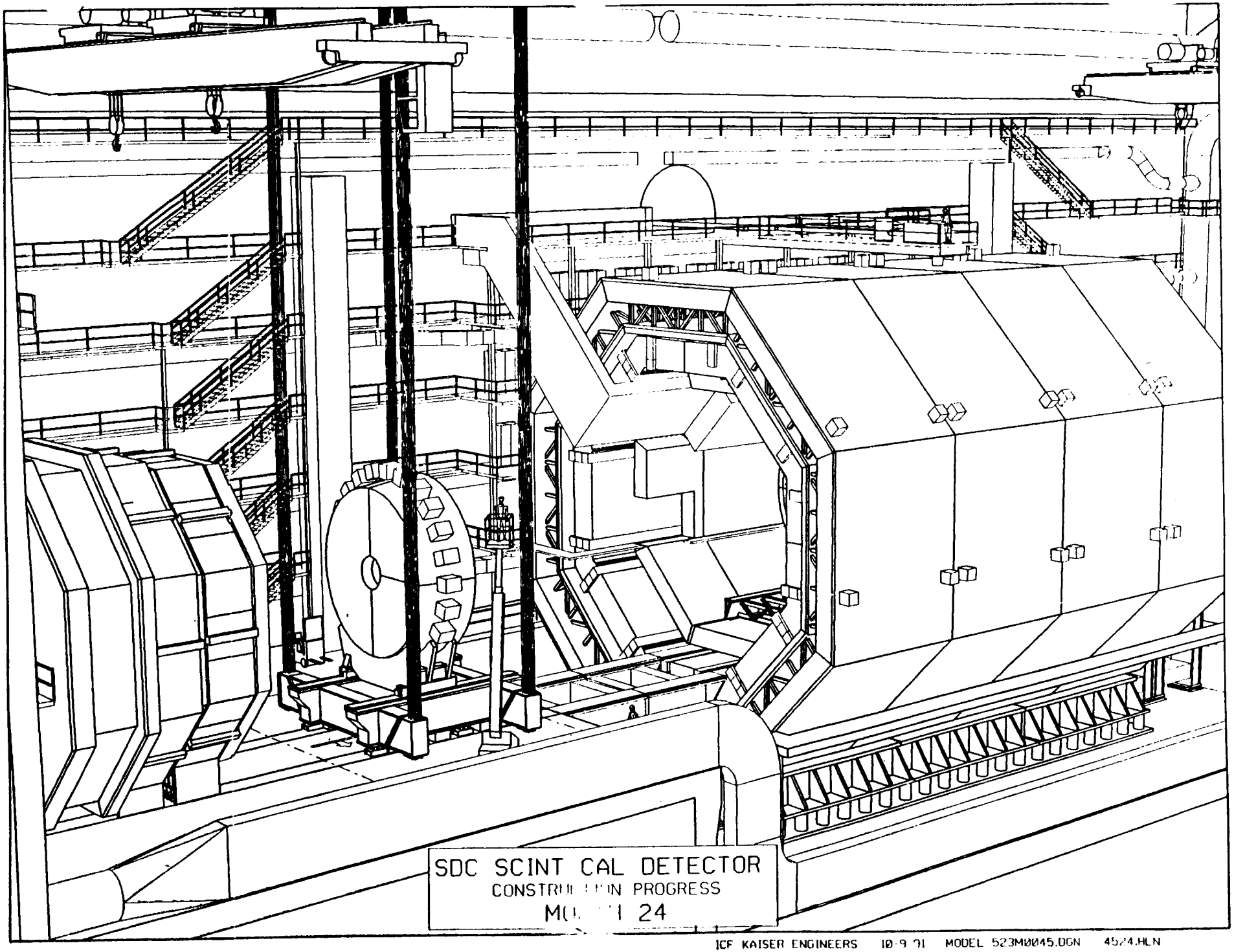
- SOUTH FORWARD TOROID ASSEMBLY COMPLETED
- COMPLETED INSTALLATION OF THREE MUON TOWERS ON OCTANT 2
- SOUTH ENDCAP CALORIMETER BEING LOWERED TO HALL FLOOR

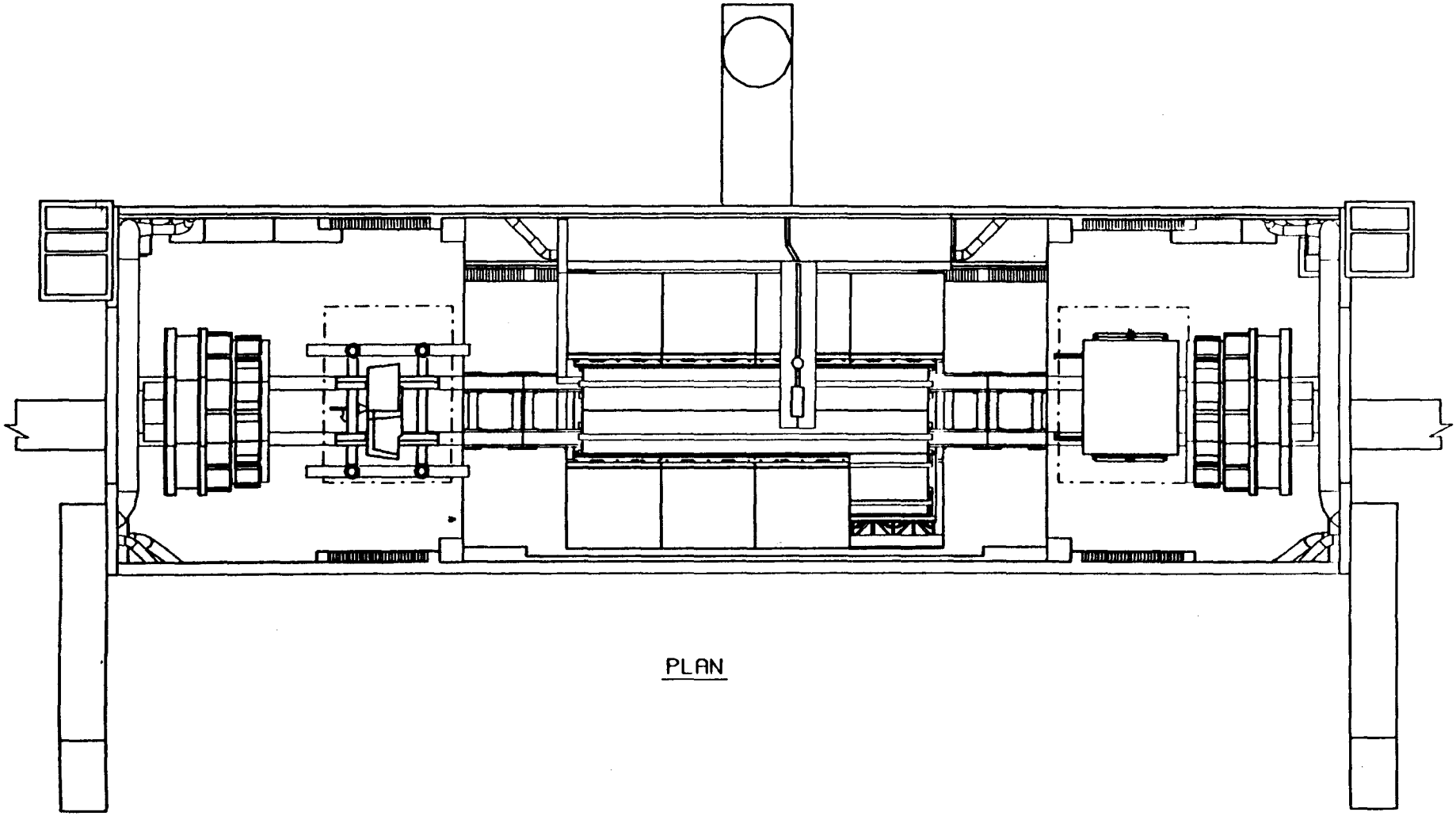
SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 24

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


SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MODEL 24
ICF KAISER ENGINEERS 10-9-91 MODEL 523M0045.DGN 4524.HLN



PLAN

SDC SCINT CAL DETECTOR
CONSTRUCTION PROGRESS
MONTH 24

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

MONTH 25

Two muon towers will be installed on octant 1 this month.

The north endcap calorimeter is lowered to the hall floor.

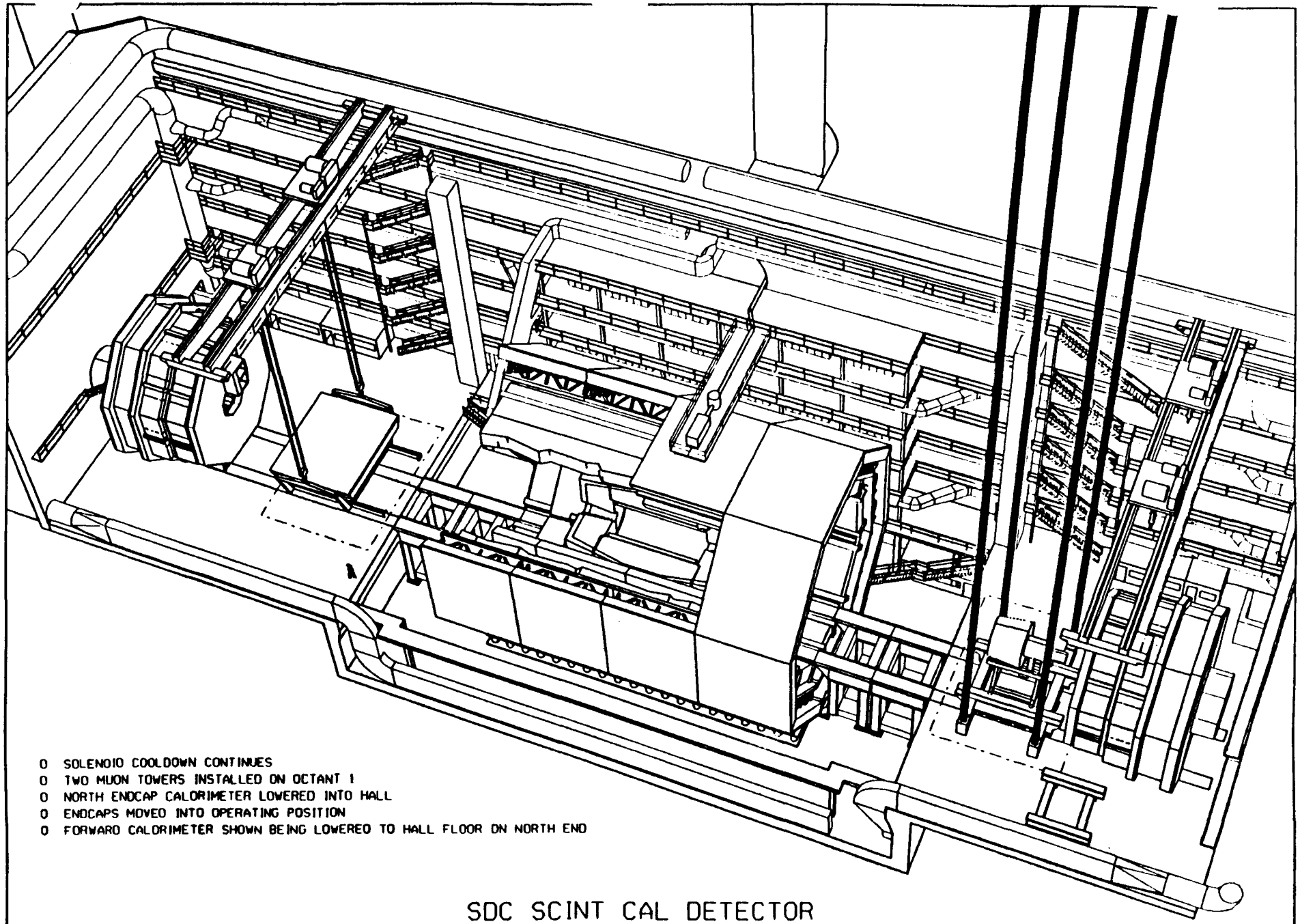
Both endcap calorimeters will be moved to their operating positions in order to begin coil field mapping. The solenoid cooldown continues.

It is assumed that the forward calorimeters are built on the surface. Since their weight will exceed the capacity of the surface and hall cranes it is also assumed that the forward calorimeters will be built on a frame with Hillman rollers that can be moved around with horizontal hydraulic jacks.

The north forward calorimeter on its frame will be lowered immediately after the endcap calorimeter is installed and the hoisting frame is freed. Using the same system as was used by the endcap calorimeter saves istallation time and costs by taking advantage of the jacking system being in place.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	3500 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	40 hrs	60 hrs
Bridge cranes usage	80 hrs	30 hrs
Large objects lowered from the surface	2 muon chamber towers	1 endcap calorimeter 1 forward calorimeter 1 encap calorimeter roller frame
Large objects lifted to the surface	4 muon chamber cradles	1 calorimeter cradle (twice)



- SOLENOID COOLDOWN CONTINUES
- TWO MUON TOWERS INSTALLED ON OCTANT 1
- NORTH ENDCAP CALORIMETER LOWERED INTO HALL
- ENDCAPS MOVED INTO OPERATING POSITION
- FORWARD CALORIMETER SHOWN BEING LOWERED TO HALL FLOOR ON NORTH END

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 25

ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN MONTH25.HLN

MONTH 26

The last two muon towers are installed on octant 1 during this month.

The solenoid cooldown has been completed and the field mapping started.

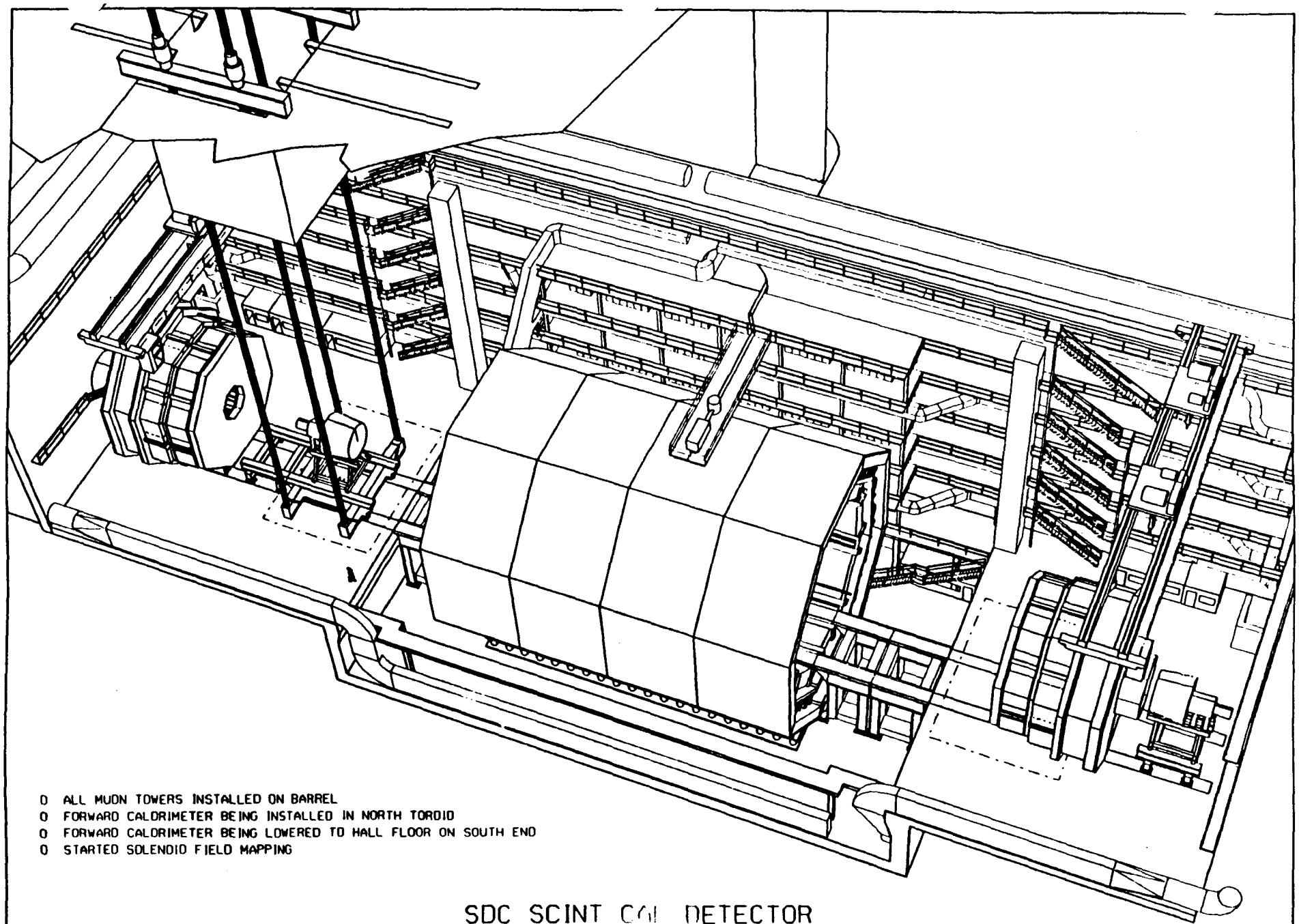
The north forward calorimeter and support frame will be transferred to the endcap temporary support which in turn will be rolled and aligned with the forward toroid by means of the hydraulic jacks placed on top of the Hillman rollers. Once this is done, the forward calorimeter will be rolled into the support cylinder for final installation.

The south forward calorimeter is shown on the drawing having been lowered to the hall floor and in the process of being transferred to the endcap calorimeter roller frame.

This operation will be different on the north side, as there is no room to insert the calorimeter roller frame between the forward toroid and the lowering frame. On the north end, the lowering frame with the forward calorimeter will have to be disengaged from the hoisting cables and moved to the east or west side of the hall where the transfer of the forward calorimeter to the endcap roller frame can take place.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	3000 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	30 hrs	4 hrs
Bridge crane usage	60 hrs	15 hrs
Large objects lowered from the surface	2 muon chamber trusses 2 muon chambers BW1 1 endcap calorimeter roller frame 1 forward calorimeter	1 field mapping kit
Large objects lifted to the surface	4 muon chamber cradles 1 calorimeter cradle	



- ALL MUON TOWERS INSTALLED ON BARREL
- FORWARD CALORIMETER BEING INSTALLED IN NORTH TORDID
- 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 10-13-91 MODEL 523M0045.DGN MONTH26.HLN

MONTH 27

The solenoid field mapping continues this month.

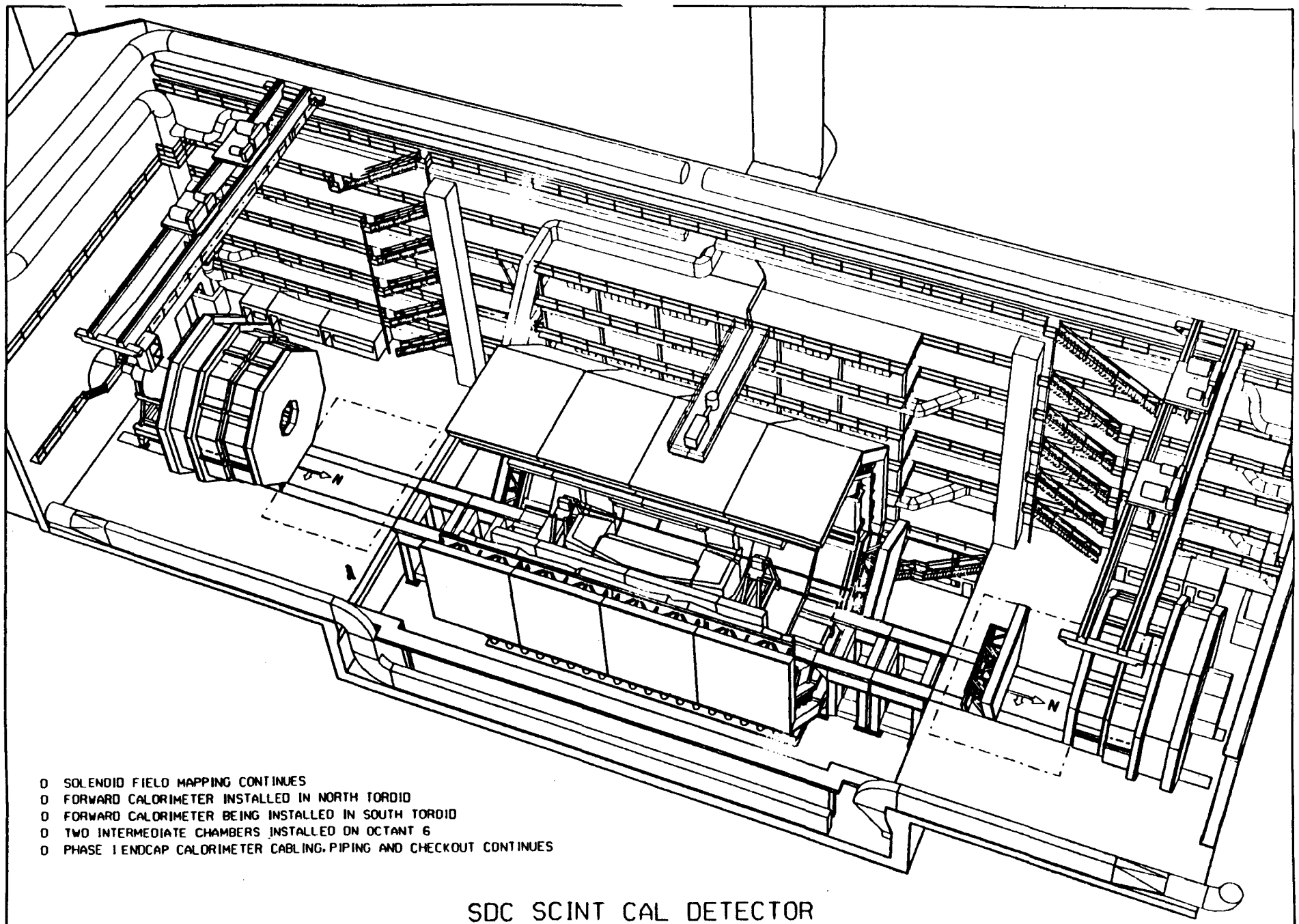
The north forward calorimeter has been installed and the forward toroid retracted to its storage position.

The south forward calorimeter is being installed in the south forward toroid.

The first two intermediate muon chambers have been installed on octant 6.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	1100 hrs	
	SOUTH END	NORTH END
Shafts crane usage	10 hrs	20 hrs
Bridge crane usage	20 hrs	40 hrs
Large objects lowered from the surface	1 intermediate chamber truss	2 intermediate chamber trusses



- SOLENOID FIELD MAPPING CONTINUES
- FORWARD CALORIMETER INSTALLED IN NORTH TORDID
- FORWARD CALORIMETER BEING INSTALLED IN SOUTH TORDID
- TWO INTERMEDIATE CHAMBERS INSTALLED ON OCTANT 6
- PHASE I ENDCAP CALORIMETER CABLING, PIPING AND CHECKOUT CONTINUES

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 27

ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN MONTH27.HLN

MONTH 28

The south forward calorimeter has been installed in the forward toroid and the toroid has been rolled back to storage position.

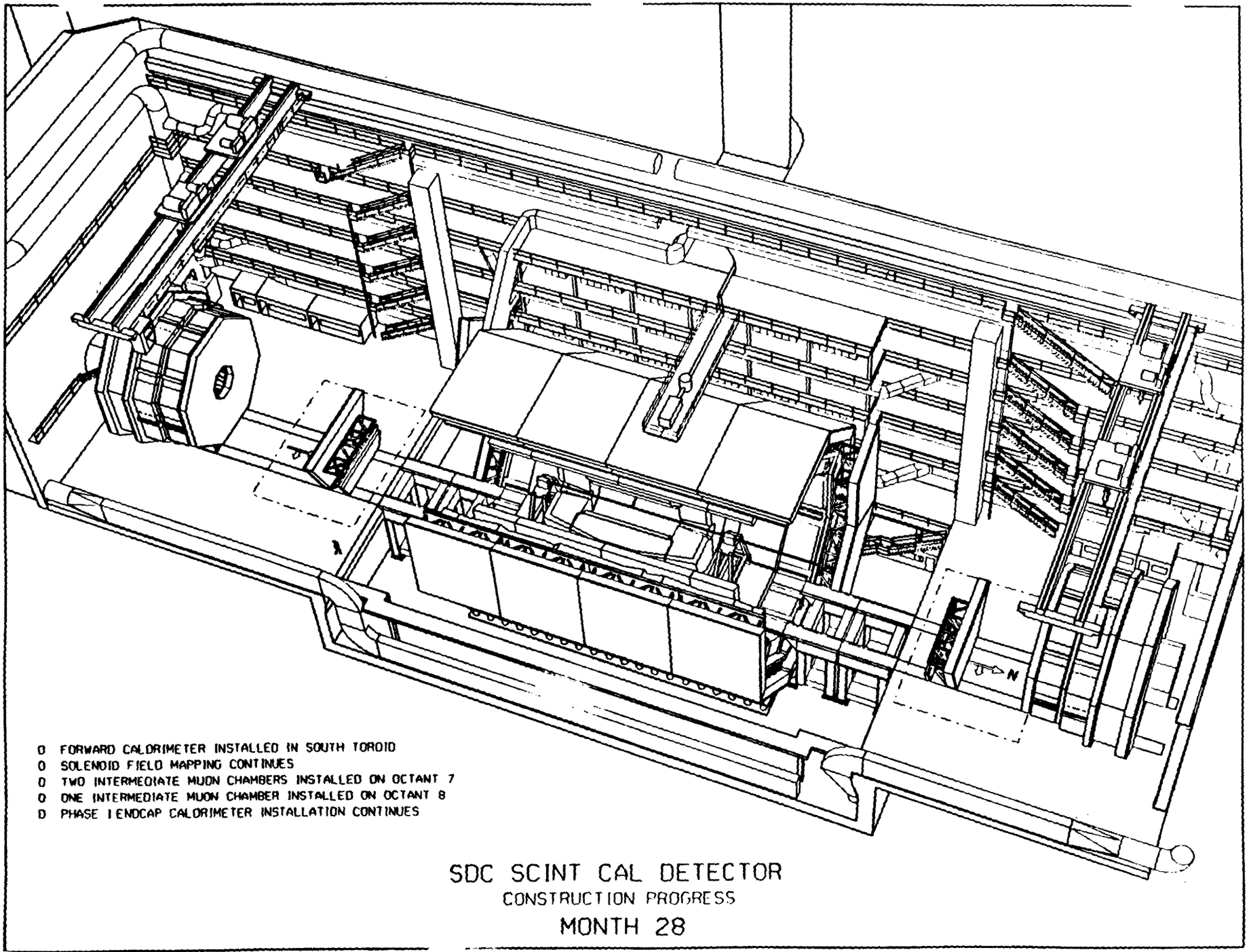
The solenoid field mapping continues.

Two intermediate muon chambers were installed on octant 7 and one on octant 8.

Note that intermediate muon chambers are shown stored on the hall floor by the surface crane ready to be picked up by the hall bridge cranes. Once the design of the intermediate muon chambers is known, further study should be made as to how to support these chambers while transfering from one crane to another. Special supports (not shown in these pictures) may be required and are bound to take space on the hall floor when not in use. This space should be considered in the overall layout.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	900 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	20 hrs	10 hrs
Bridge crane usage	40 hrs	20 hrs
Large objects lowered from the surface	2 intermediate chamber trusses	1 intermediate chamber truss



- FORWARD CALORIMETER INSTALLED IN SOUTH TOROID
- SOLENOID FIELD MAPPING CONTINUES
- TWO INTERMEDIATE MUON CHAMBERS INSTALLED ON OCTANT 7
- ONE INTERMEDIATE MUON CHAMBER INSTALLED ON OCTANT 8
- PHASE I ENDCAP CALORIMETER INSTALLATION CONTINUES

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 28

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

MONTH 29

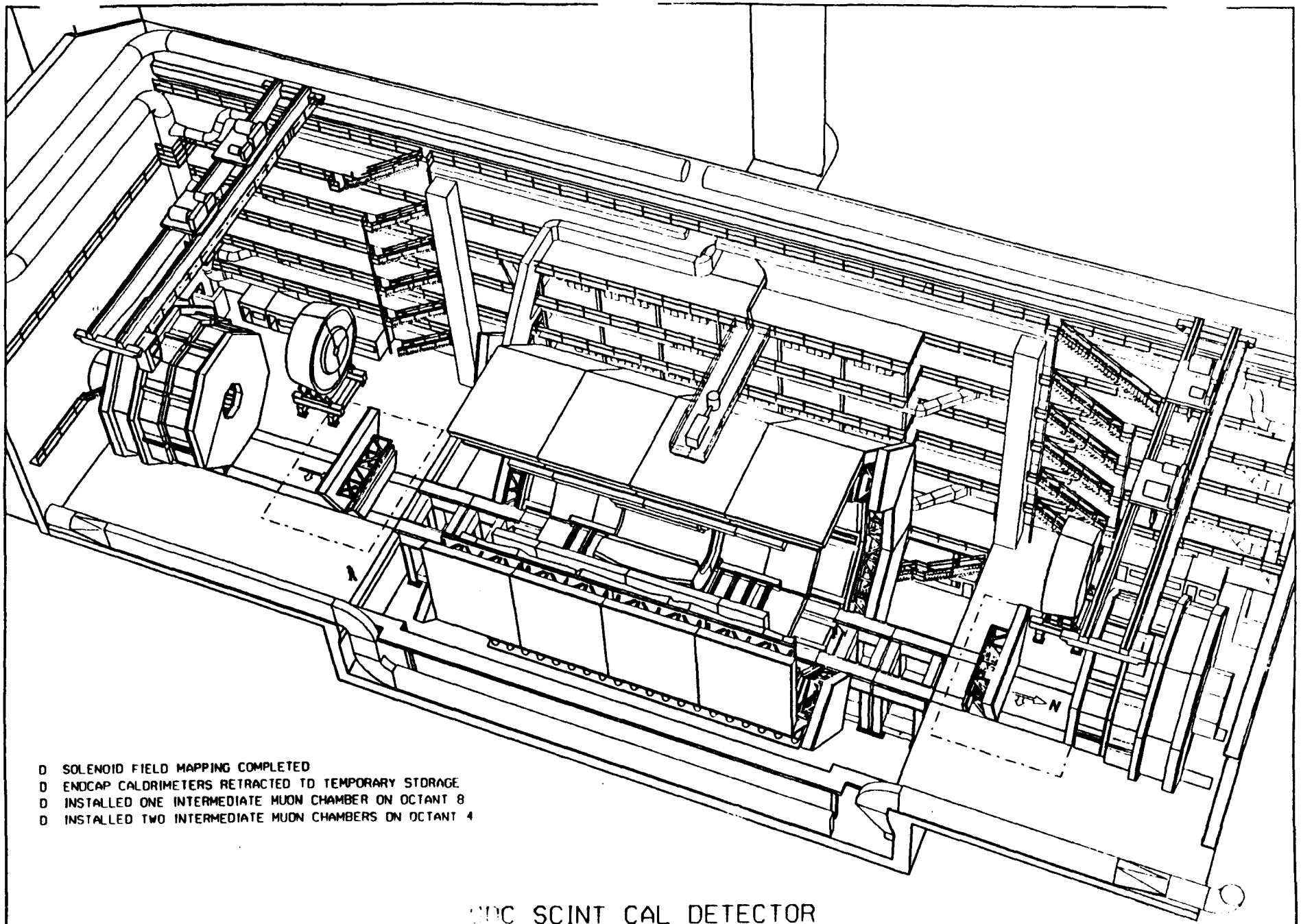
The solenoid field mapping has been completed and the endcaps have been retracted to a temporary storage position.

Two intermediate muon chambers are installed on octant 4 and one on octant 8.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	900 hrs

	SOUTH END	NORTH END
Shaft cranes usage	10 hrs	20 hrs
Bridge crane usage	20 hrs	40 hrs
Large object lowered from the surface	1 intermediate chamber truss	2 intermediate chamber trusses



- SOLENOID FIELD MAPPING COMPLETED
- ENDCAP CALORIMETERS RETRACTED TO TEMPORARY STORAGE
- INSTALLED ONE INTERMEDIATE MUON CHAMBER ON OCTANT 8
- INSTALLED TWO INTERMEDIATE MUON CHAMBERS ON OCTANT 4

CDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 29

ICF KAISER ENGINEERS 9 17 [illegible] [illegible]3M0045.DGN MONTH29.HLD

MONTH 30

This month's drawing is shown in more detail for the same reasons stated for months 18 and 21.

Two intermediate muon chambers are installed on octant 3 and one on octant 2.

The central tracking is being installed this month using the same system and procedure used to install the solenoid.

Scaffolding is shown around the endcap calorimeters which is used for electronics work.

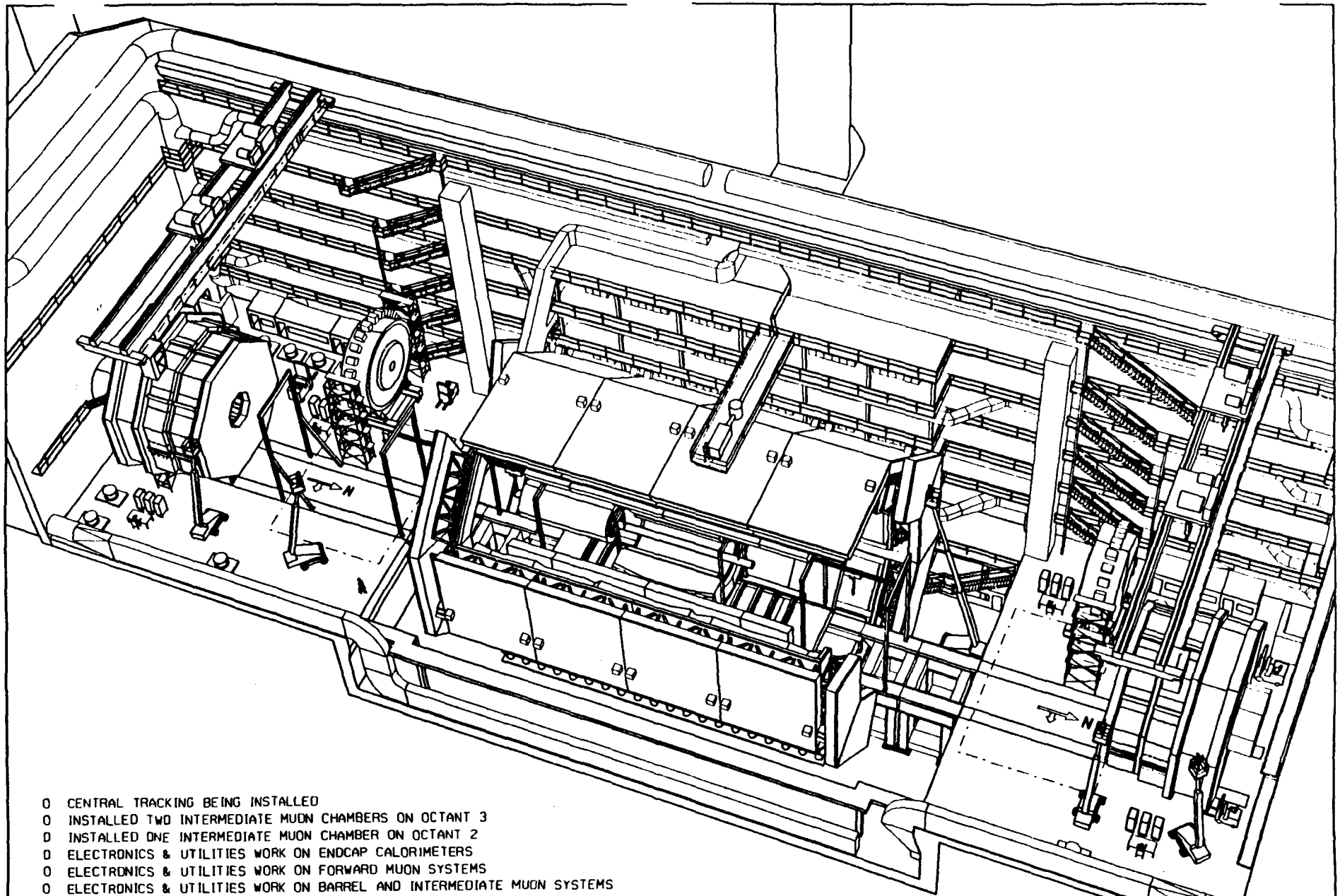
Electronic racks and desks with computers are shown checking out the electronics on several systems.

Cherry pickers are shown being used to install or check out electronic equipment, install cabling and piping, etc.

The drawing shows that the space around the endcaps scaffolding is very tight. In the future, studies should be made using narrower scaffolding or at worse turning the whole endcap arrangemnt 90 degrees. This maneuver is rather complex, so it should be avoided if possible.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	1600 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	20 hrs	10 hrs
Bridge cranes usage	40 hrs	20 hrs
Large objects lowered from the surface	2 intermediate chamber trusses 1 central tracking unit	1 intermediate chamber truss



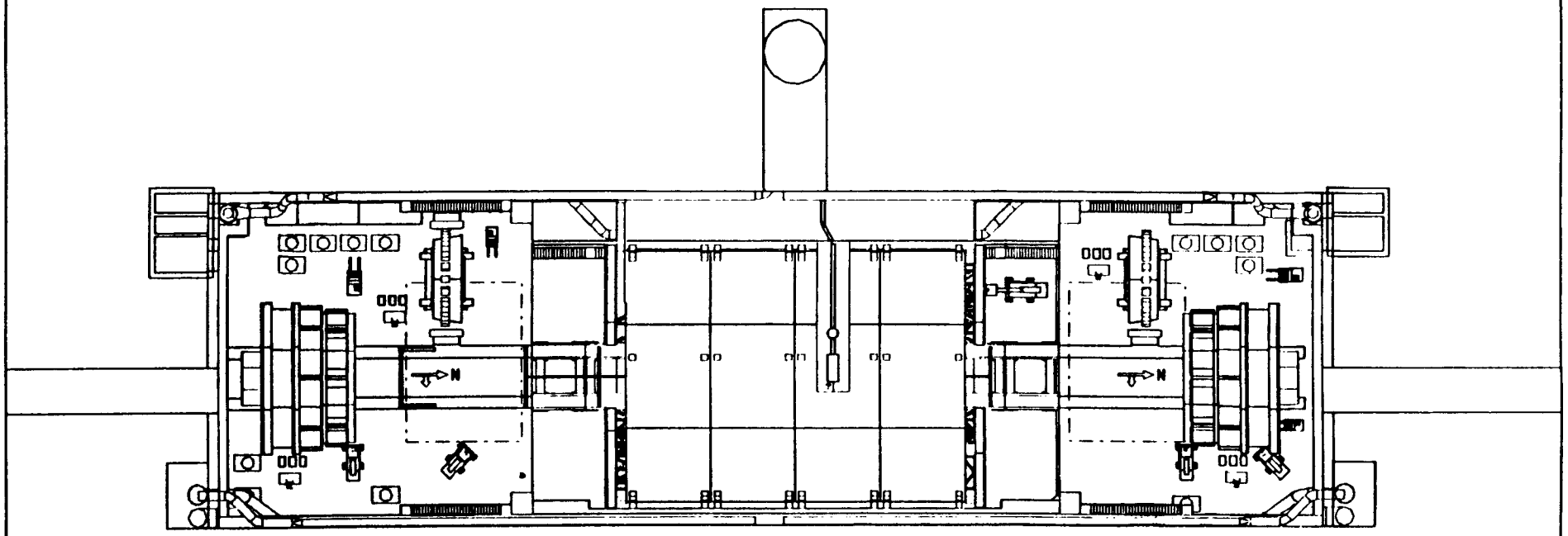
- CENTRAL TRACKING BEING INSTALLED
- INSTALLED TWO INTERMEDIATE MUON CHAMBERS ON OCTANT 3
- INSTALLED ONE INTERMEDIATE MUON CHAMBER ON OCTANT 2
- ELECTRONICS & UTILITIES WORK ON ENDCAP CALORIMETERS
- ELECTRONICS & UTILITIES WORK ON FORWARD MUON SYSTEMS
- ELECTRONICS & UTILITIES WORK ON BARREL AND INTERMEDIATE MUON SYSTEMS

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 30

ICF KAISER ENGINEERS 10-31-91 MODEL 523M0045.DGN MONTH30.HLN



SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 30

ICF KAISER ENGINEERS 10-7-91 MODEL 523M0046.DGN 523m46.mth30

MONTH 31

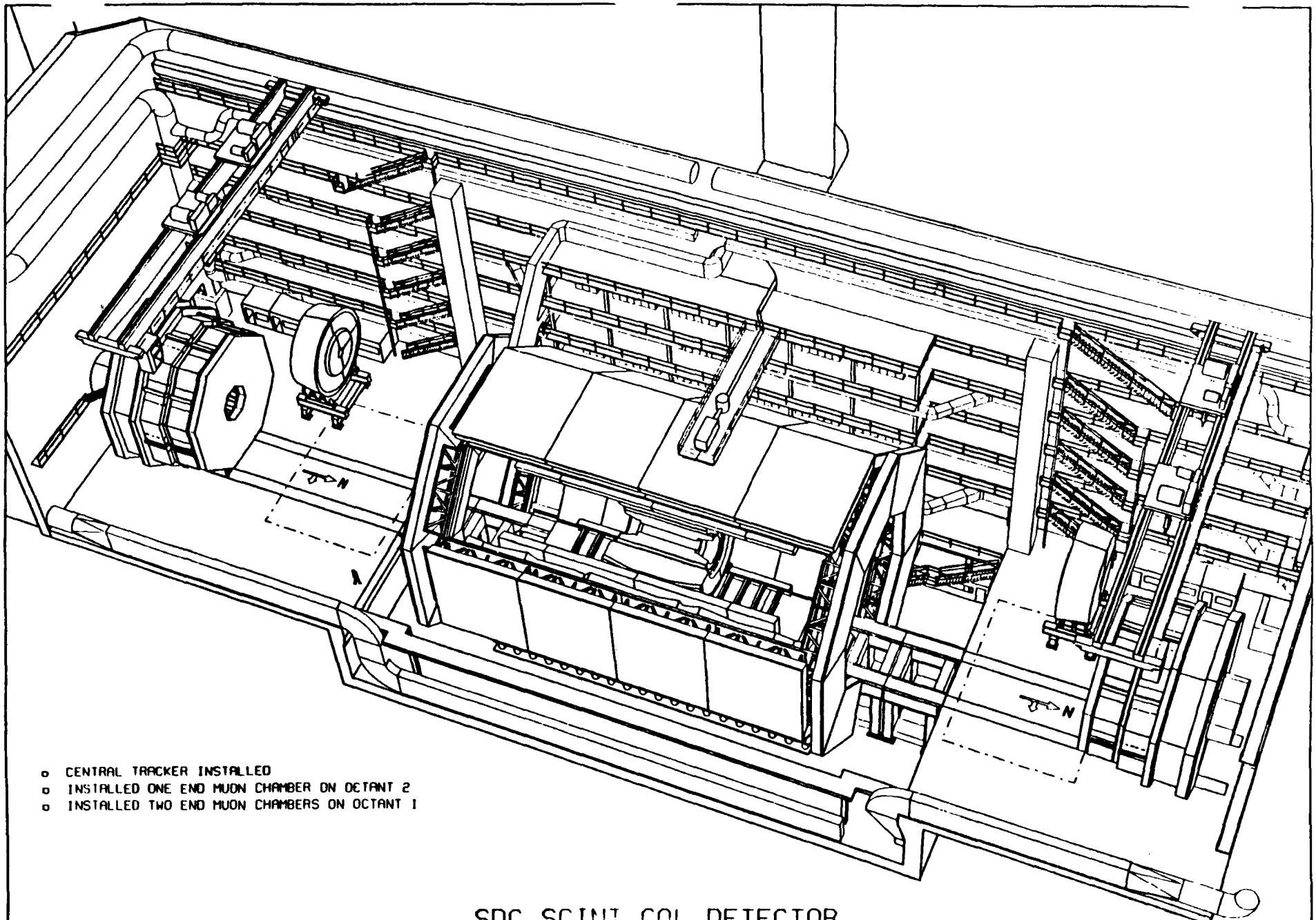
The central tracker installation including cabling is completed this month.

One intermediate muon chamber is installed this month on octant 2 and two are installed on octant 1.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	700 hrs

	SOUTH END	NORTH END
Shaft cranes usage	10 hrs	10 hrs
Bridge crane usage	10 hrs	20 hrs
Large objects lowered from the surface	1 intermediate chamber truss	2 intermediate chamber trusses



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

SDC SCINT COL DETECTOR

CONSTRUCTION PROGRESS

MONTH 31

ICF KAISER ENGINEERS 9-18-91 MODEL 523M0045.DGN MONTH31.HLN

MONTH 32

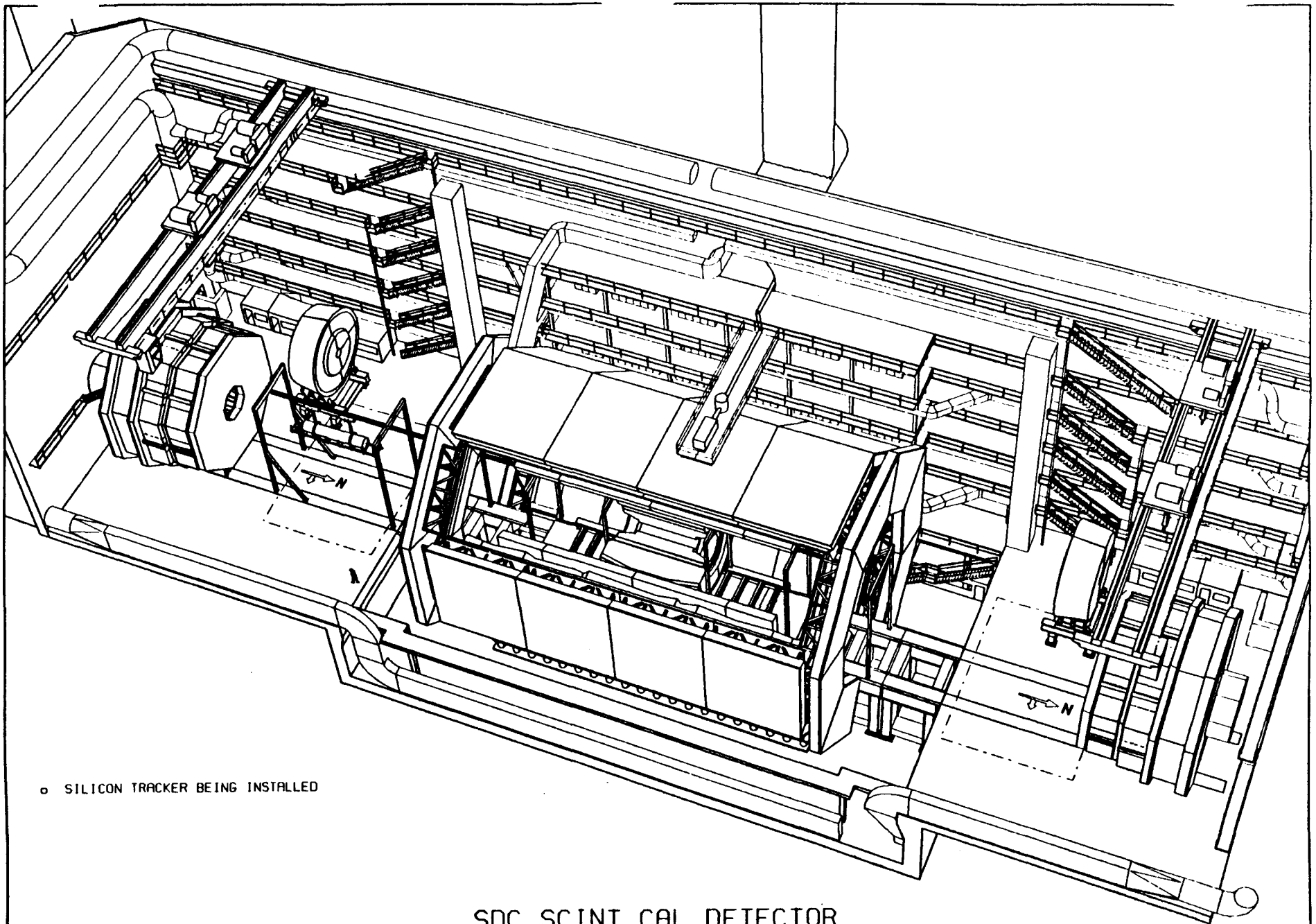
The silicon tracker is installed this month.

Figures 32.1, 32.2 and 32.3 show a sequence for the installation of the silicon tracker. The rigging used is the same as used for the solenoid and the central tracking device. The main difference in the procedure is that a cradle will be used to carry the silicon tracker and no mandrel will be used.

Since little physical change will ocurr during the next two months, drawings were not made for months 33 and 34. During these months, the silicon tracker is cabled and aligned. General electronic checkout of all subsystems continues.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	500 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	10 hrs	
Bridge cranes usage	10 hrs	10 hrs
Large objects lowered from the surface	Silicon tracker	



o SILICON TRACKER BEING INSTALLED

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 32

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

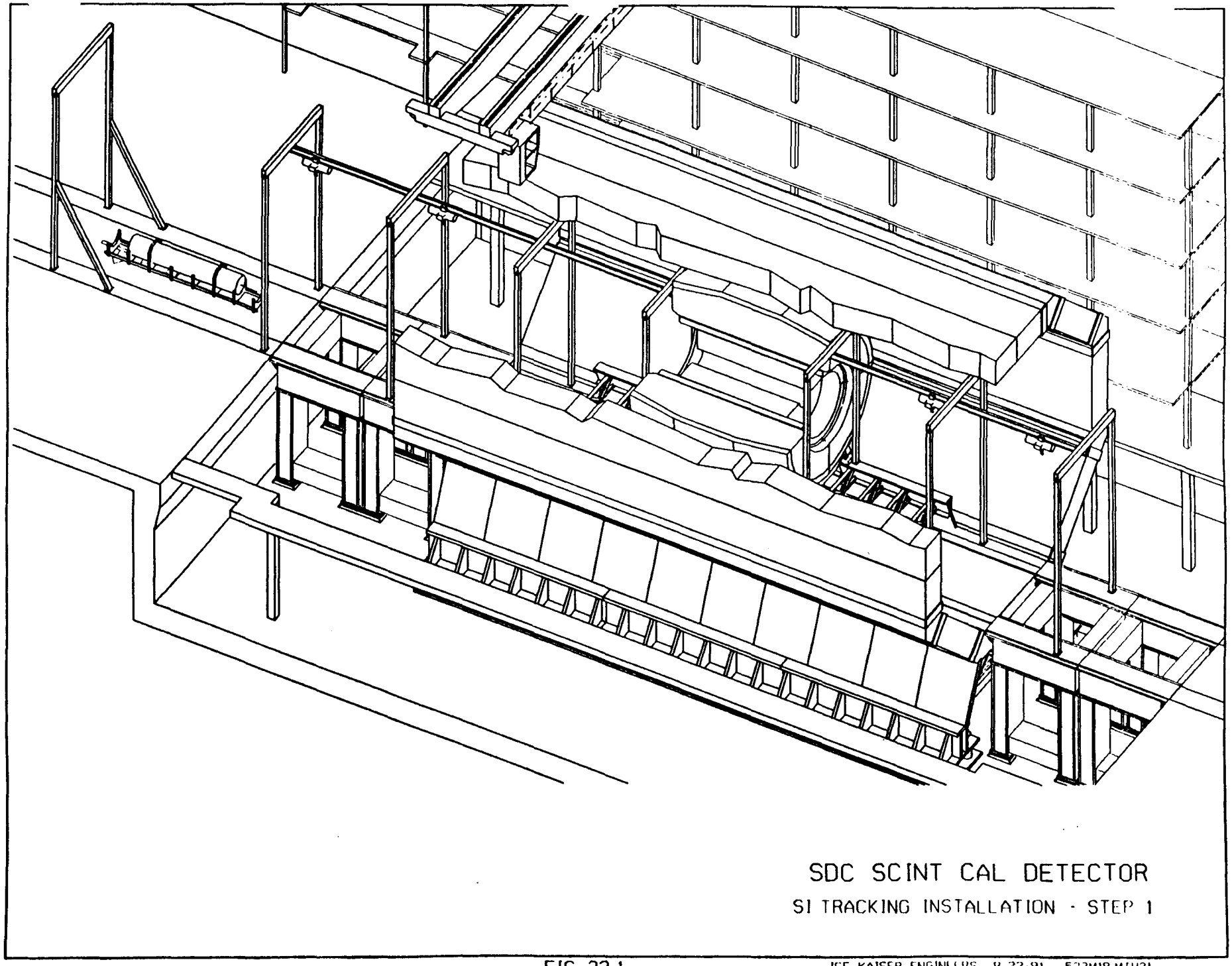


FIG. 32.1

ICF KAISER ENGINEERS 8-22-91 523M18.MTH31

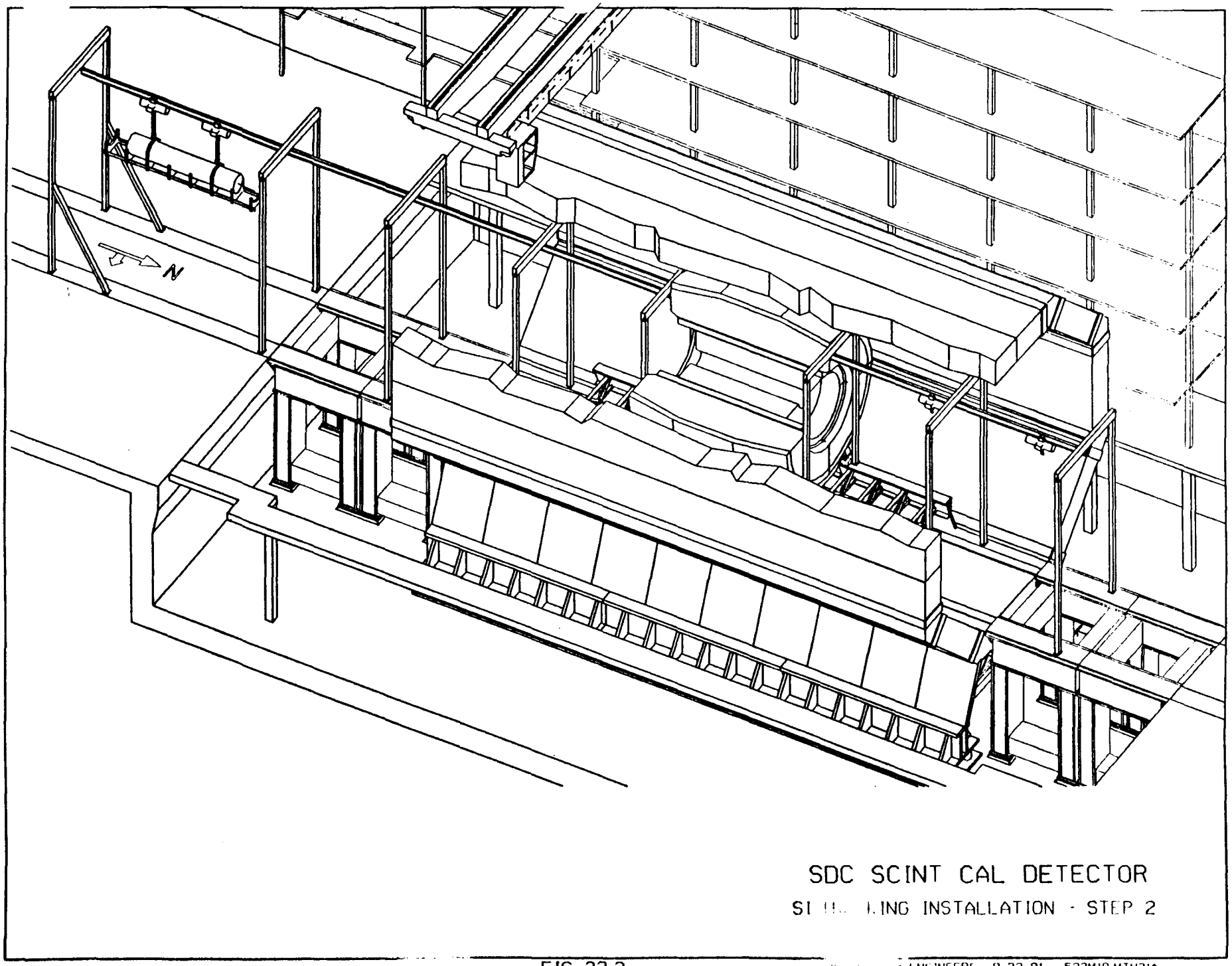

N
SDC SCINT CAL DETECTOR
SI LING INSTALLATION - STEP 2
ENGINEERS 8-22-91 523M18.MTH31A

FIG. 32.2

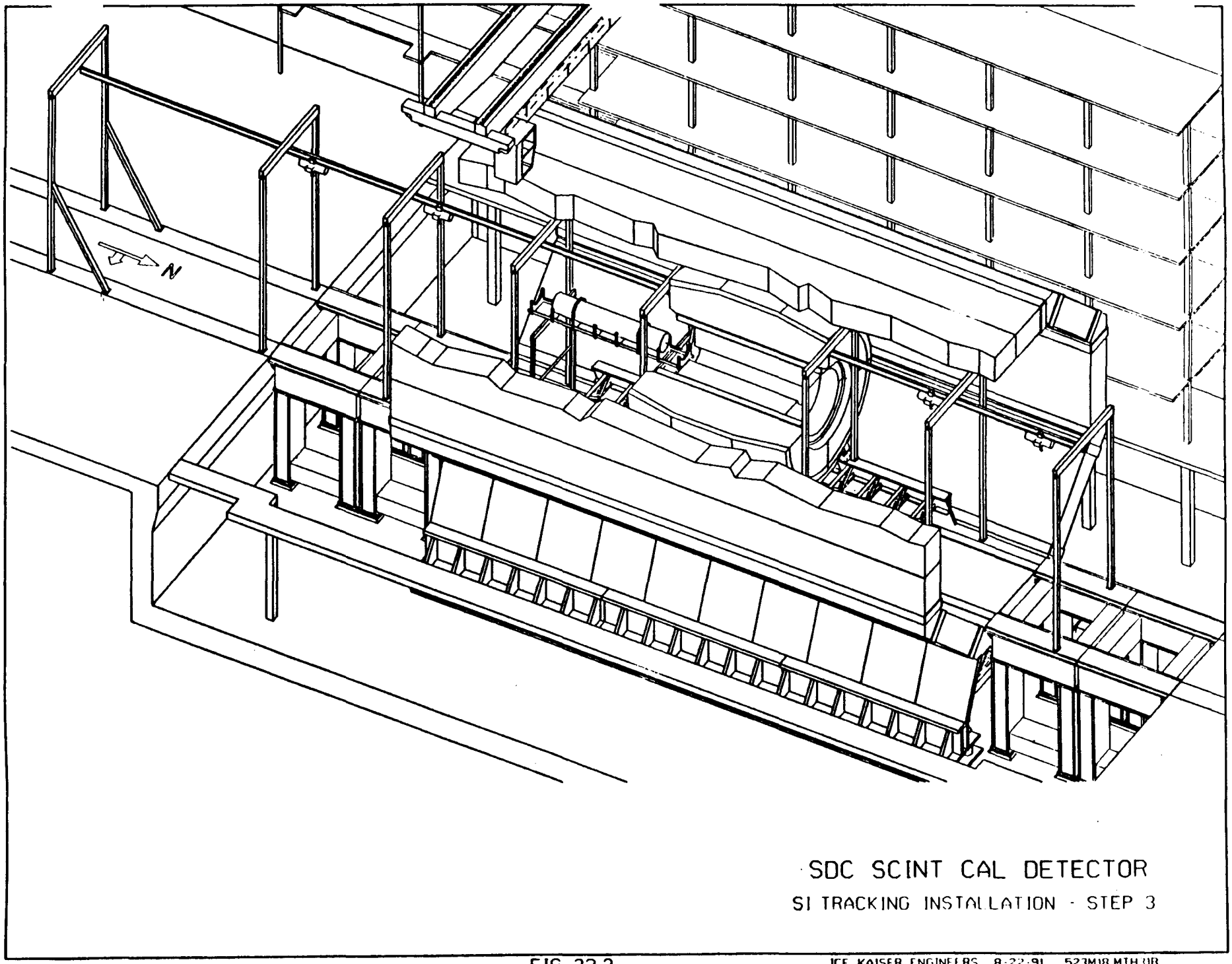

N
SDC SCINT CAL DETECTOR
SI TRACKING INSTALLATION - STEP 3
ICF KAISER ENGINEERS 8-22-91 523M18.MTH.3IB

FIG. 32.3

MONTH 35

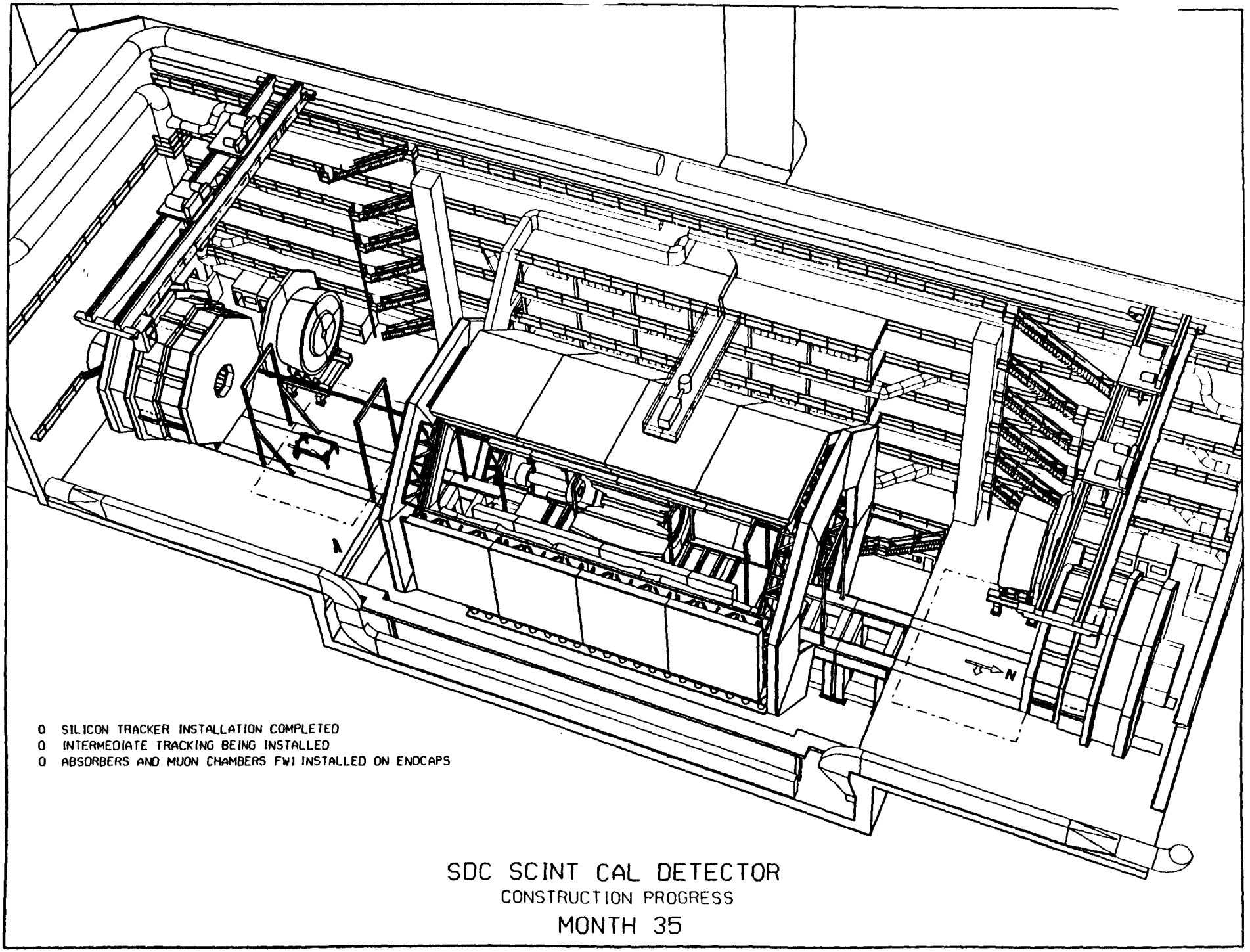
In month 34, the silicon tracker installation was completed.

Also in month 34, absorbers and the FW1 muon chambers are installed on the endcap calorimeters.

The intermediate trackers are in the process of being installed. Figures 35.1 and 35.2 show some details of this operation. Basically, the intermediate tracker is mounted on a counterweighted mandrel, which in turn uses the same rigging that was used by the other tracker installations.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	800 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	20 hrs	20 hrs
Bridge cranes usage	40 hrs	40 hrs
Large objects lowered from the surface	1 endcap calorimeter absorber 2 muon chamber FW1 sections 1 Intermediate tracking unit	1 endcap calorimeter absorber 2 muon chamber FW1 sections 1 intermediate tracking unit



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

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 35

ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN MONTH35.HLN

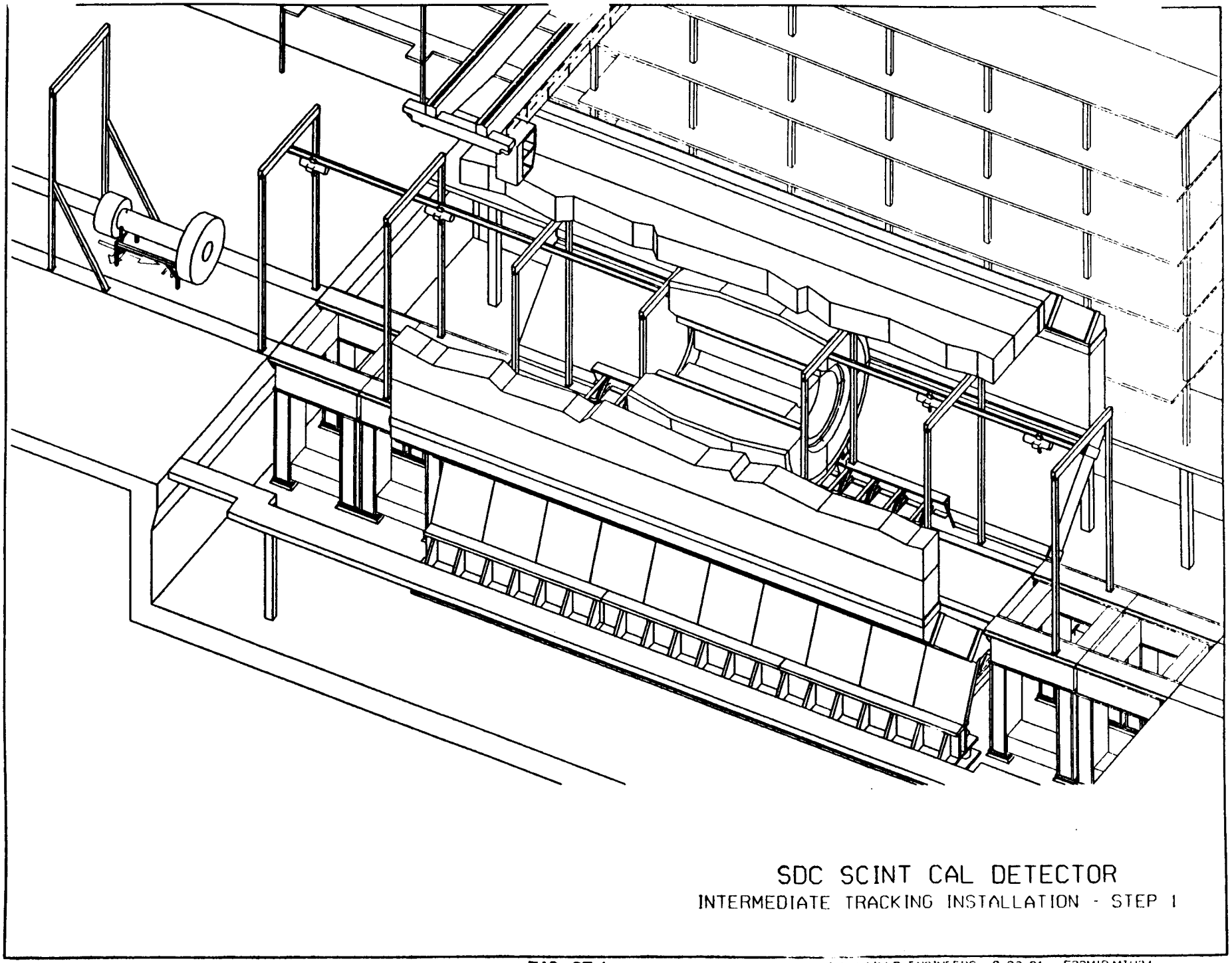

SDC SCINT CAL DETECTOR
INTERMEDIATE TRACKING INSTALLATION - STEP 1
ENGINEERS 8 22-91 523MIB.MTH34

FIG. 35.1

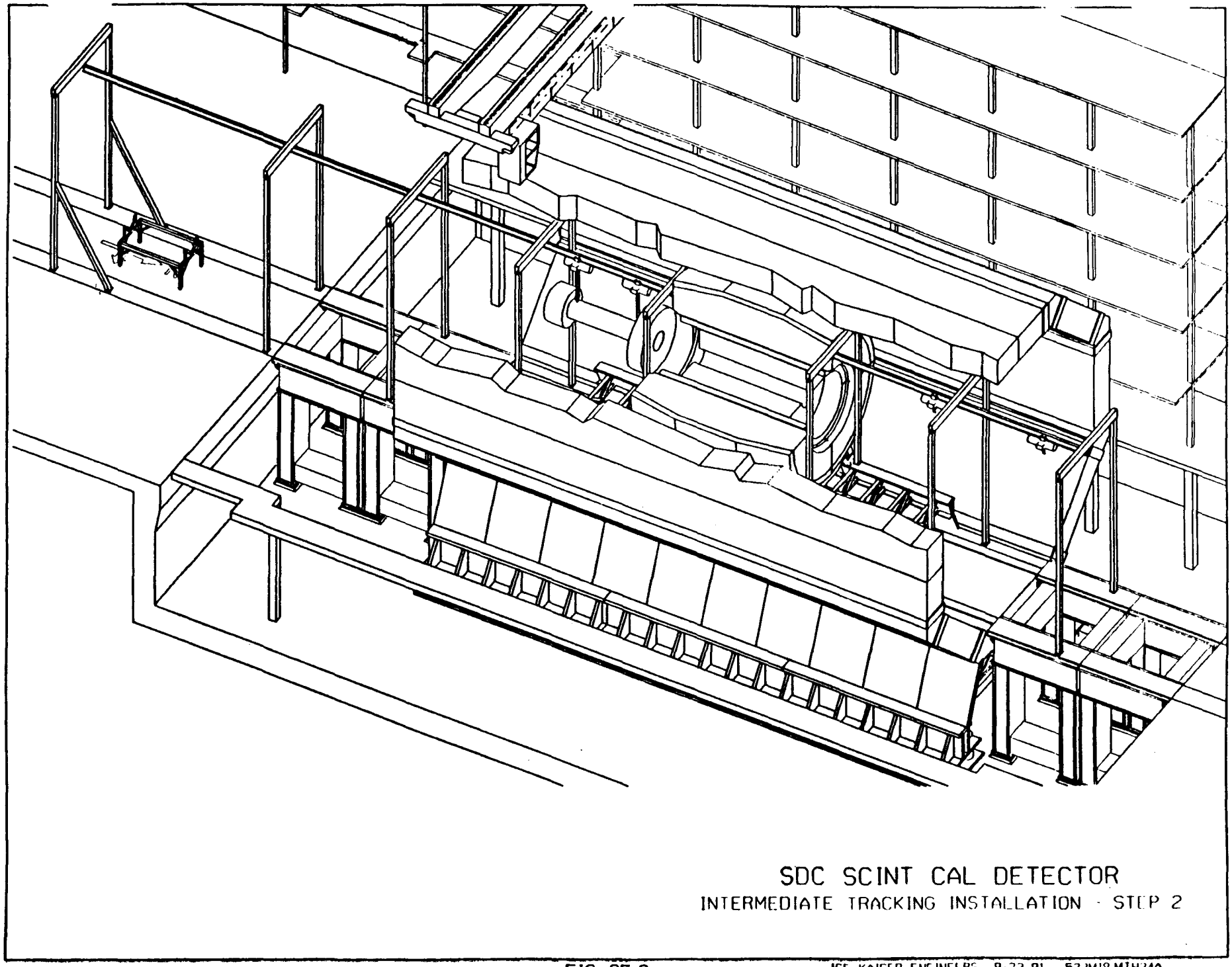


FIG. 35.2

ICF KAISER ENGINEERS 8-22-91 523M18.MTH34A

MONTH 36

The installation of the intermediate tracking is complete.

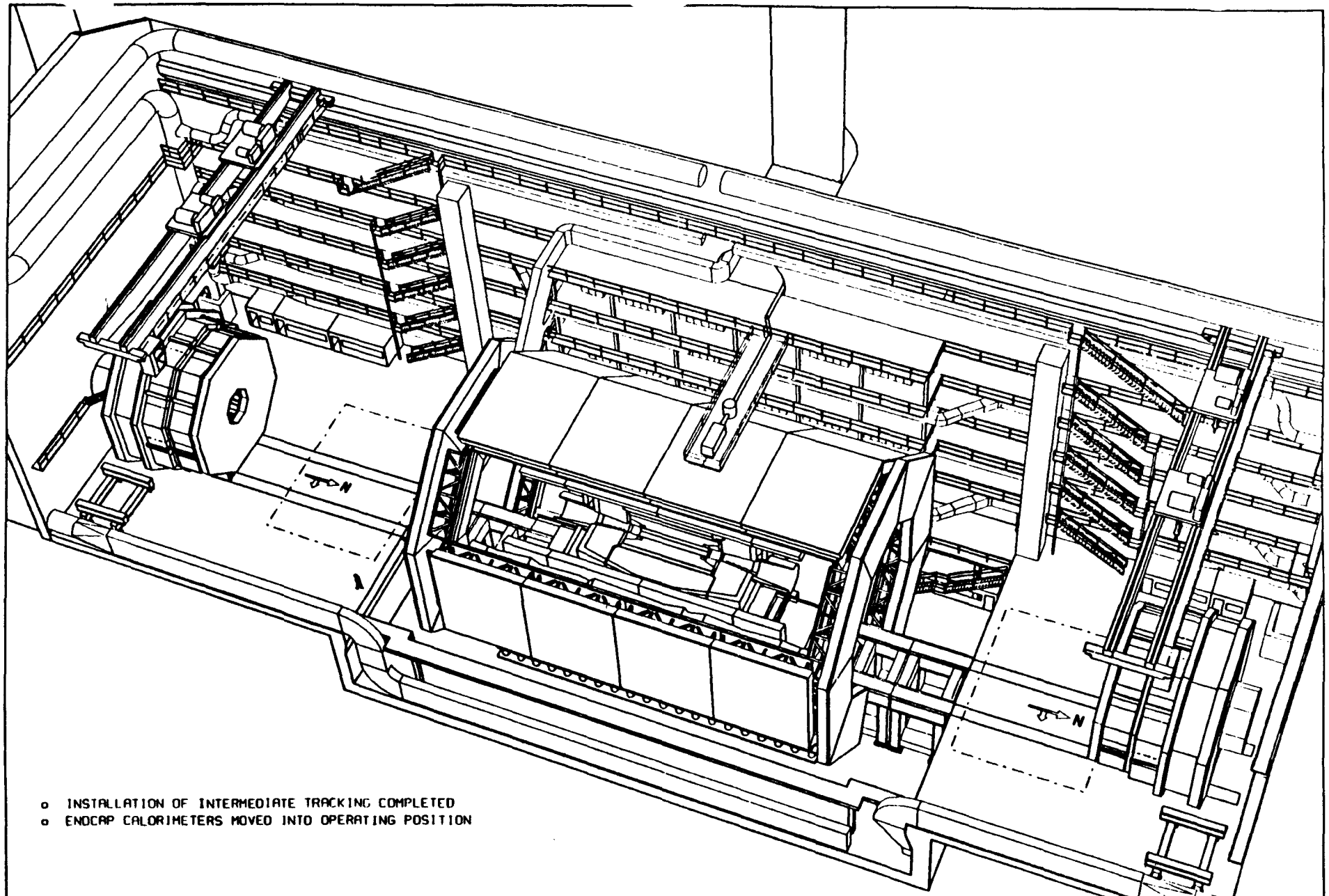
The endcap calorimeters have been moved into operating position and cabling and connection of electronic and utilities is proceeding.

Air conditioning ductwork (not shown) is connected to the detector.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	1800 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	15 hrs	10 hrs
Bridge cranes usage	60 hrs	40 hrs
Large objects lowered from the surface	2 crates of ductwork	2 crates of ductwork
Large objects lifted to the surface	5 bundles of steel for monorail	3 bundles of steel for monorail

none



- 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

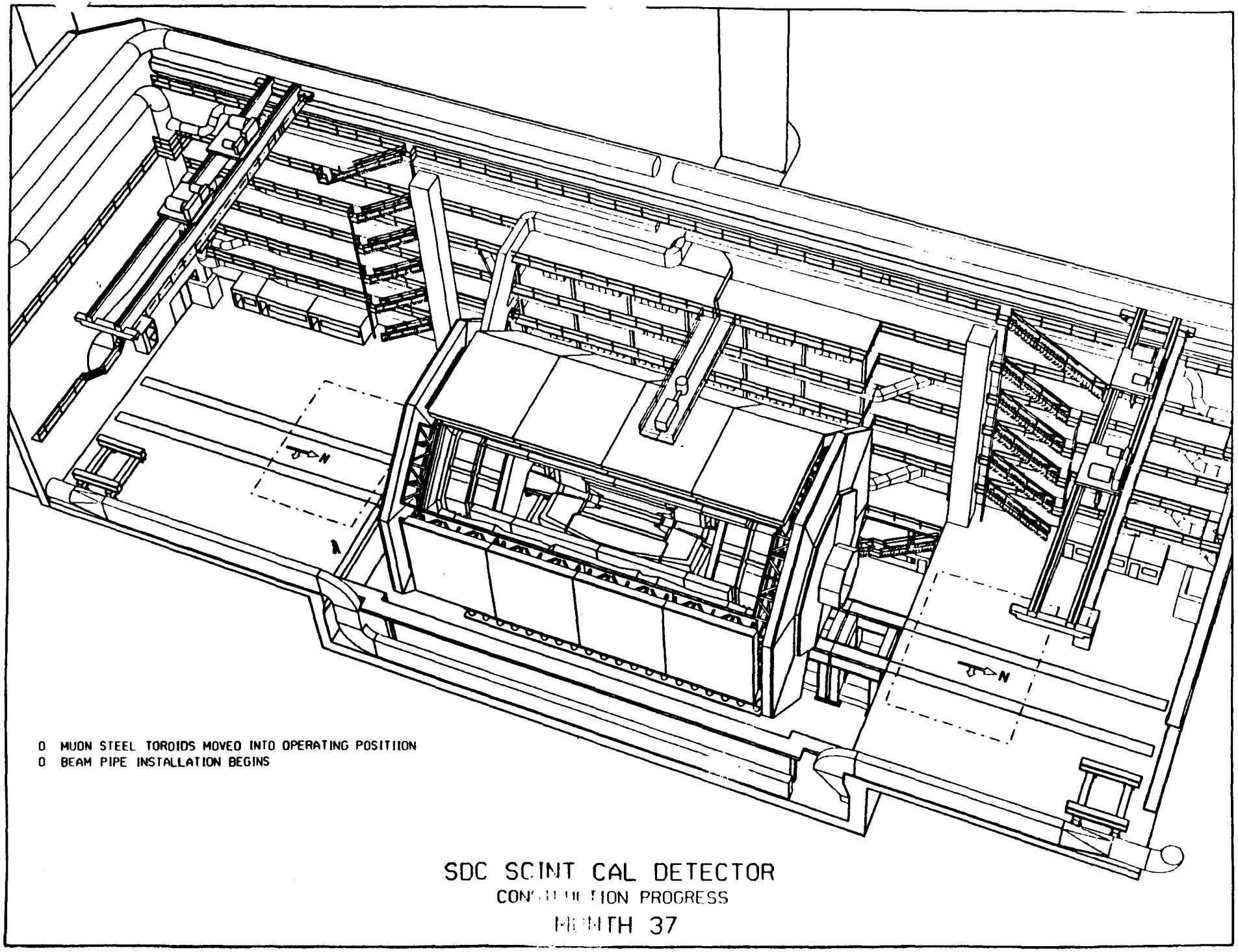
MONTH 37

The muon steel toroids are moved into operating position and electronic and utility connections are made for the forward muon systems and forward calorimeters.

The beam pipe is possibly carried into position with the forward toroids, and vacuum connections made with the central tracking volume pipe. The installation of the beam pipe requires more study.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	500 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	10 hrs	10 hrs
Bridge cranes usage	10 hrs	10 hrs



SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 37

ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN MONTH37.HLN

MONTH 38

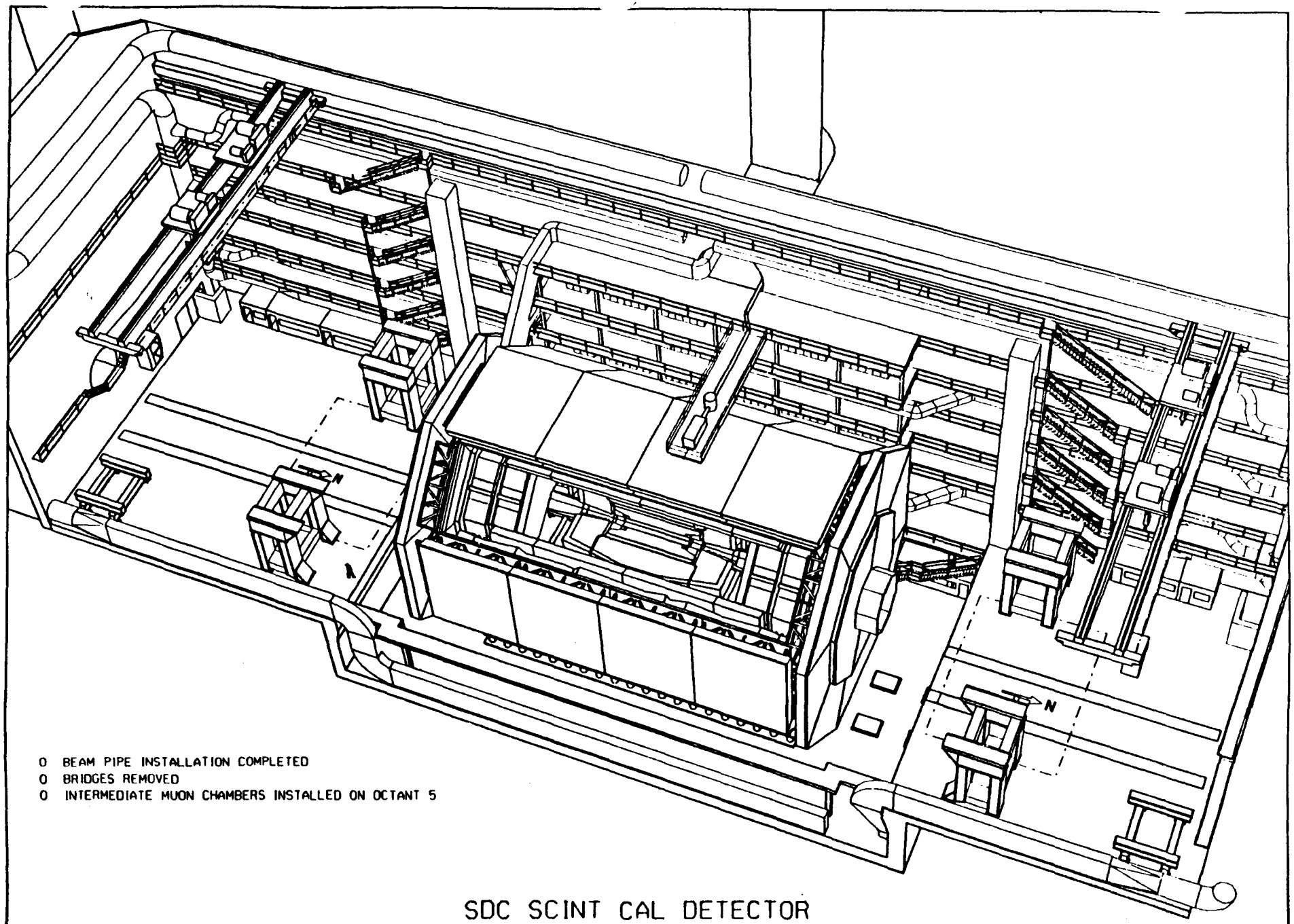
The beam pipe installation is completed.

The bridges are removed and the intermediate muon chambers for octant 5 are installed. A special counterweighted rig (not shown) will have to be designed for this operation as vertical access will not be available when these chambers are installed.

The installation of the accelerator support structure commences this month (not shown).

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	1300 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	20 hrs	10 hrs
Bridge cranes usage	40 hrs	30 hrs
Large objects lowered from the surface	1 intermediate muon chamber 2 accelerator structure sections	1 intermediate muon chamber 1 accelerator structure sections



- BEAM PIPE INSTALLATION COMPLETED
- BRIDGES REMOVED
- INTERMEDIATE MUON CHAMBERS INSTALLED ON OCTANT 5

SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 38

ICF KAISER ENGINEERS 10 13 91 MODEL 523M0045.DGN MONTH38.HLN

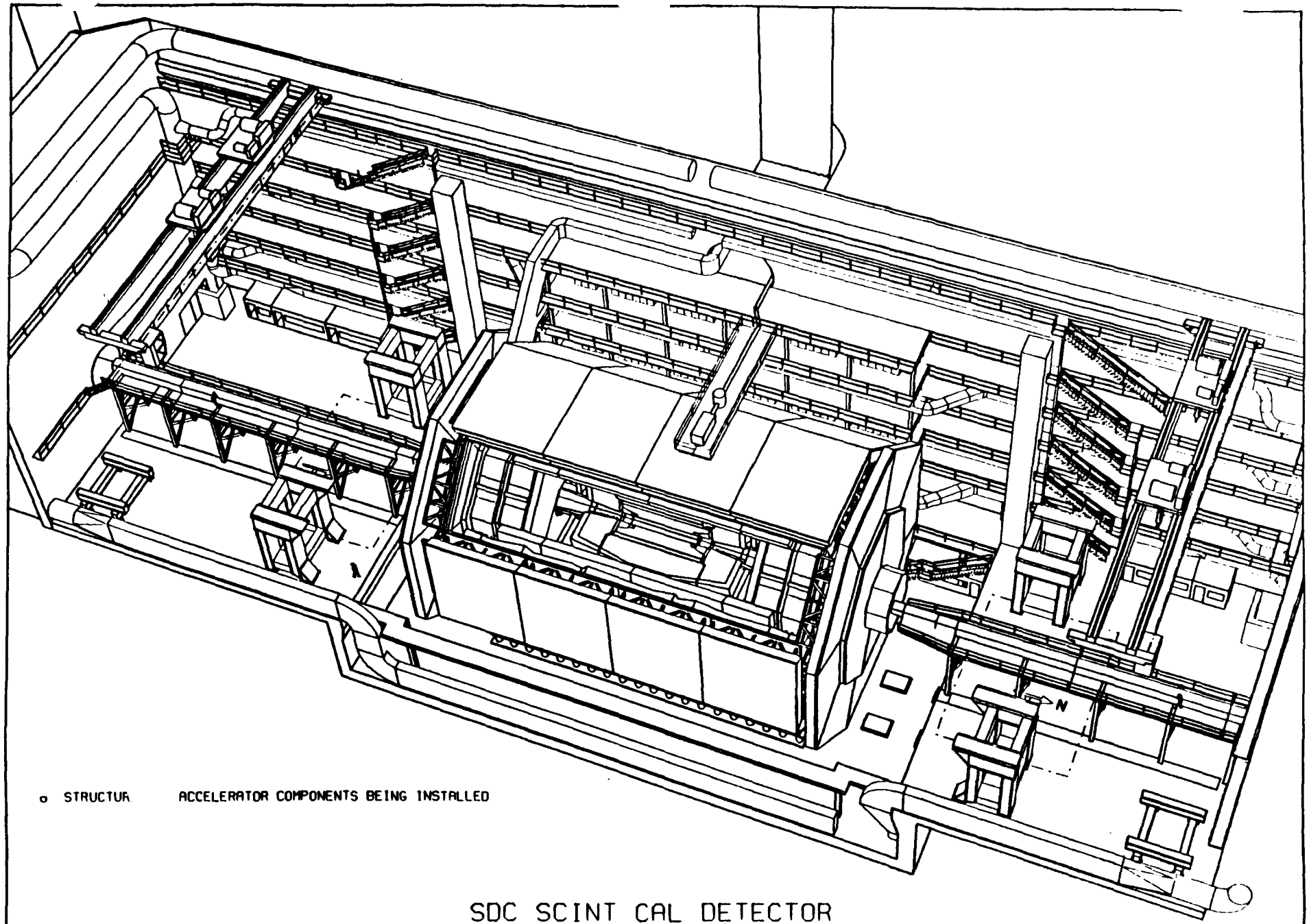
MONTH 39

During this month the installation and alignment of the structures to support the accelerator components continues.

It is not known at this time what kind of cryogenic, utilities or monitoring installations will be required to service the accelerator components inside the hall. This area needs to be defined and the facilities added to the computer model.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	1250 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	10 hrs	10 hrs
Bridge cranes usage	20 hrs	20 hrs
Large objects lowered from the surface	2 accelerator structure sections	2 accelerator structure sections



SDC SCINT CAL DETECTOR

CONSTRUCTION PROGRESS

MONTH 39

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

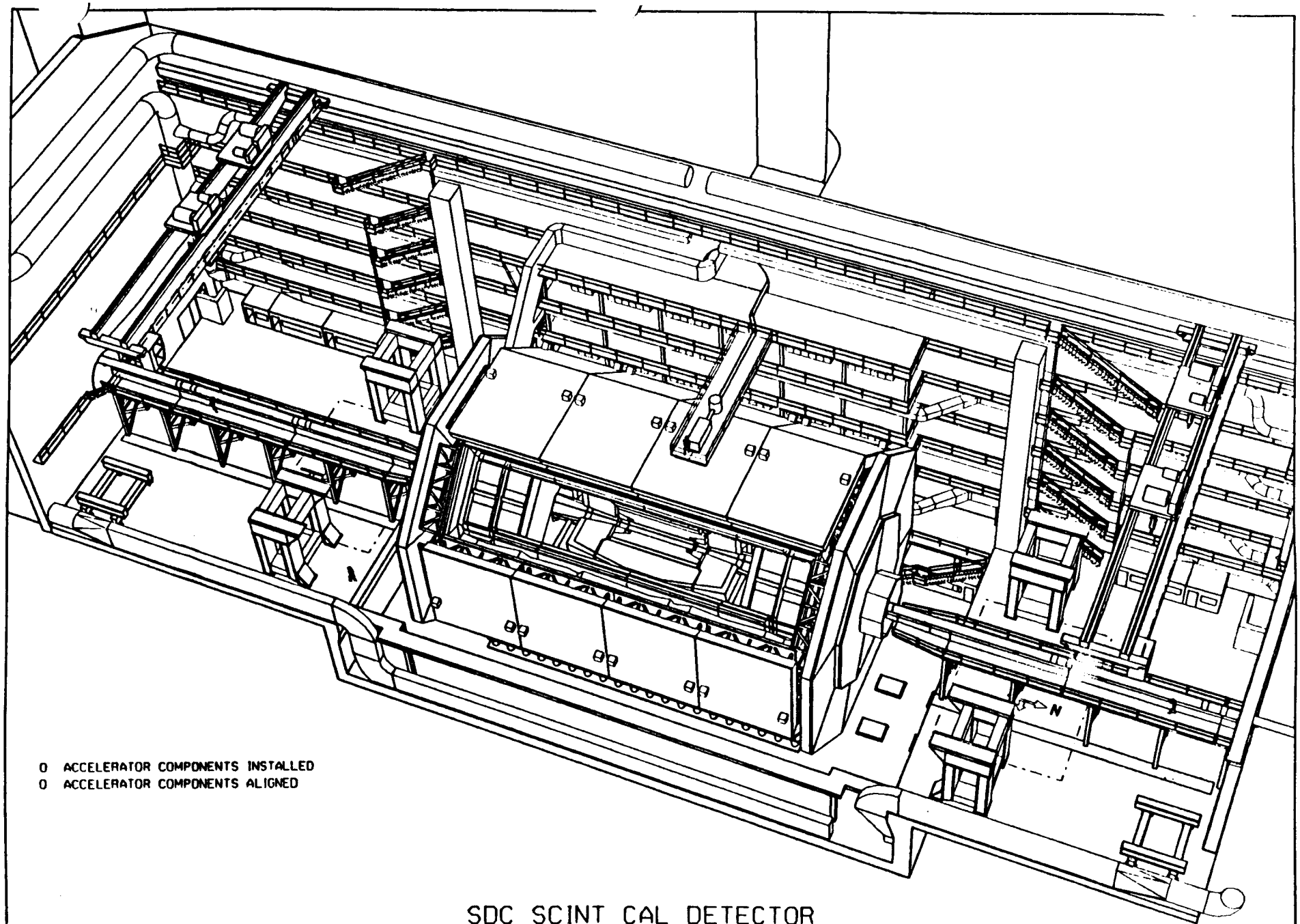
MONTH 40

During this month and the next, the accelerator components aree installed and aligned. It is not certain if enough time has been allowed for this operation, as the design of the accelerator system in the hall has not been done at this time. This area needs to be pursued and coordinated further.

It is assumed that the quadrupoles and dipoles will be lowered through the installation shaft and installed with the same equipment that is used for installation in the tunnel.

No further drawings were made for future months as no physical changes will be visible. Most of future activities will consist of checking the equipment and programming the computers.

No manpower or major equipment utilization estimate is made for this month as the work of detector installation contractors is completed



0 ACCELERATOR COMPONENTS INSTALLED
0 ACCELERATOR COMPONENTS ALIGNED

SDC SCINT CAL DETECTOR

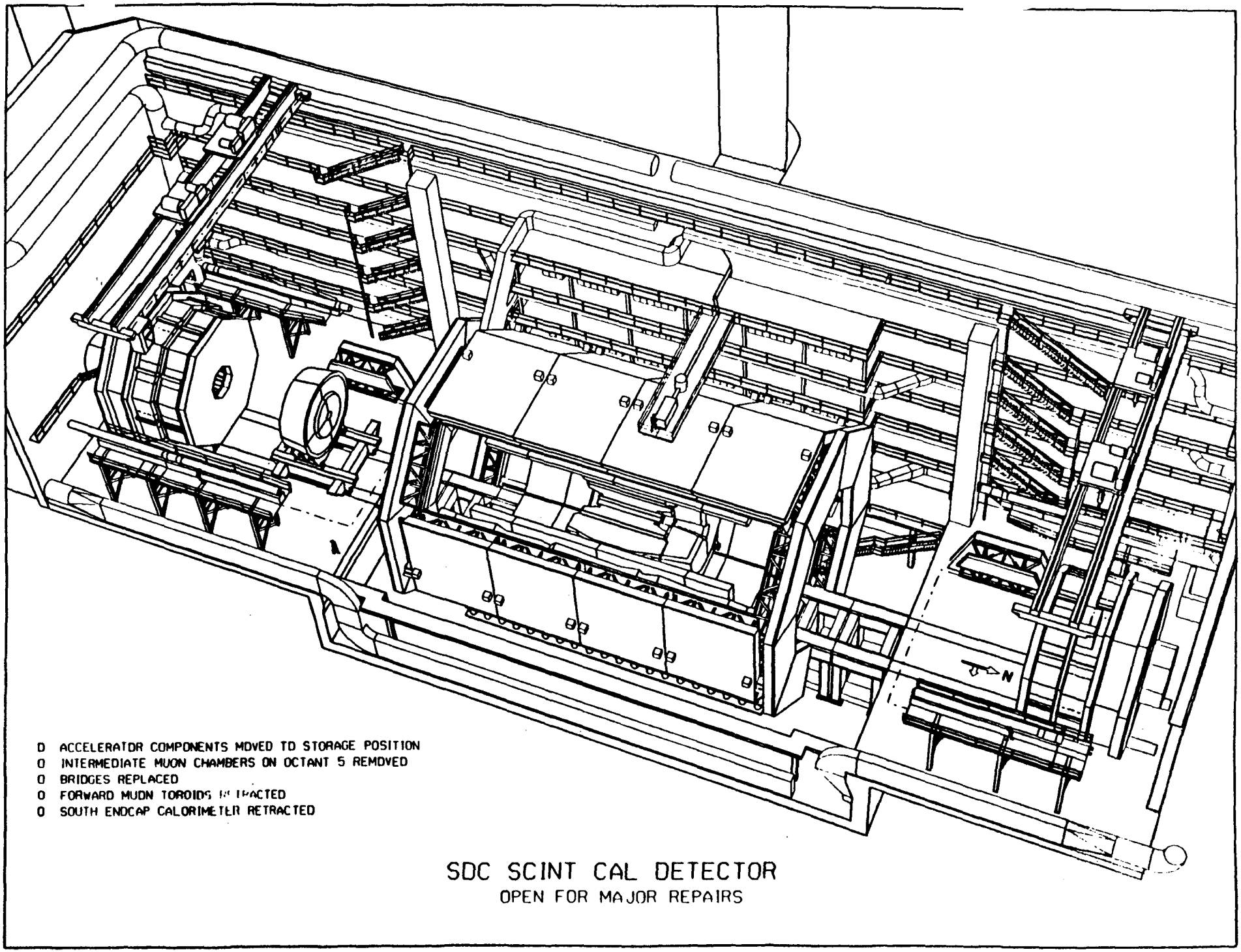
CONSTRUCTION PROGRESS

MONTH 40

ICF KAISER ENGINEERS 10-14-91 MODEL 523M0045.DGN MONTH40.HLN

MAJOR REPAIRS OF THE DETECTOR

The drawing shows the detector open for major repairs. It also 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.



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

SDC SCINT CAL DETECTOR

OPEN FOR MAJOR REPAIRS

ICF KAISER ENGINEERS 10-13-91 MODEL 523M0045.DGN REPAIR.HLN

MONTH 24

By month 24 the assembly of the south forward toroid is completed.

Three muon towers will be installed on octant 2.

The south endcap calorimeter is shown in the process of being lowered to the hall floor. It is proposed to use the same system that was used to lower the barrel calorimeter. If the hollow hydraulic jacks that were used for lowering the barrel calorimeter were rented, lighter jacks may be used for this operation. Lighter jacks use less cables and a smaller power supply saving time in the rigging.

MANPOWER AND EQUIPMENT UTILIZATION FOR THE ABOVE ITEMS

Manpower	3500 hrs	
	SOUTH END	NORTH END
Shaft cranes usage	60 hrs	40 hrs
Bridge cranes usage	20 hrs	80 hrs
Large objects lowered from the surface	1 endcap calorimeter	3 muon chamber trusses 3 muon chambers BW1
Large objects lifted to the surface	1 forward toroid chambers lifting rig 1 endcap calorimeter cradle	6 muon chamber cradles