MAINE YANKEE ATOMIC POWER COMPANY •

EDISON DRIVE
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August 27, 1982
MN-82-169 JHG-82-155

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Office of Nuclear Reactor Regulation
Division of Licensing
Operating Reactors Branch No. 3
Mr. Robert A. Clark, Chief

References:
a) License No. DPR-36 (Docket No. 50-309)
b) USNRC Letter to all Licensees dated December 22, 1980, Control of Heavy Loads
c) MYAPCo Letter to USNRC dated September 18, 1981, FMY-81-141, Control of Heavy Loads
d) Draft Technical Evaluation Report (TER): Control of Heavy Loads at Maine Yankee Atomic Power Station, dated April 5, 1982
e) MYAPCo Letter to USNRC dated July 7, 1982, MN-82-131, Control of Heavy Loads

Enclosures:
1) Safe Load Paths
2) Load Handling Procedures
3) Crane Operator Training
4) Special Lifting Devices
5) Lifting Devices (Not Specially Designed)
6) Cranes (Inspection, Testing and Maintenance)
7) Crane Design

Subject: Control of Heavy Loads

Dear Sir:

This letter provides additional information on control of heavy loads.

We apologize for the lateness of this letter. Following discussion with your technical reviewer, we felt that our draft response may not have been sufficiently detailed. Therefore, we took the additional time necessary to upgrade this submittal.

A033

Enclosures (1)-(7) correspond to sections of the technical evaluation report provided us via Reference (d). We believe these enclosures will aid your staff in evaluating Reference (c) to determine the degree to which Maine Yankee's load handling systems conform to the guidance of NUREG-0612, and the extent to which the criteria utilized in load handling systems design and operation consitute acceptable equivalents or alternatives.

As stated previously in Reference (c), in 1975 the Commission reviewed Maine Yankee's analysis of a postulated spent fuel cask drop accident in the spent fuel pool and concurred with our evaluation that no safety related equipment was beneath the path for cask travel. Additionally, the yard crane (CR-3) which would be used in handling spent fuel casks, was modified to improve reliability, including addition of limit switches and a new main hoist equalizer sheave assembly to provide overload sensing of main hoist hook loads. The limit switches were installed to prevent movement of any load over spent fuel in the pool. The Commission concurred with Maine Yankee's actions and found that provisions to prevent a postulated spent fuel shipping cask accident are acceptable. The matter of spent fuel cask drop accident is currently being again addressed in the context of Proposed Change 70. We believe it would be more appropriate to deal with that matter in that context, and therefore, do not propose to submit any additional information at this time.

Maine Yankee's efforts regarding the heavy loads issue have led to improvements in the inspection, maintenance and operating procedures for its critical load handling systems. We have devoted substantial resources to making these improvements because, according to the statistics contained in NUREG-0612, the greatest safety improvements may be realized in those areas.

We believe that the issue of heavy loads is being adequately addressed at Maine Yankee, and that our limited resources should be dedicated to other ongoing safety improvement projects.

We trust you will find this information satisfactory. If you have any questions, or desire further clarification, please do not hesitate to contact us.

Very truly yours,

MAINE YANKEE ATOMIC POWER COMPANY

A. J. Cayia

for John H. Garrity, Senior Director
Nuclear Engineering and Licensing

JHG:pjp

Enclosures

cc: Mr. Ronald C. Haynes
Mr. Paul Swetland

ENCLOSURE 1

Guideline 1 - Safe load Paths

The drawings and brief descriptions within this enclosure are provided to better depict the intersection of crane travel paths and critical volumes associated with systems required for safe shutdown and decay heat removal. Safe load paths are depicted for critical reactor vessel components. Drawings which show the location of critical areas have been incorporated in our crane operating procedure along with appropriate precautions which apply when loads must be handled within these areas.

1. The appropriate drawings and precautions will also be covered in our crane operator training program.

2. Maine Yankee also intends to clearly mark appropriate critical areas in the turbine hall, upper level PAB, fuel building and containment outer annulus.

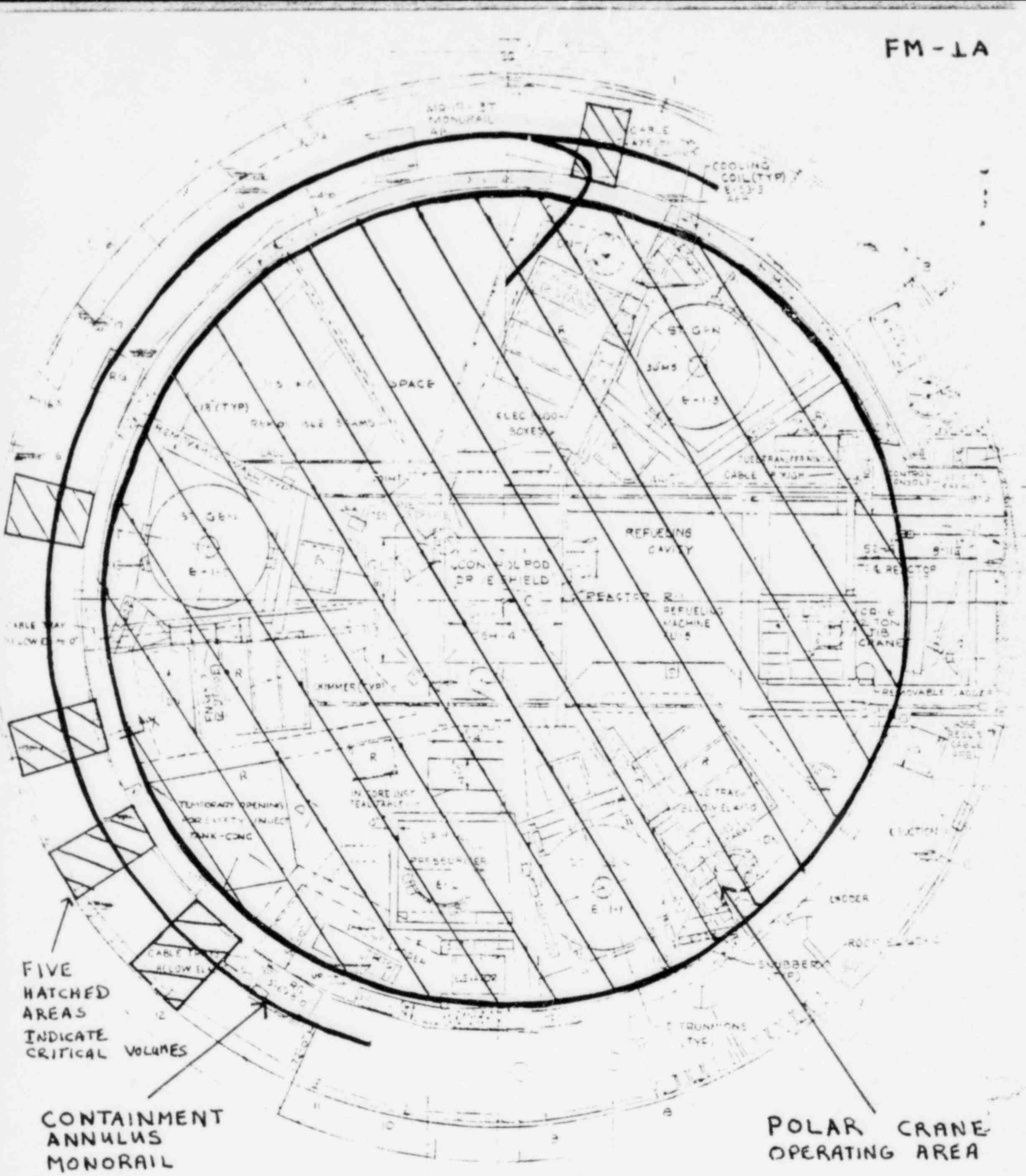
Containment Building Travel Paths

Three drawings are provided for the containment.

FM-1A depicts the areas above the charging or operating floor where the polar crane trolleys are allowed to travel to support refueling operations. The heavy black line in the outer annulus depicts the travel path for MR-19, a monorail with a three ton manual hoist. The five cross hatched areas in the outer annulus represent critical volumes where piping for systems required for safe shutdown or decay heat removal traverse across the outer annulus. All of these areas are two floors down below the 20 ft elevation. These systems were described in our first submittal dated September 18, 1981.

FM-1B depicts the containment at the 20 ft elevation and clearly shows the safe travel paths to which the three major reactor vessel components are restricted. These components are the reactor vessel closure head, upper internals package and core support barrel assembly.

FM-1C is provided to show the -2 ft elevation and the safe load travel path for the vessel head.

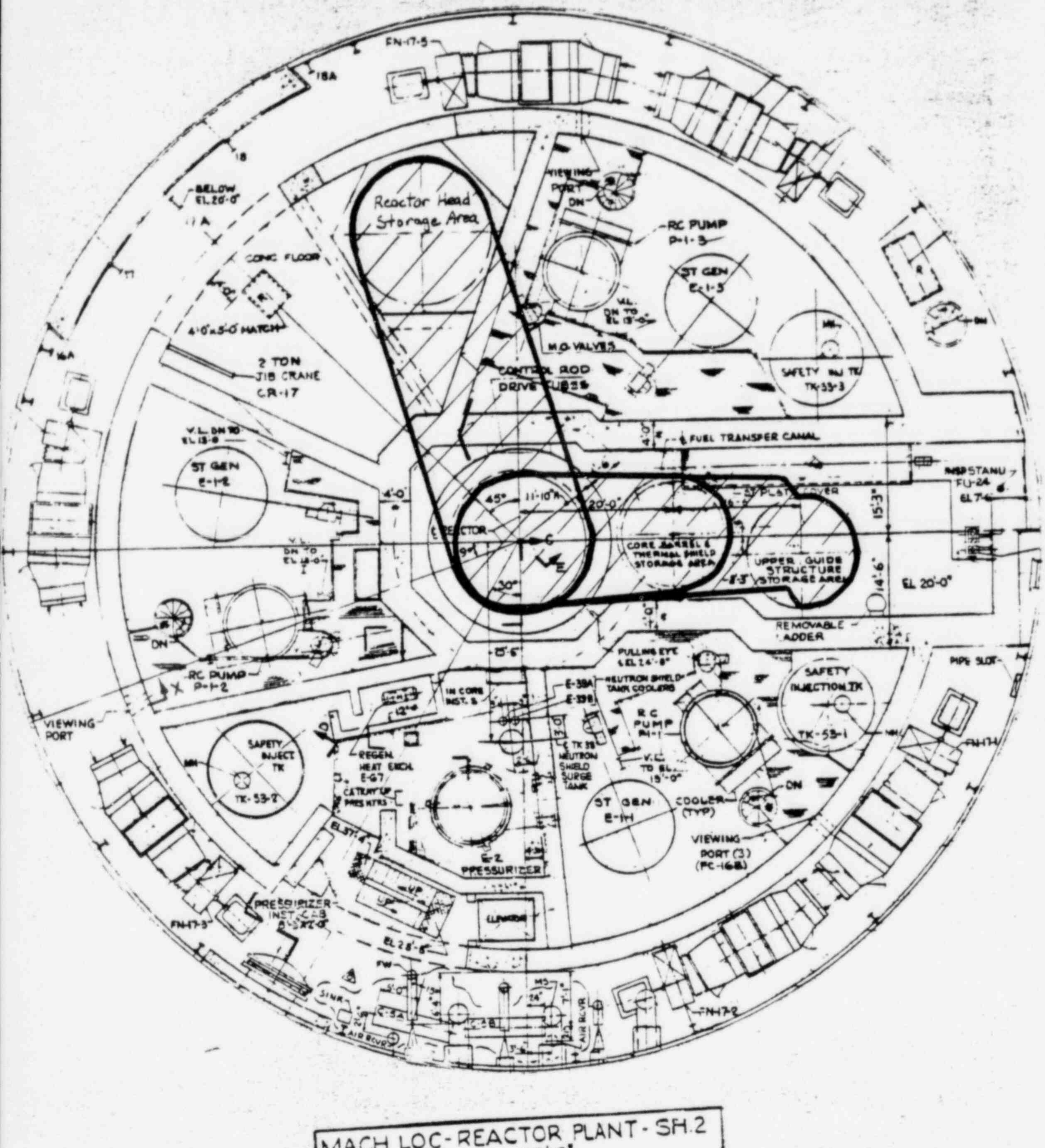


MACH LOC-REACTOR PLANT SH 1
PLAN-EL 46-0"

ATOMIC POWER STATION
MAINE YANKEE ATOMIC POWER COMPANY
WISCASSET, MAINE

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 11550-FM-1A

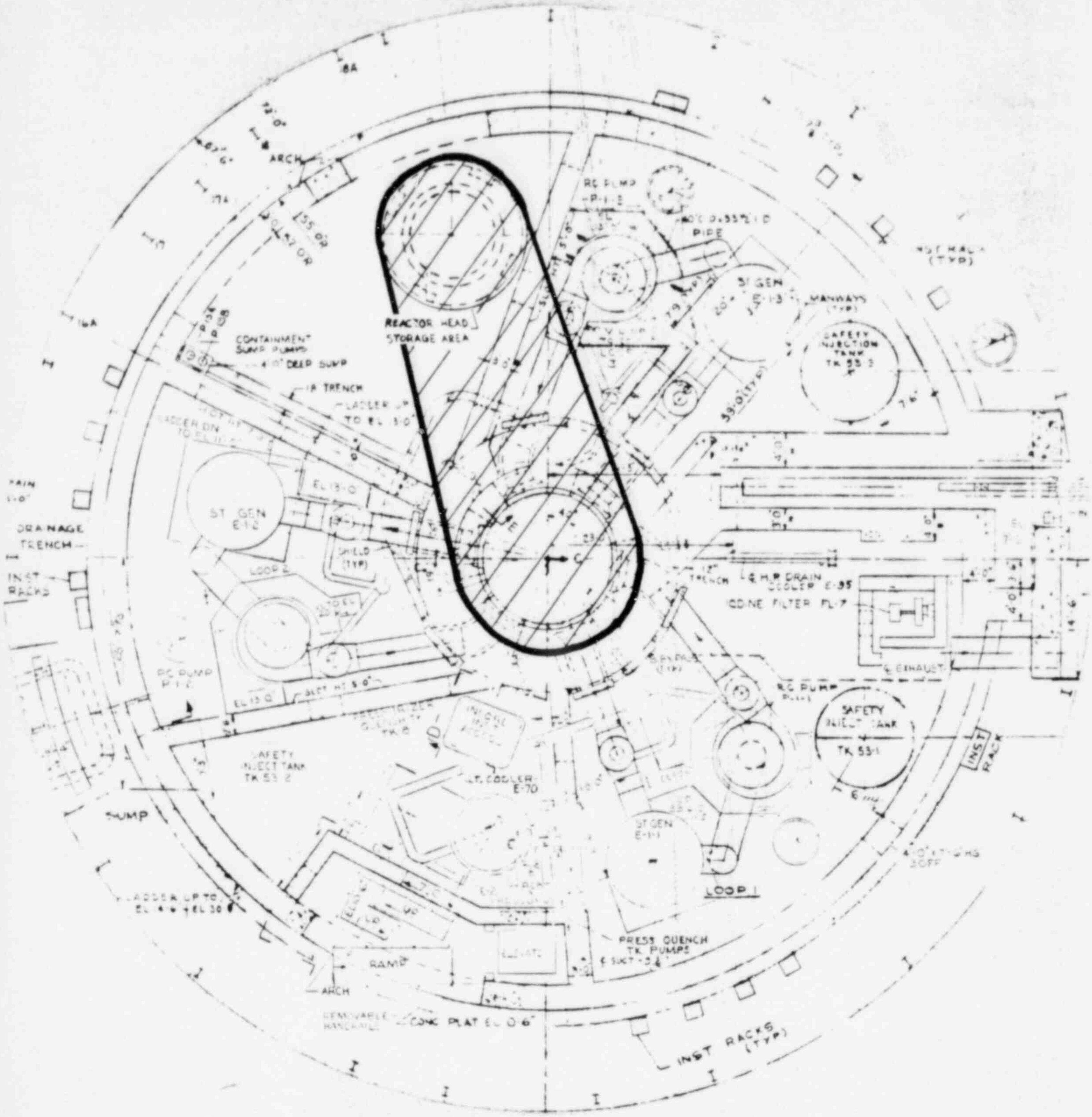


MACH LOC-REACTOR PLANT - SH.2
PLAN - EL. 20'-0"

ATOMIC POWER STATION
MAINE YANKEE ATOMIC POWER COMPANY
WISCASSET, MAINE

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 11550-FM-1B



MACH LOC-REACTOR PLANT SH 3
PLAN-EL -2-0", EL-19-2" & EL-32-2"

ATOMIC POWER STATION
MAINE YANKEE ATOMIC POWER COMPANY
WISCASSET, MAINE

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 11550-FM-1C

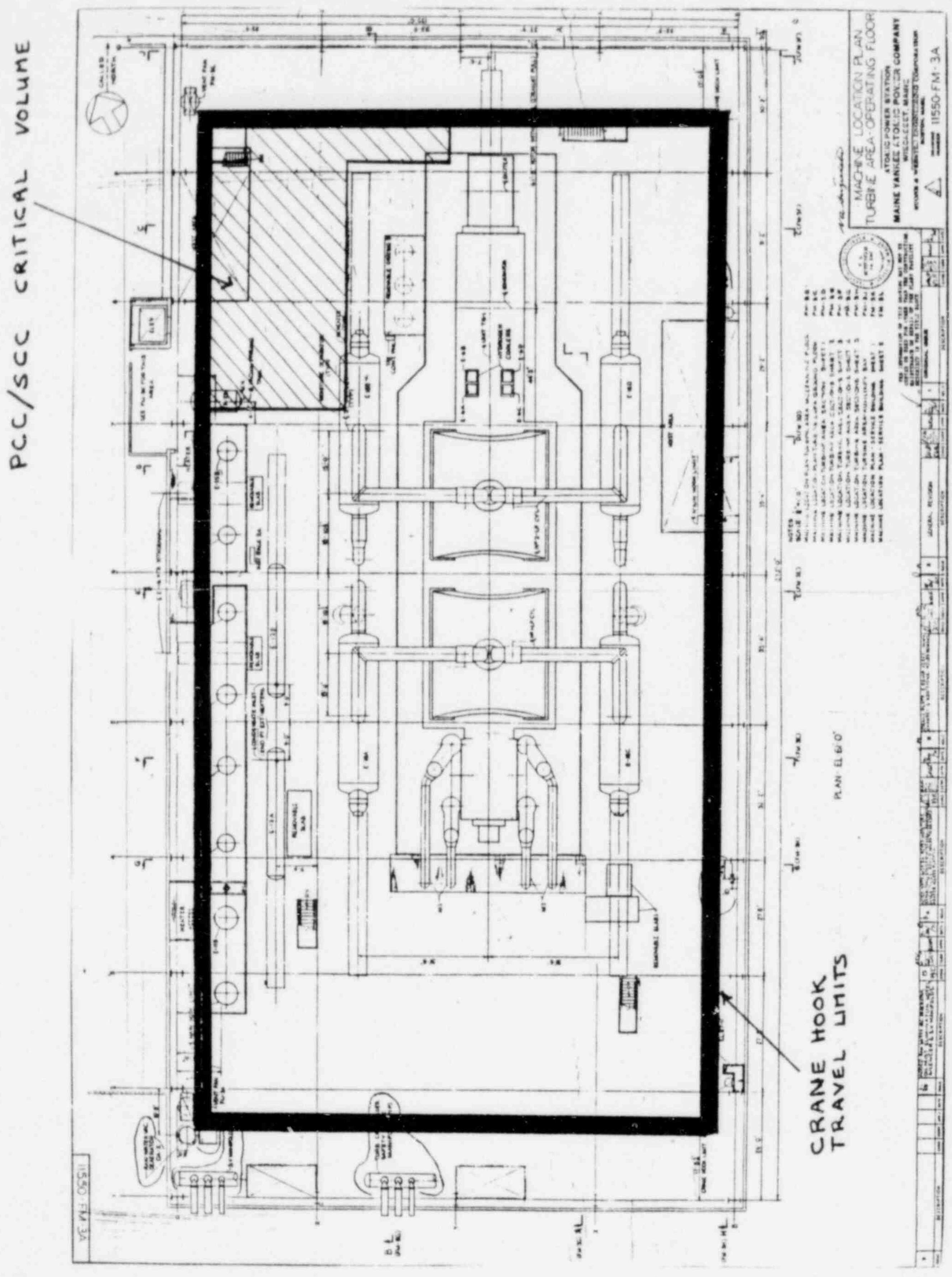
Turbine Building Travel Paths

Two drawings are provided which depict the turbine building arrangement. The heavy dark line on each drawing represents the hook travel limits of the turbine hall crane (CR-2).

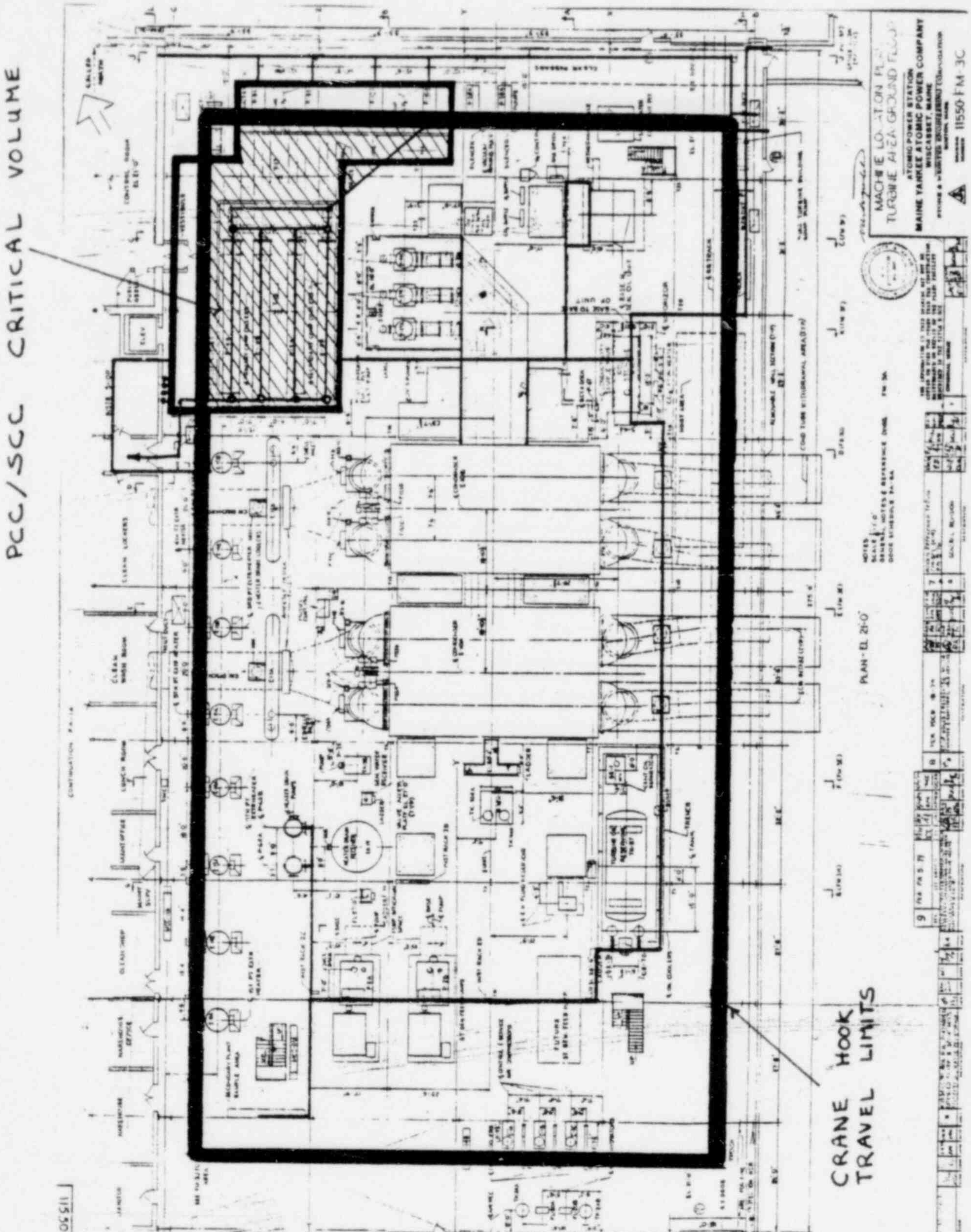
The cross hatched area in FM-3A depicts the critical volume associated with the Primary (PCC) and Secondary (SCC) component cooling systems which is common to the crane travel path. This is the only area of the turbine building which contains PCC piping. Secondary component cooling is used to cool various components within the building. Two isolation trip valves are being installed which can isolate the turbine hall portion of the SCC system in the event of a rupture there, to preserve SCC cooling for safety functions.

FM-3C shows the ground floor where the actual PCC and SCC systems are located, with the hook travel limits superimposed. In reality, the hook cannot travel in this area as one or more floors separate system components and the area where the hook operates.

FM-3A


PCC/SCC CRITICAL VOLUME
CRANE HOOK TRAVEL LIMITS
MACHINE LOCATION PLAN
TURBINE AREA-OPERATING FLOOR
ATOMIC POWER STATION
MAINE YANKEE ATOMIC POWER COMPANY
WISCASSET, MAINE
11550-FM-3A

FM-3C



PCC/SCC CRITICAL VOLUME
CRANE HOOK TRAVEL LIMITS
MACHINE LOCATION PLAN
TURBINE AREA GROUND FLOOR
MAINE YANKEE ATOMIC POWER COMPANY
11550-FM-3C

Fuel Building Travel Paths

Three drawings are provided which depict the operating zones for the yard crane (CR-3), the new fuel crane (CR-6), and the movable platform (CR-9) which has a two-ton hoist attached. This movable platform and hoist is used during refueling operations to move fuel assemblies between the fuel transfer mechanism and fuel storage racks.

The drawings depict vertical and horizontal cross sections of the building.

Drawing 1

The cross-hatched area designated "A," "B" and "C" shows the travel limits of the new fuel crane (CR-6). Area "B" represents the area where new fuel shipping containers are handled. Note the path for the fuel pool cooling pump power cables in this area. They are routed beneath a structural girder and are thus protected from a load drop. Area "C" reflects the critical volume associated with the fuel pool cooling system. Area "D" shows the travel path of the fuel yard crane (CR-3) and the spent fuel cask laydown area in the spent fuel pool. Limit switches restrict the crane's access to this area of the spent fuel pool. The movable platform and hoist operates only over the spent fuel pool.

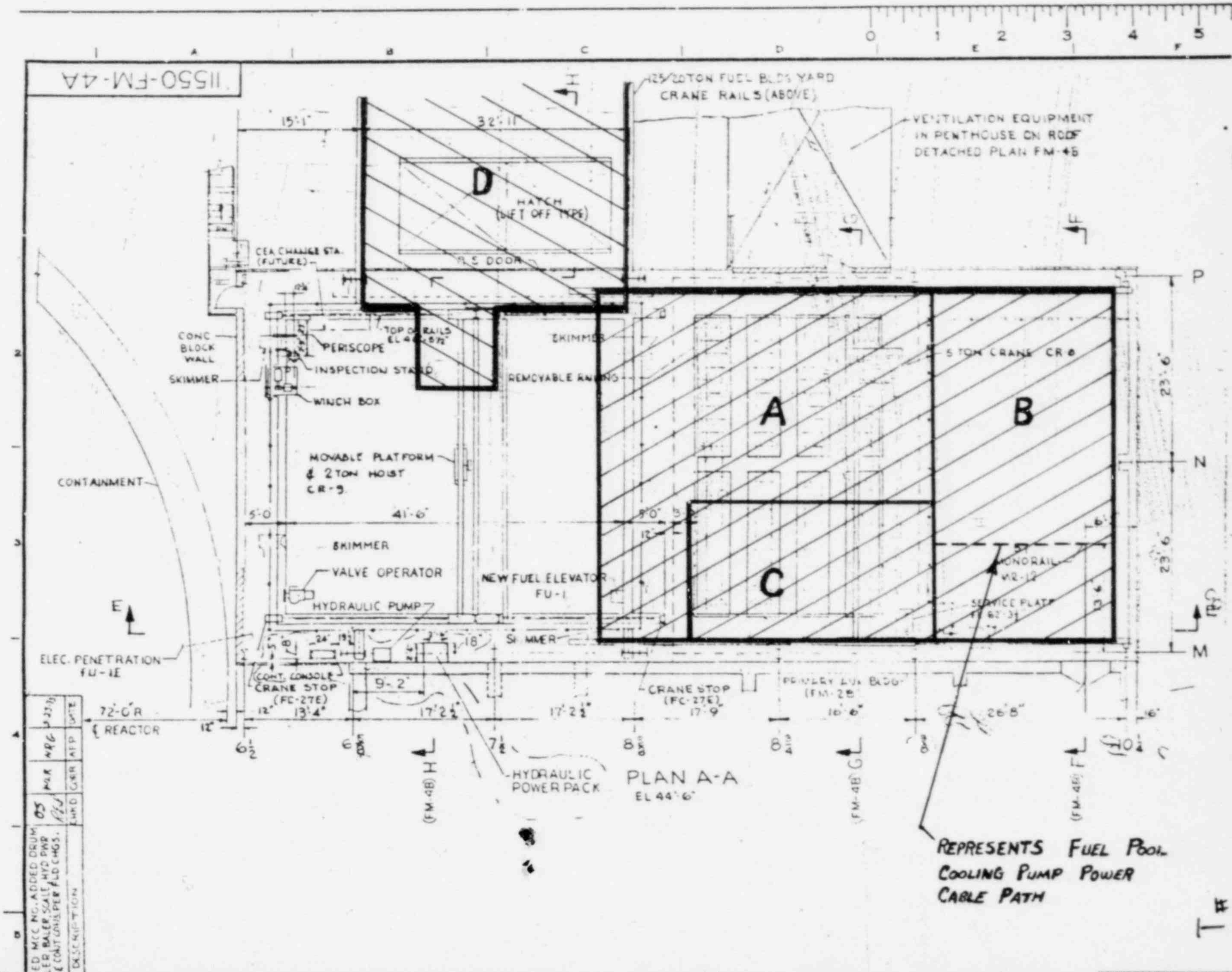
Drawing 2

This drawing provides a side view of the fuel building. The new fuel crane (CR-6), again, operates over the entire cross hatched area marked "A". In reality, the crane hook can operate only in the open areas of "B" and the area in "C" above the new fuel storage areas. Note that the fuel pool cooling system within the critical volume "C" is entirely beneath the new fuel storage area, separated from the new fuel crane by one or more floors.

Drawing 3

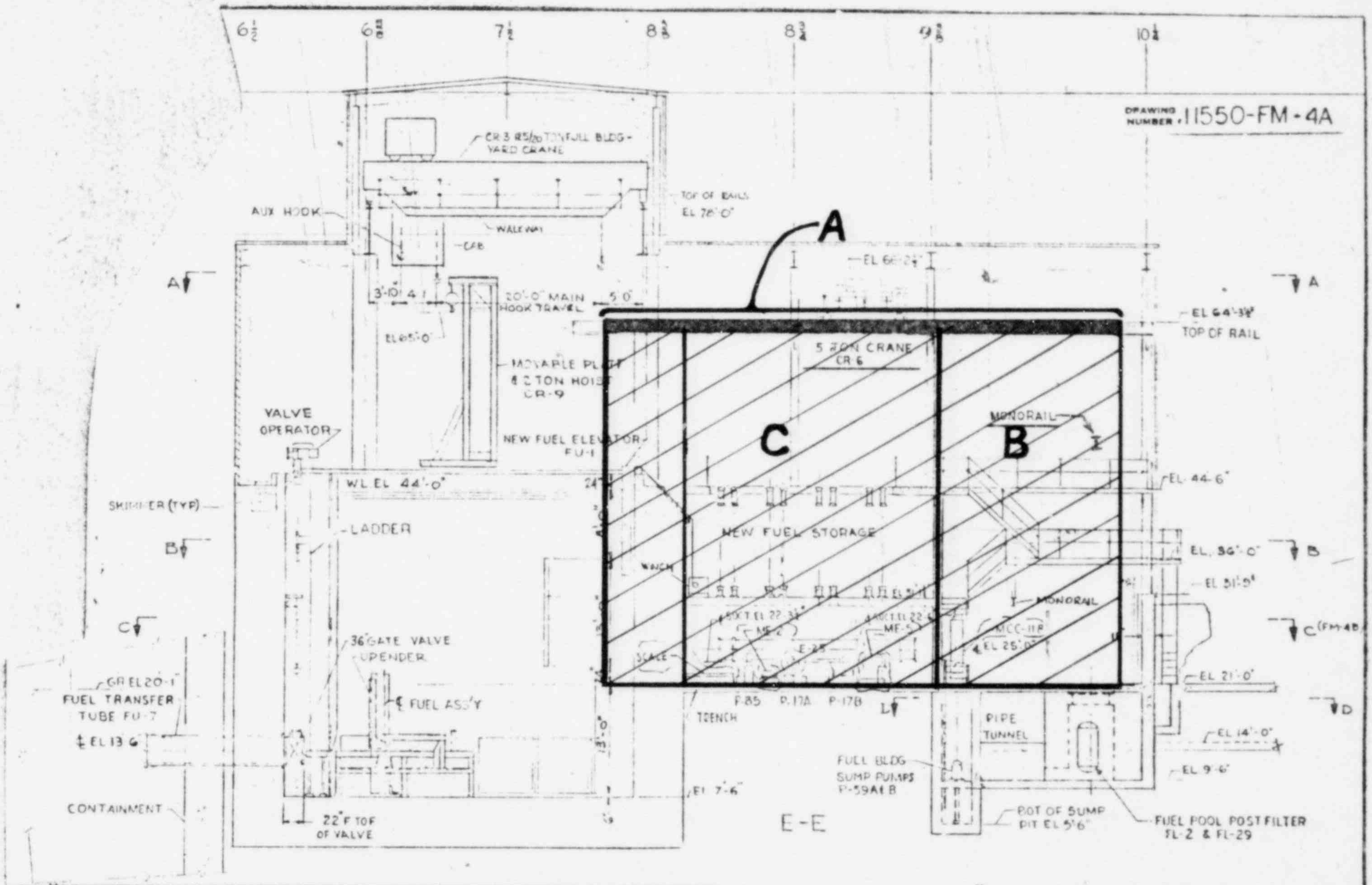
This drawing is provided to show the intersection of the areas previously described as they relate to component layout at the lowest level in the building (elevation 21').

DRAWING I



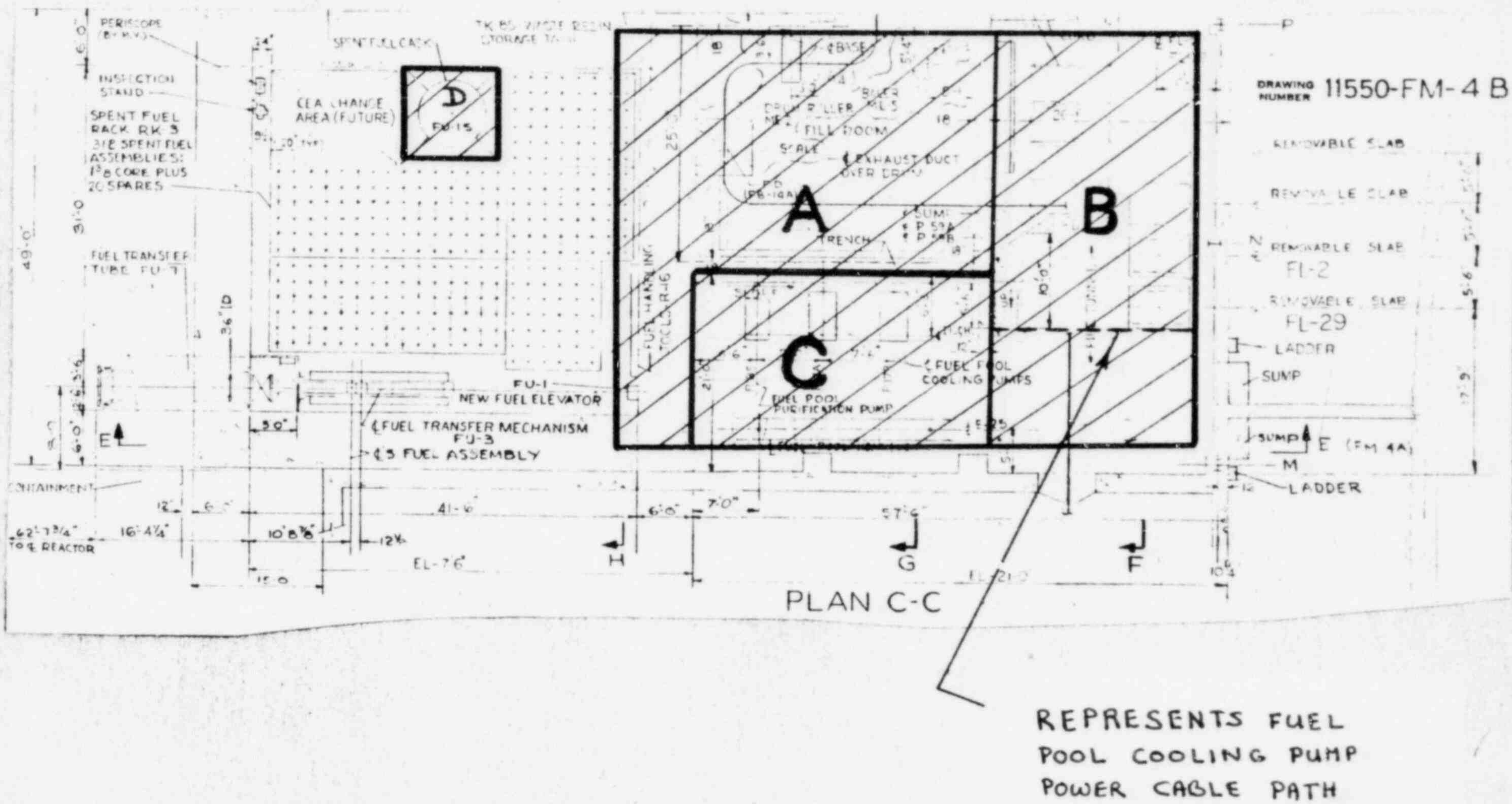
11550-FM-4A
A
B
C
D
HATCH (LIFT OFF TYPE)
125/20 TON FUEL BLDG YARD CRANE RAILS (ABOVE)
VENTILATION EQUIPMENT IN PENTHOUSE ON ROOF DETACHED PLAN FM-4B
CEA CHANGE STA. (FUTURE)
CONC BLOCK WALL
SKIMMER
PERISCOPE
INSPECTION STAND
WINCH BOX
5 TON CRANE CR-8
REMOVABLE RAILING
MOVABLE PLATFORM & 2 TON HOIST CR-9
CONTAINMENT
VALVE OPERATOR
HYDRAULIC PUMP
NEW FUEL ELEVATOR FU-1
MONORAIL MR-12
ELEC. PENETRATION FU-1E
CONT. CONSOLE
CRANE STOP (FC-27E)
72'-0" R
℄ REACTOR
HYDRAULIC POWER PACK
PLAN A-A
EL 44'-6"
P
N
M
23'-6"
41'-6"
32'-11"
15'-1"
REPRESENTS FUEL POOL COOLING PUMP POWER CABLE PATH

DRAWING 2



DRAWING NUMBER 11550-FM-4A
A
B
C
5 TON CRANE CR-6
MONORAIL
NEW FUEL STORAGE
NEW FUEL ELEVATOR FU-1
MOVABLE PLAT & 2 TON HOIST CR-9
20'-0" MAIN HOOK TRAVEL
CR-3 125/20 TON FUEL BLDG-YARD CRANE
WALKWAY
CAB
AUX HOOK
TOP OF RAILS EL 78'-0"
EL 64'-3½" TOP OF RAIL
VALVE OPERATOR
WL EL 44'-0"
SKIMMER (TYP)
LADDER
36" GATE VALVE UPENDER
FUEL ASS'Y
FUEL TRANSFER TUBE FU-7
CONTAINMENT
22" F TOF OF VALVE
TRENCH
P-85
P-17A
P-17B
PIPE TUNNEL
FUEL BLDG SUMP PUMPS P-59A & B
BOT OF SUMP PIT EL 5'-6"
FUEL POOL POST FILTER FL-2 & FL-29
EL 44'-6"
EL 36'-0"
EL 21'-0"
EL 14'-0"
EL 9'-6"
EL 7'-6"
E-E

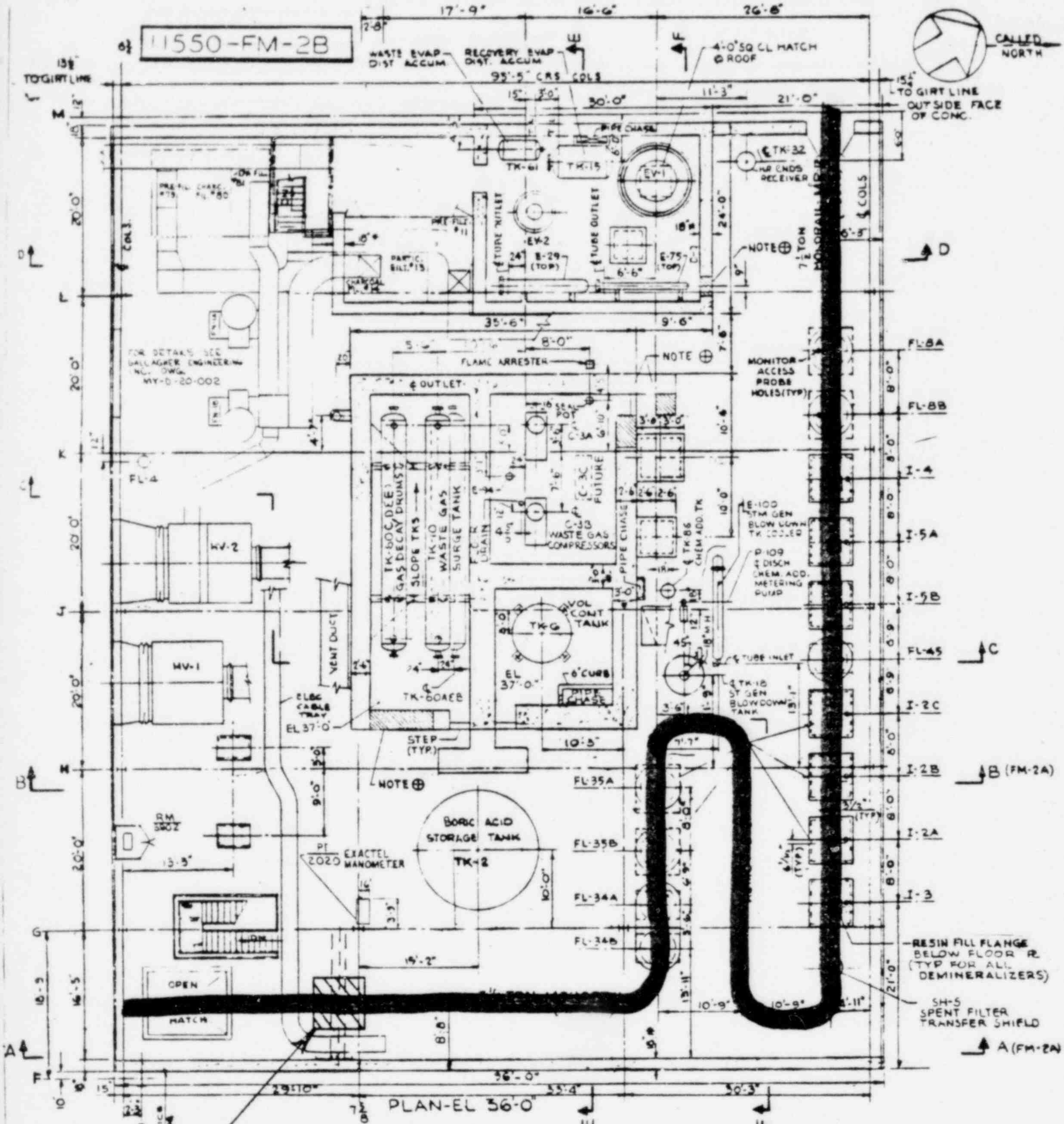
#2


DRAWING NUMBER 11550-FM-4 B
PLAN C-C
A
B
C
D
PERISCOPE
INSPECTION STAND
SPENT FUEL CASK
CEA CHANGE AREA (FUTURE)
SPENT FUEL RACK RK-3
FUEL TRANSFER TUBE FU-T
FU-1
NEW FUEL ELEVATOR
℄ FUEL TRANSFER MECHANISM FU-3
℄ S FUEL ASSEMBLY
CONTAINMENT
TO ℄ REACTOR
FILL ROOM
℄ EXHAUST DUCT OVER DRUM
SUMP
TRENCH
FUEL POOL PURIFICATION PUMP
℄ FUEL POOL COOLING PUMPS
REMOVABLE SLAB
REMOVABLE SLAB
REMOVABLE SLAB
FL-2
REMOVABLE SLAB
FL-29
LADDER
SUMP
SUMP
E (FM 4A)
LADDER
H
G
F
E
M
P
EL-7'6"
EL-21'0"
REPRESENTS FUEL POOL COOLING PUMP POWER CABLE PATH

#3

Primary Auxiliary Building Travel Paths

One drawing is provided which shows the travel path for Monorail MR-12, for the PAB upper floors. This travel path is fixed. The only critical volume associated with this system is the cross-hatched area where the monorail travels over the charging pump power cables, which run through conduit imbedded in concrete in the lower floor.



CRITICAL VOLUME: 7½ TON MONORAIL CROSSES OVER CHARGING PUMP POWER CABLES

Monorail Track — Power Cables

ENCLOSURE 2

Guideline 2 - Load Handling Procedures

We have established general operating instructions for the following six non-excluded load handling systems:

a) Polar Crane (CR-1)
b) Turbine Hall Crane (CR-2)
c) Yard Crane (CR-3)
d) New Fuel Crane (CR-6)
e) Upper Level PAB Monorail and Hoist (MR-12, CR-12)
f) Containment Annulus Monorail and Hoist (MR-19, CR-19)

The operating instructions have been incorporated into Maine Yankee's Procedure 5-201-5, "Operating Instructions for Overhead Traveling Cranes and Overhead Monorails." This procedure is available for review at the plant site.

The operating instructions are in accordance with ANSI B30.2 1976 "Overhead and Gantry Cranes." In addition to general procedural precautions, this procedure provides specific precautions which apply to each of the six load handling systems above. Separate operating procedures are provided within Procedure 5-201-5 for cab operated cranes, overhead monorails, and pendant operated cranes. Furthermore, the procedure contains a copy of the standard hand signals from ANSI B30.2 1976, the frequent inspection guidelines from the ANSI standard and travel path drawings which show the critical volumes associated with each of the six load handling systems.

ENCLOSURE 3

Guideline 3 - Crane Operator Training Program

Previously, Maine Yankee's crane operators were qualified to the standards of USAS B30.2 of 1967. Our evaluation of the historical data contained in NUREG 0612, "Control of Heavy Loads at Nuclear Power Plants" indicates that the greatest safety improvements can be achieved by improving the knowledge and capabilities of the personnel who operate and maintain our cranes. Therefore, we have devoted most of our resources in this regard to improving our procedures for crane operation, operator training, and inspection.

We have formalized our crane operator training program to insure that it meets or exceeds the standards of ANSI B30.2-1976.

The crane operator training program will be administered by our Director of Training, with the training to be provided by our Specialty Training Group.

Basically, our program will consist of the following types of training:

a) Load Handling Safety Course
b) Written examination
c) Practical crane training, as necessary
d) Practical crane operation examination

In addition to initial crane operator qualification, our program provides for annual operator certification to ensure qualification levels are maintained. Contracted employees will be trained and qualified to the same standards as Maine Yankee employees for the cranes they will be operating.

3. Our plans for the 1982 refueling outage will be to complete recertification of our crane operators that are presently qualified and who will be operating cranes during the outage period. Additionally, any contractors to be used as crane operators will complete the qualification program prior to operating any of the overhead cranes.

The specifics of this program are available for review in Procedure 18-239-1 which is maintained at the plant site.

ENCLOSURE 4

Guideline 4 - Special Lifting Devices

Two special lifting devices are used at Maine Yankee to support reactor vessel disassembly for refueling purposes. They are the reactor vessel head lifting fixture and the reactor internals lifting fixture. Additional information to complete the design review is being sought or developed. Based on our review of the available information, we have solicited proposals to perform a design review of both lifting rigs against ANSI N14.6-1978.

The design for the reactor closure head lifting rig used a dynamic load factor of 0.5g which, when added to the dead weight, produced a design load of 1.5W (W is the weight lifted). The resulting stresses were compared to stress allowables in the AISC Manual of Steel Construction.

The design criteria for the internals lifting rig are provided in the enclosed CE procurement specification and C-E design requirements.

We believe the designs of these two lifting rigs are adequate and these criteria are provided as justification for their interim use.

4. We propose to gather all available information regarding the closure head and internals lifting rigs and to have a comprehensive stress analysis performed. The scope and schedule will be provided before January 1, 1983.

5. We are developing an inspection program to verify lifting rig integrity in accordance with ANSI N14.6-1978, Section 5.3. This program will require a detailed inspection to be performed on a refueling interval basis. This inspection will consist of dimensional testing, visual inspection, and non-destructive testing of major load-carrying welds and critical areas in accordance with Section 5.5 of the ANSI standard. The program will require load testing following any major maintenance or alteration in accordance with Section 5.3.2 of the ANSI standard. Visual inspections of each lifting device will be performed prior to each use. Maintenance history records will be established to document the results of the detailed inspections.

PROCUREMENT SPECIFICATION

FOR

REACTOR INTERNALS LIFTING RIG

MAINE YANKEE PLANT

Specification No. 4467-486-441

September 1969

COMBUSTION ENGINEERING, INC.
Utilities Division
Nuclear Power Department
Windsor, Connecticut

Issued By: F.K. Greub, D.J. McLaughlin Date: 11-14-69
Cognizant Engineer

Approved By: [illegible] Date: 11-20-69
Mechanical Design Supv.

Approved By: [illegible] Date: [illegible]
Mechanical Design Mgr.

Approved By: [illegible] Date: Feb [illegible] 1970
Project Manager

REVISION APPROVALS	REV. 1	REV. 2	REV. 3
Prepared by:	[illegible]	F.K. Greub [illegible]	
Mechanical Design Mgr.	[illegible]	[illegible]	
Project Mgr.	[illegible]	[illegible]	

RECORD OF REVISIONS

REVISION NO. AND DATE	PAGES INVOLVED	PREPARED BY	FUNCTIONAL MANAGER APPROVAL	PROJECT MANAGER APPROVAL
Appendix A 1 6-9-70	Page A1: Para. 1.0 & 1.2	F. L. [illegible]	GHP 27 July 70	
2 7-22-70	Page 2; Para. 2.5.1 & 2.5.2 Page 5; Para. 4.8.2		[illegible]	

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Appendix A Test Requirements

1.0 SCOPE

1.1 General

This specification covers the materials, fabrication, inspection, assembly, testing, cleaning, loading and securing for shipment of a lift rig and associated special tools for handling the reactor internals for the Maine Yankee Reactor plant. The lift rig will handle the following items:

1.1.1 Upper Guide Structure Assembly (UGS)

1.1.2 Core Support Barrel Assembly (CSB)

2.0 APPLICABLE DOCUMENTS

2.1 General

The following documents shall apply as referenced in this specification. If conflict exists between this specification and any referenced applicable document, the provisions of this specification shall govern. CENPD shall be notified of all conflicts prior to proceeding with work.

2.2 Combustion Engineering documents as follows:

2.2.1 Quality Control Program

Quality Control Program Requirements for Suppliers of Nuclear Components and Equipment, as modified by paragraphs 2.2.2, 2.2.3 and 2.2.4 of this specification. WQC 11.1 Rev. B

2.2.2 NPD-MPI-7 "Technical Change Request" in place of PR-13-30-5 where referenced in WQC 11.1, Rev. B.

2.2.3 NPD-MPI-8 "Deviation of Contract Requirements" in place of PR-13-30-6 where referenced in WQC 11.1, Rev. B.

2.2.4 NPD-MPI-6 "Request for Approval or Review" in place of PR-13-30-7 where referenced in WQC 11.1, Rev. B.

2.2.5 Drawings Combustion Engineering, Inc.

Internals Lift Rig Assembly	E-4467-164-101, Sheets 1 & 2
Support Structure Assembly	E-4467-164-102, Sheets 1 & 2
Spreader & Support Structure Assembly	E-4467-164-103
Lift Rig Details	E-4467-164-104
Lift Rig Details	E-4467-164-105

2.3 American Society for Testing Materials documents as follows:

2.3.1 ASTM-A-240-63

Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Fusion-Welded Unfired Pressure Vessels

2.3.2 ASTM-A-269-65

Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

2.3.3 ASTM-A-276-67

Specification for Hot-Rolled and Cold Finished Stainless and Heat Resisting Steel Bars

2.3.4 ASTM Standard E-165-65

Methods for Liquid Penetrant Inspection

2.4 Aerospace Material Specification as follows:

2.4.1 AMS-5643J

Steel Bars, Forgings and Rings, Corrosion Resistant, 17 Cr-4Ni-4 Cu

2.5 American Society of Mechanical Engineers documents as follows:

2.5.1 ASME Boiler and Pressure Vessel Code, Section IX, Qualification Standards for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators, 1968 Edition.

2.5.2 ASME Boiler and Pressure Vessel Code, Section III, Article 6, 1968 Edition.

3.0 ASSIGNMENT OF RESPONSIBILITY

3.1 The Seller's responsibilities shall include:

3.1.1 Furnishing a lift rig and associated tools as defined by the purchase order, this specification, and the drawings referenced therein and thereon. There shall be no deviations from this specification or its references without prior written approval from the Buyer. Any conflict between this specification, the purchase order, and specification listed therein, shall be brought to the attention of the Buyer for clarification prior to any action by the Seller. Approval shall be requested with written documentation in the form of a TCR per Paragraph 2.2.2. This documentation is the responsibility of the Seller.

3.1.2 Procurement of all materials and certification of all materials as required by this specification and the drawings listed in paragraph 2.2.5.

3.1.3 Establishment and maintenance of a Quality Control Program as required per Paragraph 2.2.1.

3.1.4 Performance of all non-destructive & destructive inspection required.

3.1.5 Performing dimensional inspection and all other inspection and Quality Control activities required. The Buyer reserves the right to require the Seller to perform, on a per diem basis, dimensional inspection of components at the site should there be a question of dimensions during on-site receipt, inspection or installation.

3.1.6 Trial assembly and alignment of all components prior to loading and securing.

3.1.7 Testing of the lift rig in accordance with Appendix A.

3.1.8 Cleaning all assemblies and components in accordance with Section 4.6.

3.1.9 Loading and securing the lift rig & associated tools as stated in the purchase order.

3.1.10 Furnishing suitable office space, without charge, and assuring ready entry to all areas of the plant for the Buyer's quality control inspector and authorized representatives when and where work is being performed under the specification. The Seller shall provide the inspectors all reasonable facilities to satisfy them that the material is being furnished in accordance with this specification. All material tests and inspections shall be made at the place of fabrication prior to shipment unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the Seller's plant.

3.2 Combustion Engineering's responsibility includes the following:

3.2.1 Furnishing three prints and a reproducible of drawings referenced in Section 2.2.5.

3.2.2 Furnishing three sets of the CE documents referenced in Section 2.2.

3.2.3 Reviewing, approving or commenting on documents submitted in accordance with this specification. On documents submitted for approval, the Buyer shall respond within two weeks.

4.0 REQUIREMENTS

4.1 General

The fabrication of the end product shall be in accordance with this specification and any referenced specification or documents to the extent specified herein.

4.2 Drawings

4.2.1 The Seller shall produce and be responsible for shop drawings. Shop drawings shall be submitted to the Buyer for information prior to use. Seller-produced shop drawings shall reference the product drawings (2.2.5).

4.2.2 Seller's Procedures and Processes

Any Seller's standard procedures or processes called out on the shop drawing shall be described in detail on the drawing or be referenced to a commercially approved specification including any supplimentary information and shall be submitted to the Buyer for approval.

4.3 Fabrication

4.3.1 Workmanship

High commercial standards of workmanship shall be practiced consistent with industry accepted techniques for this type of equipment. Particular attention shall be given to the elimination of burrs and sharp edges.

4.3.2 Welding

4.3.2.1 The Seller shall be responsible for all weld processes, procedures, qualifications, weld joint geometry and inspection of all welds. All welding procedures and qualification data shall be submitted to the Buyer for approval.

4.3.2.2 Unless otherwise specified on the drawings, butt weld penetration shall be 100 percent and complete fusion of the joint line shall be obtained.

4.3.2.3 Cracks in either the weld or parent metal shall be unacceptable.

4.3.2.4 Weld areas shall be free of undercuts.

4.4. Quality Control and Inspection

4.4.1 The Seller's quality control program shall conform to all requirements of paragraph 2.2.1.

4.4.2 Material inspection shall be performed or witnessed by the Seller and certified to be in accordance with the requirements of applicable documents and specifications.

4.4.3 Nondestructive Inspection

Nondestructive inspection shall be performed as required by the specification and drawings in accordance with the applicable requirements of Article 6 of Section III of the ASME Boiler and Pressure Vessel Code, 1968 Edition.

4.4.3.1 Dimensional inspection shall be performed to the requirements of the drawings and documented per 5.0. The equipment, methods, etc. employed shall conform with paragraph 2.2.1.

4.4.3.2 Weld Inspection

All welds shall be inspected to assure compliance with the applicable specification and drawing requirements.

4.4.3.2.1 Full Penetration Welds

All full penetration welds shall be radiographically examined per Section N-624 of 2.5.2.

All full penetration welds shall be liquid penetrant tested over the surface of root layer, the back cope surface and final surface per Section N-627 of 2.5.2.

4.4.3.2.2 Partial Penetration Welds

All partial penetration welds shall be liquid penetrant tested over the surface of the root layer, each half-inch thickness surface and final surface per Section N-627 of 2.5.2.

4.5 Assembly and Testing

The Seller shall completely assemble the lift rig prior to performing the tests required in Appendix A. The tests and test techniques required by Appendix A shall constitute the acceptance testing for the lift rig.

4.6 Cleaning

The lifting rig shall be free of chips, scale, grease and other contaminants incident to fabrication and assembly, clean to the extent that extraneous material is not visible to the unaided eye and surfaces are free of contaminants that are injurious to material properties. The unit shall be degreased and cleaned prior to shipment.

4.7 Lubrication

Any lubricant other than Neolube shall have prior approval of CENPD.

4.8 Loading and Securing

4.8.1 Procedures for loading and securing the lift rig for shipment shall be submitted to the Buyer for approval. The procedure shall include, as a minimum, the following:

4.8.1.1 Method of protecting against dirt, distortion, wear or damage, loads imparted by transportation carrier, and movement during shipment.

4.8.1.2 The methods and materials used in securing the load for shipment, e.g., types of devices, size of devices, number of devices, how devices are secured, etc.

4.8.1.3 Items not rigidly attached to the lift rig, such as tools and adjustable fasteners shall be shipped disassembled.

4.8.2 Assembly for Shipment

The internals lift rig shall be shipped assembled to the maximum extent possible. Where disassembly is required, all items are to be match marked to assure proper field assembly. Each shipping package shall be capable of passing through an opening 20' dia.

4.8.3 Marking

Each shipping package or structure shall be plainly marked with the Purchaser's order number, Seller's name and identification of the equipment contained.

5.0 REPORTS, RECORDS AND DATA

The following reports, records and data shall be submitted as indicated below and represents the required documentation applicable to delivery of the hardware end item.

	Document	Reference Paragraph No.	Date Required	Purpose
5.1	Certification of Material	4.4.2	Prior to use.	Record
5.2	Weld Procedures & Qualification Data	4.3.2.1	Prior to use.	Approval
5.3	Shop Drawings	4.2.1	Prior to use.	Information
5.4	Seller's Procedures and Processes	4.2.2	Prior to use.	Approval
5.5	Three (3) copies of certification of product conformance to applicable requirements, including a list of all waivers, signed by the Seller's responsible Quality Control representative.	3.1.1	Prior to delivery of end item.	Approval
5.6	Three (3) copies of the test	Appendix A, 4.4.3	Within five (5) days of test completion.	Record
5.7	Three (3) copies of a monthly progress report		Within 15 days of the reporting period.	Information
5.8	Monthly progress photographs consisting of negatives and five (5) each 8 x 10 inch prints.		Within 15 days of the reporting period.	Information
5.9	Three (3) copies of the following:	2.2.1		
5.9.1	Evidence of satisfactory completion of the requirements of Section 4.4 if not included in 5.5 above.		Prior to delivery of end item.	Record
5.9.2	Three (3) copies of all approved Request for Approval or Review (RAR), Deviation Change Request (DCR), and Technical Change Request (TCR).		Prior to delivery of end item.	Record

APPENDIX A

TEST REQUIREMENTS

1.0 GENERAL

The Internals Lift Rig shall be subjected to a static load test.

1.1 The static load test shall be performed to simulate the lifting of the Core Support Barrel Assembly (CSB). This assembly represents the largest load to be lifted by the lift rig. The weight is composed of the weight of the Core Barrel, Thermal Shield, Core Shrouds and Instrumentation Support Structure. The operating load of the CSB is 269,000 lbs., the test load shall be 125% of the operating load equalling 336,250 lbs. This test shall prove the lifting capability of the fully assembled lift rig.

1.2 During the test, all remote handling tools shall demonstrate their working capabilities.

1.3 Structural welds of the primary structure shall be dye penetrant checked to the maximum extent possible without disassembly after completing tests.

1.4 Successful completion of the above tests shall constitute proof of the adequacy of the design and manufacturing techniques and the acceptability of the lift rig.

1.5 Test Procedure Documentation

The Seller shall prepare detailed, step-by-step procedures for the Buyer's approval not less than 6 weeks prior to the start of testing. These procedures shall include the details of the test setup, equipment configuration, test report requirements, instrumentation description, etc., to permit the Buyer's evaluation of the test to be performed.

2.0 LIFT RIG TESTING

2.1 Static Load Test

2.1.1 Requirements

The lifting rig shall be static tested for fifteen minutes with a load of approximately 351,000 lbs. applied vertically from the lifting rig clevis. The actual load shall be calculated from:

Load (L) = 336,000 lbs. + actual Rig Weight + 3,000 lbs.

The rig shall be fully assembled during this test. The rig shall be examined visually and dimensionally for indications of damage.

2.1.2 Test Fixture

All interfaces with the lifting rig pickup studs or spreader beams shall be fabricated of corrosion-resistant steel.

2.1.2.1 Vertical Lift Capability

When assembled, the vertical lift capability shall meet the following requirements:

a. The lift mechanism shall be capable of repeatably locating over the lift rig's geometric center within a 0.1" diameter circle.

b. The lift mechanism shall incorporate a hydraulic lift system with either load cell or hydraulic pressure readout accurate to ± 3,000 lbs. in the required lift force range.

NOTE: A HYDRASET may be employed for this application.

2.1.2.2 Permanent Set Measurement

Measurement of permanent set shall be made with capability of measuring deformations within ± 1/8 inch.

2.1.3 Test Procedure

The following is suggested as a test procedure outline. It shall be the Seller's responsibility to prepare a detailed procedure prior to performing the test.

2.1.3.1 Install the lift rig on the test fixture with its lift bolts. Employ the T-handled, stud installation tool to fasten the three pickup studs with the operator located on the platform 20 feet above the studs.

2.1.3.2 Verify that the lift rig weight is evenly distributed. Record the value at each pickup stud.

2.1.3.3 Proceeding in 10,000 lbs. or less increments, increase the vertical load to 60,000 lbs. Unload in like increments to zero load. Adjust the datum of the deflection measuring equipment. Proceeding in 10,000 lbs. or less increments, increase the up load until the static test load is reached. Record the deflections. Hold this load for 15 minutes.

NOTE: Allow the rig to settle for one minute minimum following each increment. Load cell data and deflection shall be recorded at approximately one minute intervals throughout the test.

2.1.3.4 Relieve the vertical load to 60,000 lbs. and record the deflection.

2.1.3.5 Relieve the vertical force to zero and record the deflection. This deflection (permanent set) shall not exceed 1/8 inch. Disengage the pickup studs utilizing the T-handled stud installation tool.

2.1.3.6 Examine pick-up studs for indication of damage.

COMBUSTION ENGINEERING, INC.

REACTOR: Maine Yankee

CONTRACT NUMBER: 4467

TASK NUMBER: 16-40-00

DESIGN REQUIREMENT NO: 4467-DR-4

SUBJECT: Maine Yankee Internals Lift Rigs

DATE: August 29, 1969

COGNIZANT ENGINEER: F. K. Dressler [signature]

APPROVED BY: [signature]
[signature] 9/24/69

August 29, 1969

Design Requirement 4467-DR-4

Maine Yankee Internals Lift Rig

1.0 PURPOSE

The purposes of the lift rig are the following:

1.1 To provide a structure for lifting the upper guide structure during installation at site and in the course of the refueling operations.

1.2 To provide a structure for lifting the core support barrel assembly during installation at site and during periodic inspection of vessel and core support barrel.

2.0 ENVIRONMENT

The lift rig shall be designed to withstand the effects of complete submergence in the refueling pool water during the refueling operation. During plant operation, the lift rig shall be stored on the operating floor in the containment building atmosphere.

3.0 FUNCTIONAL REQUIREMENTS

3.1 Performance

3.1.1 The lift rig shall be designed to be compatible with the CSB and UGS.

3.1.2 The lift rig shall be designed to support the weight of the core support barrel assembly consisting of the core barrel, thermal shield, core shroud and instrumentation structure. This joint assembly provides the maximum load. The UGS shall not be in the CSB when the latter is handled.

3.1.3 The lift rig shall provide a means of guiding each structure into position on the reactor vessel by utilizing the guide pins located on the vessel flange.

3.1.4 The lift rig shall provide a means of positioning the rig on the UGS structure when the latter is picked up outside the reactor vessel.

3.1.5 The lift rig shall provide a means of positioning the rig on the CSB structure when the latter is picked up outside the reactor vessel.

3.1.6 The lift rig shall provide a working platform for personnel access during the period in which the lift rig is being attached to UGS or CSB. This platform shall remain above water level while positioned over the reactor vessel.

3.1.7 The lift rig shall be designed for passage in a maximum of two sub-assemblies through a 24' square opening in the containment structure.

3.2 Life

The lift rig shall be designed to operate with periodic maintenance for a period of 40 years without loss of function.

4.0 DESIGN CRITERIA AND CODES

4.1 The design loading on all components shall be twice the applied service load.

4.2 Allowable stresses for general primary membrane stress shall be 2/3 yield stress at temperatures to 100°F (Sm). General primary membrane plus bending shall be 1.5 Sm. Shear stresses shall be .6 Sm. Bearing stresses not to exceed yield. Ref: ASME Section III, Appendix II, N414.3; N417-1.

Material	General Primary Membrane	General Primary Membrane plus Bending	Shear	Bearing
Type 304	20,000	30,000	12,000	30,000
17-4 PH(H900)	63,330	95,000	38,000	170,000

4.3 The design load where buckling or instability could occur shall be limited to 2/3 of the critical buckling load or 2/3 of the load to yield, whichever is less.

5.0 REQUIRED INFORMATION

5.1 Design Loads

5.1.1 The design loads for the lift rig (see paragraph 3.1.2) shall be 538,000 pounds.

6.0 RESTRAINTS AND INTERFACES

6.1 Internals

6.1.1 The connections of the lift rig for attachment to the core support barrel shall be compatible with the holes provided in Drawing E-4467-164-014.

6.1.2 The connections of the lift rig for attachment to the upper guide structure shall be compatible with the holes provided in Drawing E-4467-164-032.

6.1.3 The seating area of the lift rig shall be compatible with the geometry of the top surface of the upper guide structure assembly as shown on Drawing E-4467-164-031.

6.1.4 The position of the lift rig guide bushing shall be compatible with the position of the guide pins.

ENCLOSURE 5

Guideline 5 - Lifting Devices (Not Specially Designed)

We have completed our evaluation of slings and their usage as requested by the draft TER Section 2.1.6.C. Our response is as follows:

A. TER Comment

Verify that slings are installed and used in accordance with ANSI B30.9-1971.

Response

Our engineering review has shown that the slings employed at Maine Yankee adequately meet the design guidelines of ANSI B30.9-1971 regarding minimum safety factor of five (5), proof loading (two times rated capacity), end attachments, minimum sling length and construction requirements.

We also evaluated our sling storage areas to verify that protection guidelines against extreme heat, structural damage, deterioration, and corrosion are satisfied.

5. Two areas were found where slings were subject to year round weather exposure. We are currently in the process of providing adequate protection for slings in these areas.

Additionally, our periodic inspection procedure has been extensively revised to satisfy the guidelines of ANSI B30.9-1971. This procedure, 5-202-5 "Periodic Inspection of Synthetic Webbed (Nylon, Polyester, Polypropylene) and Wire slings" is available for review at the plant site. Although not addressed in the TER, Procedure 5-204-5 "Periodic Inspection of Chain Falls and Come-A-Longs" was also revised because we consider these lifting devices to fall in the same general category as slings.

B. TER Comment

Verify that the load used in selecting and marking the proper sling is based on the sum of the maximum static and dynamic loads.

Response

Each of Maine Yankee's wire rope and synthetic webbed slings has an attached tag indicating the sling's load capacity. These tags identify the maximum safe working load capacity that the sling can accommodate and still maintain a minimum safety factor of five (5). This maximum safe working load capacity was established and has been verified by the manufacturer to be the working load which could result from static loading, dynamic loading, or their combination.

6. Additionally, where specific sling lengths and sizes are specified in procedures, we are conducting an evaluation to ensure that the sling sizes currently specified are based on a combination of the maximum static and dynamic load.

C. TER Comment

Verify that slings restricted in use to certain cranes are clearly marked to so indicate.

Response

Maine Yankee currently does not restrict slings to usage on certain cranes.

ENCLOSURE 6

Guideline 6, NUREG-0612, Section 5.1.1(6) - Cranes (Inspections, Testing, and Maintenance)

Maine Yankee has completed an evaluation of its current inspection, testing and maintenance programs. Although the programs met the intent of ANSI B30.2-1976, we felt they did not provide sufficient guidance.

Our crane operating procedure has been updated to incorporate the Frequent Inspection Guidelines of ANSI B30.2-1976 for all six of the non-excluded load handling systems. Additionally, two procedures for the four overhead cranes in this group have been extensively revised to include the guidance found in the ANSI standard for conducting inspections and maintenance. These two procedures are:

5-203-5 - "Inspection and Maintenance of the Reactor Polar Crane (CR-1), Turbine Hall Crane (CR-2), or Fuel Yard Crane (CR-3)."
5-205-5 - "Inspection and Maintenance of the New Fuel Handling Crane (CR-6)."

These procedures are available for review at the plant site. Both of these procedures include the Frequent and Periodic Inspection Guidelines of ANSI B30.2-1976 as they apply to our crane configurations. The procedures also include the necessary precautions to follow when maintenance is required as a result of the inspections. When the cranes are in use, The Frequent Inspections will be performed daily or at the beginning of each shift as appropriate. The Periodic Inspections will be performed annually or at refueling outage intervals as applicable for the cranes concerned.

7. The Maintenance Department is also ensuring that any contracted inspections for the upcoming refueling outage will be done to the standards of ANSI B30.2-1976.

These procedures now also require that if as a result of the inspections, the cranes must be extensively repaired or altered, they shall undergo an operational and rated capacity load test in accordance with Section 2-2.2 of ANSI B30.2-1976.

The Maine Yankee crane inspection, testing and maintenance programs satisfy the requirements of NUREG-0612, Section 5.1.1(6).

ENCLOSURE 7

Guideline 7 - Crane Design (Paragraph numbers correlate to the thirteen points from the TER)

Part A

Maine Yankee's three large overhead cranes, Polar Crane (CR-1), Turbine Hall Crane (CR-2), and Yard Crane (CR-3), were designed by The Whiting Corporation to the standards of EOCI-61. The evaluation of their designs to the thirteen specific points from CMAA-70 specified in the draft Technical Evaluation Report (TER) is provided below: (Each crane's design was evaluated individually, but they are discussed as a group due to design similarity.)

1. Torsional Forces

Our review of the polar, turbine hall, and yard crane designs indicates that no nonsymmetrical girder sections (e.g., channels) were utilized during construction of the crane's bridge girders.

The design requirements of EOCI-61, Article 18 and CMAA-70, Article 3.3.2.1.3, are therefore equivalent.

2. Longitudinal Stiffeners

Two longitudinal stiffeners were used to strengthen each box girder web plate in all three cranes. CMAA-70, Article 3.3.1, states that the h/t ratio of the web plate, when provided with transverse stiffeners or diaphragms is limited by the use of longitudinal stiffeners as follows:

The h/t ratio of the web shall not exceed:

$\frac{h}{t} = c(K+1)\sqrt{\frac{17.6}{fc}}$ nor shall it exceed M

For Two stiffeners C=243 and M= 564

$$K= \frac{ft}{fc}= \frac{16.0 \text{ k.s.i.}}{16.0 \text{ k.s.i.}}$$

$$\frac{h}{t} = (243)\ (1+1)\sqrt{\frac{17.6}{16.0}}$$

$$\frac{h}{t} = 509$$

This is the maximum allowed h/t ratio in accordance with CMAA-70. The web plate dimensions and h/t ratios for each crane follow:

	Web Plate h,t	h/t Ratio
Polar Crane (CR-1)	9'2" X 3/8"	293.3
Turbine Hall Crane (CR-2)	8'8" X 5/16"	332.8
Fuel Yard Crane (CR-3)	5'2" X 5/16"	198.4

In all cases, the h/t ratios are far less than the maximum allowable.

The longitudinal stiffeners in each crane consist of two angles welded to the inside face of each of the two box girder web plates. All are fabricated from ASTM-A-131C normalized steel and run nearly the length of the girder spans. A description of the longitudinal stiffeners and their location for each crane follows:

Polar Crane - Each longitudinal stiffener is an angle 8" X 8" by 1" thick. They are located 2'9" and 6'2" from the compression or top flange.

Turbine Hall Crane - These longitudinal stiffeners are of different sizes. The top one is an angle 5" X 5" by 1/4" thick and is located 2'4" from the compression or top flange. The lower stifferner is an angle 2" X 2" by 1/4" thick which is located 5'6" from the top flange.

The Fuel Yard Crane - These stiffeners are both angles 2" X 2" by 1/4" thick. The upper one is 1'8" from the compression or top flange and the lower one is 3'5" from the top flange.

The design of each crane is considered adequate for its intended use.

3. Allowable Compressive Stress

CMAA-70, Article 3.3.3.1.3, requires that the ratio of the distance between web plates to the thickness of the top cover plate (b/c ratio) be less than or equal to 38. The b/c ratio calculations for each of the cranes follows:

b = distance between girder web plates (inches)
c = girder top cover plate thickness (inches)

polar crane: $\frac{b}{c} = \frac{38.25 \text{ in}}{2.75 \text{ in}} = 13.91$

turbine hall crane: $\frac{b}{c} = \frac{29.0 \text{ in}}{1.875 \text{ in}} = 15.47$

yard crane $\frac{b}{c} = \frac{10.0 \text{ in}}{1.0 \text{ in}} = 10.0$

The welded box girder b/c ratio for each crane is substantially less than 38 and therefore complies with the restrictive CMAA-70, Article 3.3.3.1.3 guidelines.

4. Fatigue Considerations

All three cranes were designed and fabricated in accordance with EOCI-61 (Class A Service) which is defined as standby service, or very infrequent use for expensive loads. CMAA-70, Article 3.3.3.1.3, defines loading cycles relating to Class A Service Cranes as being in the range of 20,000-100,000 cycles. Maine Yankee is unable to determine if fatigue failure was considered in the original crane design, but considers that this is immaterial since the anticipated number of loading cycles at or near rated load is estimated to be far less than 20,000 cycles. An estimate of the number of lifts over the life of the plant which approach crane capacity for each crane is as follows:

Polar Crane	Less than 200
Turbine Hall Crane	Less than 2000
Yard Crane	Less than 100

This estimate might be revised upward if fuel reprocessing were available, and spent fuel shipping casks were utilized.

Since all three cranes are used infrequently, we feel that performing a reanalysis of the cranes design to incorporate realistic load cycles is not justified.

5. Hoist Rope Requirements

Since EOCI-6I neglected to specifically require adding the weight of the lower block and hook to the rated load to determine safety factors, we have taken the largest load currently handled by each crane to determine the safety factor now realized.

For the polar crane, each main hoist is rated at 180 ton capacity. The weight of the bottom block and hook is about 13,000 lbs. The current maximum single hoist lift made is the core support barrel assembly at 269,000 lbs. The lifting rig weighs about 15,000 lbs. The total weight of the lift is 297,000 lbs or 148.5 tons.

The safety factor for this lift is as follows:

hoist rope rated load capacity = 180 tons
hoist rope safety factor at rated load = 5
maximum rope capacity = 180 tons X 5 = 900 tons

$$\text{actual safety factor realized during the 148.5 ton lift} = \frac{900 \text{ tons}}{148.5 \text{ tons}} = 6.06$$

The turbine hall crane was specifically designed to lift the generator rotor which weighs about 288,000 lbs. The weight of the slings used to handle the rotor totals approximately 2,400 lbs. The load block for this crane weighs approximately 8,000 lbs, or 4 tons. The total weight of the lift is about 298,000 lbs or 149.2 tons. This crane, normally rated at 125 tons was specially designed with an overload capability to perform this lift. The purchase specification states that "the weight of the rotor lifting accessories is estimated as approaching but not exceeding the 312,500 lb overload capability of the 125 ton rated capacity crane. Accurate weights of lifting accessories will be determined later by the turbine generator manufacturer." The generator rotor assembly is only handled about every third refueling outage. This lift is performed only with the plant shutdown and cooled down when the demands on the PCC and SCC systems are far less critical. The next largest load handled during refuelings would be the low pressure turbine rotors which weigh about 100 tons each. This load results in a rope safety factor of about 6.0.

The actual rope safety factor follows:

hoist rope rated load capacity = 125 tons
hoist rope safety factor at rated load = 5
maximum rope capacity = 125 ton x 5 = 625 tons

actual safety factor realized during the 149.2 ton lift: $= \frac{625 \text{ tons}}{149.2 \text{ tons}} = 4.2$

The main hoist utilized by the fuel yard crane also has a capacity of 125 tons. This crane does not currently handle loads which approach the capacity of the crane. The crane was designed to handle spent fuel shipping casks which are estimated to weigh approximately 200,000 lbs loaded, inclusive of the handling device. The actual cask has not been identified since shipment of spent fuel is not foreseen in the immediate future. The actual total weight of the lift, including the lower block assembly, is about 208,000 lbs or 104 tons. The actual rope safety factor for this lift is as follows:

hoist rope rated load capacity = 125 tons
hoist rope safety factor at rated load = 5 tons
maximum rope capacity = 125 tons x 5 = 625 tons

actual safety factor 104 ton lift realized $= \frac{625 \text{ tons}}{104 \text{ tons}} = 6.0$

6. Drum Design

The drums for all three cranes were designed and manufactured to the best engineering principles available at the time of construction (1968-1969). Conversations with the manufacturer have indicated that it is likely that the standards of CMAA-70, Article 4.4.1, were probably met because Whiting Corporation was probably aware of the imminent code changes to be made under CMAA-70. The only issue in this area is whether or not the combined crushing and bending loads were used to design the drums versus the EOCI-61 standard of maximum bending and crushing loads. An overload lift of approximately 445 tons was successfully made during plant construction to install the reactor vessel. We consider that this is acceptable proof that the polar crane was adequately designed.

7. Drum Design

The available design drawings and instruction books for all three cranes do not specify drum groove depth and pitch. The manufacturer has indicated to us that all three cranes comply with CMAA-70 in that drum groove depth is 3/8 x nominal rope diameter and pitch is nominal rope diameter + 1/8".

8. Gear Design

Since EOCI-61 provides no guidance on gearing horsepower ratings and allowable horsepower, this information is not available in the instruction books or design drawings. This information has been requested of the crane manufacturer.

9. Bridge Brake Design

Neither cab-control, nor cab-on-trolley configurations were used on any of the three cranes. The cab is permanently attached to the bridge girders, therefore CMAA-70, Article 4.7.2.2, is not considered applicable.

10. Hoist Brake Design

Our analysis of hoist brake design indicates that the hoist holding brakes for each crane exceed the standards in CMAA-70, Article 4.7.4.2. Each crane employs an identical combination of brakes. Each hoisting mechanism has two independent holding brakes which possess a rated braking torque of no less than 150% of the motor's full load torque. These brakes are of the spring set, electrically released, double shoe type, and automatically stop hoist movement whenever the hoist motor is de-energized. Safety is maximized through redundancy by incorporating two sets of hoist holding brakes on both the main and auxiliary hoist motors. Furthermore, a speed control load brake of the eddy current type is provided which prevents load acceleration, and limits load speed regardless of load size.

11. Bumpers and Stops

The polar crane, since it is capable of 360° of travel, does not employ bridge bumpers. The polar crane has maximum operating speeds of 3 ft/min (main hoists), 20 ft/min (auxiliary hoist), 50 ft/min (bridge speed at polar rail), and 25 ft/min (trolley speed on bridge girders).

The polar crane's trolley and bridge operating mechanisms each have four operational modes; stop and three steps of speed regulation. Crane operations are sometimes required near the end of trolley travel at the bridge extremes. However, simultaneous bridge or trolley travel during hoisting operations is avoided. The polar crane's trolley frames possess heavy duty bumpers, employed to distribute impact loads to the frame structure instead of the trolley wheel faces. These bumpers were designed and built to resist impacts against the corresponding railway stops in accordance with good engineering practices available at the time. CMAA-70, Article 4.12.3, states that trolley bumpers shall be capable of stopping the trolley at an average deceleration rate of 4.7 ft/sec^2 or less. These values are not known for our cranes, but we ensure our cranes are not operated under load at substantial bridge or trolley speed near the end of travel. This is controlled administratively in our procedures and in our crane operator training program. We conclude that the polar crane meets the intent of CMAA-70 in this area.

The turbine hall crane and fuel yard crane are designed and operated to the same guidelines specified above. The major difference in this particular area is that these cranes employ bridge bumpers and stops as they are not polar in design.

Maximum operating speeds for these two cranes are 3 ft/min (main hoists), 20 ft/min (auxiliary hoist), 50 ft/min (bridge) and 40 ft/min (trolley speed on bridge girders). These cranes are also operated to the same guidelines as the polar crane and are occasionally required to make heavy lifts in proximity to bridge and trolley extremes. The turbine hall and fuel yard cranes employ heavy duty trolley and bridge girder bumpers, employed to distribute impact loads to the crane structure instead of the trolley and bridge wheel faces. CMAA-70, Articles 4.12.1 and 4.12.3, state that bridge and trolley bumpers shall be capable of stopping the bridge and trolley at an average deceleration rate of no more than 3.0 ft/sec^2 and 4.7 ft/sec^2, respectively. The actual design criteria for the crane bumpers are not available for these cranes either.

In all cases the installation of the crane bumpers comply with CMAA-70 in that attachment bolts are situated such that they are not subject to any shear stresses. Since crane operation near the end of the bridge trolley travel is performed at slow speeds, as specified in procedures and in our crane operator training program, the bumpers and railway stops are considered adequate.

12. Static Control Systems

    All three of the Whiting cranes utilize only magnetic motor controls in accordance with EOCI-61 specifications. The guidelines established under EOCI-61, Article 36, regarding magnetic controls are equivalent to those codified under CMAA-70, Article 5.4.5. Therefore, Maine Yankee's cranes adequately conform to the requirements of CMAA-70.

13. Restart Protection

    CMAA-70, Article 5.6.2, regarding crane electrical controls, addresses crane motor restart protection and the essential design criteria necessary to ensure crane motor de-energization. All of the operator controls employed on the polar, turbine hall, and fuel yard cranes are spring return controls. These safety designed controls prevent automatic crane operation, and necessitate manual control of the crane by the crane operator. We feel that this provides adequate crane motor restart protection, and that the design requirements of CMAA-70, Article 5.6.2 are substantially complied with.

Part B - NEW FUEL HANDLING CRANE (CR-6)

The new fuel handling (CR-6) crane was designed and constructed to the standards of EOCI-61. The following evaluation of the thirteen specific areas serves to demonstrate equivalency to the thirteen CMAA-70 criteria specified in the TER:

1. Torsional Forces

    Our review of the crane's design shows that nonsymmetrical girder sections (e.g., channels) were not used during construction of the crane's bridge girders. The girders employed are standard wide flange beams (24" - WF - 76#). The design in this area is equivalent to CMAA-70, Article 3.3.2.1.3.

2. Longitudinal Stiffeners

    Since this crane does not utilize welded box girders, longitudinal stiffeners were not used during fabrication. Therefore, the requirements of CMAA-70, Article 3.3.3.1, are not applicable in this case.

3. Allowable Compressive Stress

CMAA-70, Article 3.3.3.3, specifies maximum compressive stresses of 17.6 ksi for single web girders (e.g., wide flange beams), and a maximum vertical deflection of 0.00125 inches per inch of span. The calculations are as follows:

Compressive Stress:

$$C.S. = \frac{12,000}{Id/Af} \quad \text{with a maximum of 17.6 ksi}$$

where - I = span in inches
- Af = area of compression flange in square inches
- d = depth of beam in inches

Actual values: I = 44'6" = 534.0 in
Af = 8.98" X .682 = 6.12 in.^{2}
d = 23.91 in

C.S. 12,000 ÷ (534)x(23.91) ÷ 6.12 = 5.75 ksi

∴ Compressive stress is satisfactory

Maximum allowable deflection (MAD): 0.00125 inches/inch of span

MAD = (0.00125 inches/inch of span)(534.0 inches of span)

MAD = 0.668 inches

Actual deflection = 0.05 inches

∴ Deflection is satisfactory

Therefore, this Crane (CR-6) adequately complies with the design guidelines established in CMAA-70, Article 3.3.3.3.

4. Fatigue Considerations

Fatigue failure was not considered in the design of CR-6. However, the number of loading cycles at or near rated load is estimated to be far less than 20,000 cycles. The safety factor designed into the crane at the rated load of five tons is five. The largest load identified that this crane may be required to handle is a concrete floor slab which weighs about 7,800 lbs. Since the number of cycles expected for this crane does not fall into the Class A service category (20,000-100,000 cycles), CMAA 70, Article 3.3.3.1.3 does not apply.

5. Hoist Rope Requirements

The rated load capacity of this crane is 5 tons or 10,000 lbs. The weight of the lower block and hook assembly is about 80 lbs. The ratio of the lower block to the rated load is 1 to 125, which is not considered to seriously degrade safety margins. The largest load currently identified for this hoist is a concrete floor slab weighing about 7,800 lbs. With the lower block, this lift is about 7,880 lbs. The crane safety factor for this lift is as follows:

hoist rope rated load capacity = 10,000 lbs.
hoist rope safety factor at rated load = 5
maximum rope capacity = 5 x 10,000 lbs = 50,000 lbs.
maximum identified load = 7,880 lbs.

actual safety factor realized during the 7,880 lb. lift: $= \frac{50,000 \text{ lbs}}{7,880 \text{ lbs}} = 6.34$

Based on this analysis, this crane is considered to meet the intent of CMAA-70, Article 4.2.1.

6. Drum Design

We have verified with the crane manufacturer that the drum design was based on the combination of crushing and bending loads. Dwight Foote Inc.'s EOCI-61 design was equivalent to CMAA-70, Article 4.4.1. Consequently, the design was not required to be changed when CMAA-70 was published.

7. Drum Design

The drum groove depth for this crane is equal to one half the rope diameter of 7/16" and the groove pitch equals 9/16". The new fuel crane, therefore, conforms to the recommendations of CMAA-70, Article 4.4.3.

8. Gear Design

The crane manufacturer has verified for us that their design under EOCI-61 was equivalent to CMAA-70, Article 4.5. Consequently, the design used in this crane was not changed after CMAA-70 was published.

9. Bridge Brake Design

This overhead crane is not cab operated, but is controlled entirely from floor level through a ganged pendant type pushbutton controller unit, independently suspended from the crane bridge in a trolley type arrangement. Therefore, CMAA-70, Article 4.7.2.2, does not apply.

10. Hoist Brake Design

CMAA-70, Article 4.7.4.2, requires that electrically and mechanically operated hoist holding brakes have torque ratings no less than 125% and 100% of the hoist motor torque, respectively. The new fuel crane utilizes two independent hoist holding brakes, one of which is mechanically and the other is electrically operated. Each of these brakes possesses a rated braking torque of no less than 150% of the motor's full load torque. As a result, the design guidelines of CMAA-70 are easily satisfied in this area.

11. Bumpers and Stops

The new fuel crane's bridge operating mechanism has three operational modes, stop and two steps of speed regulation, while the trolley has two operational modes, stop and one step of speed regulation. Maximum operating speeds for this crane are 20 ft/min (main hoist), 20 ft/min (bridge) and 20 ft/min (trolley). Crane operation under load near the end of the bridge or trolley travel is allowed, but is performed at slow speeds as specified in administrative controls and in our crane operator training program. The trolley and bridge bumpers are installed to distribute impact loads to the crane structure instead of the trolley and bridge girder wheel faces. Furthermore, the bumpers are attached to structural members such that the attachment bolts will not be subjected to any shear stresses. Although the actual deceleration values are not known, the crane manufacturer has verified that the design of the bumpers and stops used on this crane are equivalent to the CMAA-70 criteria.

12. Static Control Systems

This crane utilized magnetic motor controls only, which were in accordance with EOCI-61, Article 36. This adequately conforms to the design guidelines delineated under CMAA-70, Article 5.4.5.

13. Restart Protection

Crane motor controls are of the "dead man" type with spring return to "off" position. The crane is controlled by push buttons incorporated in a ganged pendant controller suspended by a strain free cable.

Adequate restart protection exists and the design criteria of CMAA-70, Article 5.6.2 are satisfied.