GAI REPORT 2364

CONTROL OF HEAVY LOADS AT VIRGIL C. SUMMER NUCLCAR STATION

Initial Issue - October 30, 1981

Revision 1 - June 25, 1984

PREPARED BY

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1.0 INTRODUCTION

This report responds to a request by the United States Nuclear Regulatory Commission (NRC) to all Licensees of Operating Plants, Applicants for Operating Licenses, and Holders of Construction Permits to review their controls for the handling of heavy loads to determine the extent to which their facilities satisfy the recommendations as reported in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

The procedures to implement the recommendations of NUREG-0612 were outlined in enclosures that accompanied a letter dated December 22, 1980, by Darrell G. Eisenhut. This letter requires a report, with information submitted at a six-month and a nine-month interval. The six-month submittal responded to the identification of the extent of potentially hazardous load-handling operations at a site and the extent of conformance to appropriate load-handling guidance. The nine-month submittal responds to the requirement of demonstrating that adequate measures have been taken to ensure that the likelihood of a load drop which might cause damage to either fuel or components necessary for safe shutdown or decay heat removal is extremely small; or that the estimated consequences of such a load drop will not exceed the limits set by the evaluation criteria of NUREG-0612.

The review that is addressed in this report follows the guidelines as set forth in Darrell G. Eisenhut's December 22, 1980 letter, Enclosure 3, and Section 5 of NUREG-0612. The guidelines that are outlined in these references, and followed in this report, require the evaluation of overhead handling systems that handle heavy loads. A heavy load is defined as a load heavier than a spent fuel assembly and its associated handling tool. At the Virgil C.

Summer Nuclear Station, this is defined as a load greater than 2500 pounds. The guidelines for this report are:

a. Identify all overhead handling devices from which a load drop could cause damage to fuel or components necessary for safe shutdown or decay heat removal.

b. Justify the exclusion of any overhead handling device that handles heavy loads by verifying that it is a single-failure-proof handling system or that there is sufficient physical separation from the point of impact and any component necessary for safe shutdown, decay heat removal, or spent fuel storage and fuel in the reactor vessel.

c. Demonstrate, by analysis, that any overhead handling device not excluded in item b. adheres to Criteria I, II, III, and IV as outlined in Section 5.1 of NUREG-0612.

d. Define safe load paths and procedures for the handling of heavy loads to minimize the possibility of the impact of a heavy load dropped onto spent fuel storage racks, spent fuel in the reactor vessel, safe shutdown equipment, or decay heat removal equipment.

e. Verify degree to which overhead lifting devices comply with either ANSI B30.9-1971, Slings, or ANSI N14.6-1978, Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More for Nuclear Material.

f. Verify cranes are designed according to CMAA Specification 70 and ANSI B30.2-1976, Overhead and Gantry Cranes, Chapter 2-1.

g. Verify cranes are inspected, tested, and maintained in accordance with ANSI B30.2-1976, Overhead and Gantry Cranes, Chapter 2-2.

h. Review crane operators' training, qualifications, and conduct in reference to ANSI B30.2-1976, Overhead and Gantry Cranes, Chapter 2-3.

Revision 1 of GAI Report 2364 incorporates changes resulting from comments made by the NRC through EG&G Idaho, Inc., Report EGG-HS-6371. This issue is also intended as a general update to the original report which was prepared during the construction of the Virgil C. Summer Nuclear Station. Items revised include the addition of piping, valves, and conduit into the determination of safe load paths; dynamic analysis of lifting devices; and the addition of several small hoists. A field walkdown of all the hoists at the Virgil C. Summer Nuclear Station was conducted on April 2 through 5, 1984, to determine the locations of the safe shutdown/decay heat removal piping, valves, cable trays and conduit previously excluded from the study. Several items of concern were discovered during the re-evaluation and are currently under investigation. These items deal mainly with safe load paths and are identified within the body of the report. Revision 2 of Report 2364 will be issued at the completion of these investigations.

Table 1-1 lists the general information for each overhead handling device at the Virgil C. Summer Nuclear Station.

TABLE 1-1

OVERHEAD HANDLING DEVICES, VIRGIL C. SUMMER NUCLEAR STATION

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight	Figure No.	Location
XCR-1	Reactor Cavity Manipulator Crane	Spent and New Fuel Assembly and Handling Tool	2500 lbs	5, 6, & 7	463' el. Reactor Building
XCR-2 & XCR-16	Spent Fuel Pit Bridge Crane	Spent Fuel Assembly and Handling Tool	2500 lbs	5 & 7	463' el. Fuel Handling Building
XCR-3, XCR-45, & XCR-49	Fuel Handling Building Crane	a) New Fuel Shipping Container and Vendor-Supplied Lifting Device	6600 lbs	5 & 7	463' el. Fuel Handling Building
		b) Spent Fuel Shipping Cask and Vendor-Supplied Lifting Device	(later)		
		c) Fuel Transfer Canal Gates and 2 Part Sling Cable	4500 lbs		
		d) Irradiated Specimen Shipping Cask and Vendor-Supplied Lifting Device	(later)		

TABLE 1-1 (Cont'd)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight	Figure No.	Location
XCR-4	Reactor Building Polar Crane	a) CRDM Missile Shields	54,000 lbs	5, 6, & 7	552' el. Reactor Building
		b) Reactor Vessel Head Assembly	268,000 lbs		
		c) Reactor Vessel Head Lifting Rig	21,000 lbs		
		d) Upper Internals and Internals Lifting Rig	92,000 lbs		
		e) Lower Internals and Internals Lifting Rig	268,000 lbs		
		f) Internals Lifting Rig	19,000 lbs		
		g) ISI Tool and Westinghouse-Supplied Lifting Device	20,000 lbs		
		h) RCP Internals	48,000 lbs		
		i) RCP Casing and Lifting Beam	52,000 lbs		
		j) RCP Motor	77,140 lbs		
		k) RV Studs, Nuts, and Washer Stand	8500 lbs		
		l) Equipment Bridge	4000 lbs		
XCR-17	Turbine Building Crane	General Electric Turbine Generator and Associated Power Plant Equipment	Less than max. capacity	7 & 11 (10) *	463' el. Turbine Building

*This building does not contain any safe shutdown or decay heat removal equipment.

TABLE 1-1 (Cont'd)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight	Figure No.	Location
XCR-18	10-ton Electric Cable Hoist and Trolley	Power Plant Equipment	Less than max. capacity	4 (2 & 3)	436' el. Auxiliary Building
XCR-19	7.5-ton Electric Cable Hoist and Trolley	Power Plant Equipment	Less than max. capacity	6 (2,3,4,&5)	485' el. Auxiliary Building
XCR-20A & XCR-20B	5-ton Hand Chain Hoist and Trolley	a) RHR Pumps b) RHR Pump Motor	4400 lbs 3200 lbs	2	374' el. Auxiliary Building
XCR-21A & XCR-21B	5-ton Manual Chain Hoist and Trolley	a) RB Spray Pumps b) RB Spray Pump Motors	5400 lbs 5880 lbs	2	374' el. Auxiliary Building
XCR-54A, XCR-54B & XCR-54C	5-ton Manual Chain Hoist and Trolley	SI Charging Pumps a) Pump b) Base c) Gear d) Motor	 7500 lbs 6000 lbs 2100 lbs 6700 lbs	2	388' el. Auxiliary Building
XCR-23A & XCR-23B	2-ton Manual Chain Hoist and Trolley	a) RB Spray Sump Isolation Valve Protective Chamber Tops b) SI Recirculation Sumps Isolation Valves Protective Chamber Tops	3000 lbs 3000 lbs	3	412' el. Auxiliary Building

TABLE 1-1 (Cont'd)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight	Figure No.	Location
XCR-24	8-ton Hand Chain Hoist and Trolley	Main Steam Stop Valves	Less than max. capacity	11 *	463' el. Turbine Building
XCR-25A, XCR-25B, XCR-25C, & XCR-25D	10-ton Hand Hoist and Trolley	Main Condenser Water Boxes (2 Cranes per Water Box)	26,500 lbs	9 *	412' el. Turbine Building
XCR-26	4-ton Hand Chain Hoist and Trolley	Feedwater Booster Pumps a) Pump b) Driver c) Bedplate	 7800 lbs 8500 lbs 5900 lbs	9 *	412' el. Turbine Building
XCR-27	5-ton Electric Cable Hoist and Trolley	Power Plant Equipment	Less than max. capacity	4	436' el. Intermediate Building
XCR-28	2-ton Electric Cable Hoist and Trolley	Chemical Storage Containers	Less than max. capcity	1 *	Water Treatment Building
XCR-29A, XCR-29B	2-ton Hand-Operated Hoist and Trolley	Generator Parts	Less than max. capacity	4	Diesel Generator Building
XCR-31	1/2-ton Hand Chain Hoist and Trolley	Under heavy load limit		4	436' el. Intermediate Building

*This building does not contain any safe shutdown or decay heat removal equipment.

TABLE 1-1 (Cont'd)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight	Figure No.	Location
XCR-33	2-ton Hand Chains Hoist and Trolley	Turbine-Driven Emergency Feedwater Pump		3	412' el. Intermediate Building
		a) Pump	3000 lbs		
		b) Base	2400 lbs		
		c) Driver	3260 lbs		
XCR-34	1-ton Electric Cable Hoist and Trolley	Under heavy load limit	N/A	4	Reactor Building Tendon Access Gallery
XCR-36	20-ton Electric Cable Hoist and Trolley	Radwaste Facility Equipment	Less than max. capacity	4	436' el. Drumming Station
XCR-40	5-ton Hand Chain Hoist and Trolley	Main Steam Isolation Valve Subassemblies	4500 lbs	4	436' el Intermediate Building
XCR-40A, XCR-40B, XCR-40C	10-ton Hand Chain Hoists and Trolleys	Main Steam Isolation Valve Subassemblies	4500 lbs	4	436' el. Intermediate Building
XCR-42	10-ton Bridge Crane	Hot Machine Shop Applications	Less than max. capcity	4 *	Hot Machine Shop
XCR-43	10-ton Bridge Crane	Service Building Applications	Less than max. capacity	1 *	Service Building

*This building does not contain any safe shutdown or decay heat removal equipment.

TABLE 1-1 (Cont'd)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight	Figure No.	Location
XCR-46	3-ton Bridge Crane	a) Concrete Plugs b) Filters and Cartridges c) Storage Casks	1770 lbs Negligible 2590 lbs	5	463' el. Auxiliary Building
XCR-47	10-ton Bridge Crane	Hot Machine Shop and Low Level Waste Storage	Less than max. capacity	4	436' & 447' el. Drumming Station
XCR-48	1-1/2-ton Hand Chain Hoist and Trolley	Instrument and Service Air Compressors	Less than max. capacity	9 *	412' el. Turbine Building
XCR-51 & XCR-50	10-ton Bridge Crane and Hoist	a) Service Water Traveling Screen Parts b) Service Water Pump c) Service Water Pump Motor	Less than max. capacity 14,000 lbs 15,650 lbs	8	436' el. Service Water Intake Screen and Pumphouse
XCR-53A, XCR-53B, XCR-53C	2-ton Twin Hook Extension Hoists	CRDM Cable Support Structures	N/A	5	475' el. Reactor Building
XCR-55	1-ton Jib Crane	Under heavy load limit	N/A	5	463' el. Reactor Building

*This building does not contain any safe shutdown or decay heat removal equipment.

TABLE 1-1 (Cont'd)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight	Figure No.	Location
XCR-56	1-ton Jib Crane	Under heavy load limit	N/A	5	463' el. Reactor Building
XCR-57	1-ton Jib Crane	Under heavy load limit	N/A	5	463' el. Reactor Building
XCR-58	1-ton Jib Crane	Under heavy load limit	N/A	5	463' el. Reactor Building
XCR-60	1/2-ton Hand Chain Hoist and Trolley	Under heavy load limit	N/A	5	485' el. Auxiliary Building
XCR-61	1/4-ton Jib Crane	Under heavy load limit	N/A	4	457'-0" el. Control Building
XRW-11	1-ton Jib Crane	Under heavy load limit	N/A	4	436' el. Drumming Station
XRW-13	3-ton Jib Crane	a) Concrete Plugs b) Spent Filters and Cartridges c) Storage Casks d) Lifting Beam	1770 lbs Negligible 2590 lbs 1350 lbs	4	436' el. Drumming Station
	Reactor Building Equipment Access Hatch Door	Equipment Hatch	N/A	5	463' el. Reactor Building

2.0 SUMMARY

This report presents the results of the study areas in the Virgil C. Summer Nuclear Station where an inadvertent drop of a heavy load from an overhead handling device could cause damage to components necessary for the plant's safe shutdown or decay heat removal. Areas where an inadvertent drop could cause a radioactive release that could result in significant offsite doses were also included. The study has shown that the Virgil C. Summer Nuclear Station layout does not present a significant number of potential problems due to the handling of heavy loads with overhead handling devices.

Safe load paths have been identified for each crane or hoist, where physically possible, to minimize the chances of an inadvertent heavy load drop and its consequences. The safe load paths are permanently marked, where practical. Riggers and operators receive training to fully understand and adhere to the safe load path concept.

In addition to the safe load paths, special operating procedures have been prepared for overhead handling devices in the plant and where possible, incorporated into standard component maintenance procedures to define the handling of heavy loads by cranes and hoists. These procedures are incorporated into the plant's operator and rigger training program.

The following paragraphs summarize the items identified in this report for which further action is required.

XCR-19

Institute special procedures for the handling of heavy loads in the area of the cable trays at elevations 471'-11" and 476'-6".

XCR-23B

Place a trolley stop at a distance 5'-10" from the north end of the monorail.

XCR-27

1. Institute administrative procedures to protect the ductwork and piping at elevations 426'-10" and 424'-0".

2. Add protective guards for the cable tray at elevation 420'-0" and the chilled water risers at elevation 436'-0".

3. Investigate the ability of the floor at the south edge of the hatchway to resist the penetration of a 5 ton load.

XCR-46

Investigate the ability of the floor directly beneath the hoist to resist the penetration of a 3 ton load.

XCR-51

Investigate the ability of the floor directly beneath the hoist to resist the penetration of a 10 ton load.

Lifting Devices

Incorporate the recommendations listed in Section 4.2 into the applicable maintenance procedures.

3.0 IDENTIFICATION OF OVERHEAD HANDLING DEVICES

This study documents the review of overhead handling devices at the Virgil C. Summer Nuclear Station that can handle a heavy load, defined as any load heavier than a spent fuel assembly and its handling tool. The following sections are descriptions of each overhead handling device, crane, and hoist at the Virgil C. Summer Nuclear Station.

Each overhead handling device has been reviewed, and each individual description includes the type of crane or hoist being reviewed, the type of handling device being employed, and the items that the device was designed and designated to handle. The Virgil C. Summer Nuclear Station was then reviewed, in reference to the overhead handling devices, by a physical inspection of the plant and by studying the up-to-date layout drawings. The various overhead handling devices are shown on Figures 1 through 11. The figures indicate each handling device's proximity to any components necessary for safe shutdown or decay heat removal, and to any area were an inadvertent drop of a heavy load may cause a radioactive release, such as the spent fuel pool or reactor vessel. The safe shutdown and decay heat removal components considered in this study include piping, valves, and electric cable.

A safe load path for every overhead handling device is defined where physically possible to do so. When a crane or hoist is operated within the confines of its defined safe load path, it would be unlikely that an inadvertent drop of a heavy load would cause damage to any component necessary for the safe shutdown of the plant, decay heat removal, or fall into an area that could cause a radioactive release. The safe load path is then defined as an area within the crane's or hoist's range where none of the above components are located. The only exceptions are those necessary components serviced uniquely by a crane or hoist for maintenance. The overhead handling device will not be operated until after these components have been isolated from their system and after their function has been assumed by a redundant component. In areas where the only separation between a dropped heavy load and an item that needs to be protected is a structural floor, a study has been conducted according to item 2, Section 5.1.5 of NUREG-0612 and Attachment 4 to Enclosure 3 of D. G. Eisenhut's December 22, 1980 letter, in order to demonstrate compliance to Criteria III and IV of Section 5.1 of NUREG-0612. The results and evaluation of this study are presented in Appendix A.

Safe load paths for some cranes and hoists could not be defined. In those cases procedures have been generated and design modifications have been made where necessary to minimize the chances and the consequences of an inadvertent load drop. Procedures for overhead handling devices have been developed to dictate the operation and use of the device.

Table 3-1 lists the impact area, the designated heavy loads and weights for each overhead handling device, and the safe shutdown/decay heat removal equipment that could be effected for each overhead device. Table 3-1 also lists a hazard elimination category, which according to Enclosure 3, Figure 1 of D. G. Eisenhut's December 22, 1980 letter are:

a. Crane travel for this area/load combination prohibited by electrical interlocks or mechanical stops,

b. System redundancy and separation precludes loss of capability of system to perform its safety-related function following load drop in this area,

c. Site-specific considerations eliminate the need to consider equipment combination,

d. Likelihood of handling system failure for this load is extremely small (i.e., Section 5.1.6 NUREG 0612 satisfied), and

e. Analysis demonstrates that crane failure and load drop will not damage safety-related equipment.

In addition to the hazard elimination categories listed in D. G. Eisenhut's letter, the following categories are included:

f. Load is less than the minimum required by NUREG-0612.

g. Administrative procedures will be instituted to govern this hazard.

h. Protective devices to be installed.

3.1 Reactor Cavity Manipulator Crane (XCR-1)

Reactor Cavity Manipulator Crane XCR-1 is located on elevation 463' directly above the reactor vessel cavity. There is no safe load path that can be defined for this crane. The Reactor Cavity Manipulator Crane is shown on Figures 5, 6, and 7.

The Reactor Cavity Manipulator Crane is supplied by the Stearns and Rogers Corporation for Westinghouse Electric Corporation. The bridge crane is supplied by Dwight Foote, Inc. and the hoist by P&H Harnischfeger Company. The hoist and crane have a 2 ton capacity and utilize a handling tool to handle the new and spent fuel assemblies. The crane is an electric motorized bridge crane, and the hoist is an electric cable hoist. Both the crane and hoist are operated from a remote station. The crane and hoist are both designed in accordance with CMAA Specification 70 and ANSI B30.2, Chapter 2-1.

The Reactor Cavity Manipulator Crane is designated solely for the handling of fuel assemblies during refueling of the reactor. Crane operation is governed by Westinghouse Refueling Procedures. By definition of a heavy load, this overhead handling device does not handle heavy loads and can be excluded from further study or concern.

3.2 Spent Fuel Pool Bridge Crane (XCR-2 and XCR-16)

The Spent Fuel Pool Bridge Crane is XCR-2. Attached to it is the Protex Cable Reel XCR-16, which is excluded from further study since its maximum capacity is well under the heavy load criteria. This crane is located on elevation 463' of the Fuel Handling Building between column lines Q.5 to R.5 and 2.5 to 6.5 directly over the Spent Fuel Pool. The crane is shown on Figures 5 and 7. No safe load path is defined for this crane.

Crane XCR-2 is supplied by Dwight Foote, Inc. through Westinghouse Electric Corporation. The crane's hoist is supplied by the P&H Harnischfeger Company. The crane and hoist are rated for a 2 ton capacity and has a maximum 25 foot lift.[1] The hoist is an electric cable hoist on a hand geared trolley with a safety hook that attaches to a fuel handling tool when handling spent fuel assemblies. The crane and hoist are controlled by a hand-held pushbutton station. The crane and hoist design adheres to CMAA Specification 70 and ANSI B30.2, Chapter 2-1.

The Spent Fuel Pool Crane is designated for the handling of spent fuel assemblies in the Spent Fuel Pool. Since it operates over the Spent Fuel Pool, there is no safe load path defined for this crane. The operation of this crane and hoist are governed by the Westinghouse Refueling Procedures which are currently being reviewed and placed into a standard format. By definition of a heavy load, this overhead handling device does not handle heavy loads and can be excluded from further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.3 Fuel Handling Building Crane (XCR-3, XCR-45, XCR-49)

Fuel Handling Building Crane XCR-3 has associated with it the Fuel Transfer Canal Gate, Hoist XCR-49, and the New Fuel Elevator Winch, XCR-45. The New Fuel Elevator Winch is not considered further since by definition it is not an overhead handling device. All three items are located in the Fuel Handling Building on elevation 463' between column lines Q.5 to S and 2.5 to 4.91. The three items are shown on Figures 5 and 7, along with the safe load path which includes the New Fuel Laydown Area, New Fuel Storage Area, the Decontamination Area, and the Cask Loading Pit and surrounding area. The Fuel Handling Building Crane's safe load path does not include any area within 15 feet of the Spent Fuel Pool.

The Fuel Handling Building Crane is supplied by the Whiting Corporation and the Fuel Transfer Canal Gate Hoist is supplied by the American Chain and Cable Company. The Fuel Handling Building Crane has a main electric motor cable hoist with a 125 ton capacity, a sister hook with eye, and a potential for a 60 foot lift. The auxiliary electric motor cable hoist has a 25 ton capacity, a single hook, and a potential lift of 60 feet 6 inches.[1] The Fuel Transfer Canal Gate Hoist is physically attached to the bridge of the Fuel Handling Building Crane and is a 3 ton capacity electric cable hoist. The assembly as a whole is designed in accordance with CMAA Specification 70 and ANSI B30.2, Chapter 2-1.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

The Fuel Handling Building Crane is designated to handle New Fuel Shipping Containers, Spent Fuel Shipping Casks and Irradiated Specimen Shipping Casks with vendor-supplied lifting devices. The Fuel Handling Building Crane does not carry a heavy load within an area or near any equipment necessary for the plant's safe shutdown or decay heat removal. Between column lines Q.5 and R.6 (Figure 5) it is possible for the Fuel Handling Building Crane to operate within 15 feet of the Spent Fuel Pool while handling a heavy load. The Fuel Transfer Canal Gate Hoist is designated to handle the Fuel Transfer Canal Gates with a two-point sling cable. Procedures have been developed (See Section 4.0) to minimize the risk of a dropped heavy load in the Fuel Handling Building. Special procedures have been developed for the Fuel Transfer Canal Gate Hoist since it is necessary to operate within 15 feet of the Spent Fuel Pool. Refer to GMP 100.012, "Crane Operations - Fuel Handling Building."

3.4 Reactor Building Polar Crane (XCR-4)

Reactor Building Polar Crane XCR-4 is located in the Reactor Building at elevation 552'. The Reactor Building Polar Crane is shown on Figures 5, 6, and 7.

The Reactor Building Polar Crane is supplied by the Whiting Corporation and has a main electric motor cable hoist rated at 360 ton with a sister hook with eye. The auxiliary electric motor cable hoist has a 25 ton capacity with a single hook. The hoists, bridge, and trolleys all have separate Whiting Telemotive radio control with redundant pushbutton station. The Reactor Building Polar Crane is designed in accordance with CMAA Specification 70 and ANSI B30.2, Chapter 2-1.

The Reactor Building Polar Crane is designed to handle the loads listed in Tables 1-1 and 3-1. As shown in Figure 5, safe load paths are identified where the Reactor Building Polar Crane can be operated without danger of damage to vital components due to an inadvertent load drop. The vital components in the Reactor Building are the:

a. Reactor Vessel, XRE-1-RC.
b. Steam Generator, XSG-2A,B-RC.
c. Pressurizer, XTK-24-RC.
d. Reactor Building Cooling Units, XAA-1A,B-AH and XAA-2A,B-AH.
e. Reactor Building Cooling Unit Fans, XFN-64A,B-AH and XFN-65A,B-AH.
f. Reactor Building Cooling Unit Cooling Coil, XCE-8A,B-AH and XCE-8A,B-AH.

The Reactor Building cooling unit assemblies are necessary for the plant's safe shutdown. However, the Reactor Building Polar Crane only operates during cold shutdown and would not jeopardize the cooling unit assemblies when their operation is necessary. A

Westinghouse study has shown that effects of a dropped heavy load would not result in damage to the reactor vessel, reactor pressure vessel, and reactor coolant system piping pressure boundary, core cooling capability, or integrity of the fuel cladding such as to exceed Criteria I through IV of Section 5.1 of NUREG 0612. The procedures used by Westinghouse in this analysis are presented in Appendix B.

3.5 Turbine Building Crane (XCR-17)

Turbine Building Crane XCR-17 is located on elevation 463' of the Turbine Building. The crane is shown on Figures 7 and 11 along with its safe load path. The safe load path encompasses the entire 463' elevation of the Turbine Building between column lines 1 and 12, and A and F, as well as those areas on elevation 436' open to hatches from the 463' elevation as shown in Figure 10.

The Turbine Building Crane is supplied by P&H Harnischfeger Corporation, and is a 220 ton, five motor overhead traveling crane with a 30 ton, 6 inch auxiliary hoist. The main hoist has a 95 foot lift and the auxiliary hoist a 111 foot lift.[1] The crane is operated through an operator's cab or pendant control and has a festoon conductor on the trolley. The crane's main hoist employs a sister hook and the auxiliary hoist employs a fish hook rated as stated above. The crane and associated hoists are designed in accordance with CMAA Specification 70 for Class A indoor service and ANSI B30.2, Chapter 2-1.

The Turbine Building Crane is designed to service the General Electric Turbine Generator and Associated Power Plant Equipment. Since there is no equipment in the Turbine Building required for safe shutdown or decay heat removal, this crane can be excluded from further study or concerns.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.6 10-Ton Electric Cable Hoist and Motor Operated Trolley (XCR-18)

The 10-ton electric cable hoist and motor operated trolley XCR-18 is located on elevation 436' of the Auxiliary Building between column lines 9.5 and L. The hoist is shown on Figure 4 and its safe load path is the equipment hatch and surrounding area through elevations 436', 412', 397', 388', and 374' of the Auxiliary Building. The safe load path is shown on Figures 2, 3, and 4. This monorail and hoist system is designed in accordance with HMI 100, Standard Specifications for Electric Wire Rope Hoists.

Hoist XCR-18 is supplied by the American Chain and Cable Company and is a 10-ton capacity electric cable hoist with a motor driven trolley. The hoist has a 90 foot lift and is controlled with a single speed hand held controller.[1] The hoist's lifting device is a forged steel shank hook.

The 10-ton electric cable hoist is designated to lift power plant equipment through the equipment hatch from elevations 372' to 436' of the Auxiliary Building. Inside the safeload path and in the nearby surrounding area there is no equipment necessary for safe shutdown or decay heat removal. Therefore, the hoist is excluded from further study and concerns.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.7 <u>7.5-Ton Electric Cable Hoist with Motor Operated Trolley (XCR-19)</u>

The 7.5-ton electric cable hoist and motor operated trolley XCR-19 is located on elevation 485' of the Auxiliary Building between columns P and 6.6. The hoist is shown on Figure 6, and its safe load path is the equipment hatch through elevations 388', 397', 412', 436', 463', and 485' of the Auxiliary Building as shown on Figures 2 through 5. This monorail and hoist system is designed in accordance with HMI 100, Standard Specifications for Electric Wire Rope Hoists.

Hoist XCR-19 is supplied by the American Chain and Cable Company and is a 7.5-ton capacity electric cable hoist with a motor driven trolley. The hoist has 126 foot lift and is controlled by a hand-held controller.[1] The hoist's lifting device is a forged steel shank hook.

The 7.5-ton electric cable hoist is designated to lift general power plant equipment through the equipment hatch from elevations 388' to 485' of the Auxiliary Building. Several safety related cable trays and pipelines are located near the hatchway opening at various elevations. The following items were considered as possible hazards: two cable trays located near the north side of the hatchway at elevations 471'-11" and 476'-6"; a 16" service water line running near the southeast corner of the hatchway at elevation 451'-6"; and a cable tray located near the southeast corner of the hatchway at elevation 428'-3". None of the affected items are within the load path of the hoist and would not be affected by a direct drop.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

The two cable trays located at elevations 471'-11" and 476'-6" were considered to be in the most vulnerable position. The trays run diagonally near the northwest corner of the hatch opening, then turn and run along the north side of the hatch. The trays could be struck if an odd size load such as a steel beam were being handled and the operator inadvertently moved the trolley in the wrong direction. However, this situation is best handled through the use of taglines on odd-sized loads and administrative procedures. Any guards placed on the cable trays would cause an obstruction of the hatchway opening and a potentially greater hazard.

The service water piping located at elevation 451'-6" was determined to be in no significant danger due to an uncontrolled movement of the hoist. Calculations were performed to analyze the effect of a large steel beam striking the pipe. The basis and results for the calculation are discussed in Appendix C, "Analysis of Impact Loads."

The cable tray located at elevation '28'-3" is considered to be a sufficient distance from the edge of the hatchway to be eliminated as a hazard. The closest distance between the edge of the hatch and the cable tray is approximately four (4) feet. Considering the 32 fpm trolley speed and load sway, the trolley would need to be inadvertently engaged for approximately six (6) seconds before the load would make contact with the cable tray. This is considered to be a sufficient amount of time for the operator to take corrective action.

3.8 5-Ton Hand Chain Hoist and Plain Trolley (XCR-20A/B)

The 5-ton chain hoists and trolleys XCR-20A and XCR-20B are located in Auxiliary Building on elevation 374' between the column lines K and 8.8 above the Residual Heat Removal Pumps. The hoists are shown on Figure 2 along with their safe load paths. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoists XCR-20A and XCR-20B are supplied by the American Chain and Cable Company and are 5-ton capacity hand operated chain hoists with a plain trolley. The hoists have 20 foot lifts and forged steel shank hooks.[1]

The 5 ton hand chain hoists and plain trolleys XCR-20A and XCR-20B are designated to service the RHR pumps and motors, XPP-31A and XPP-31B, respectively. The RHR pumps necessary for the removal of decay heat are located within the safe load paths of hoists and trolleys XCR-20A and XCR-20B. While a heavy load drop from the hoists could cause damage to the RHR pumps the only time this would occur is when the pump in question would have maintenance being performed on it. During maintenance periods on an RHR pump, the pump would be isolated from its systems and replaced by a redundant unit. Each pump is isolated in its own concrete cubicle; therefore, an inadvertent drop by either hoist would not affect the redundant pump. On this basis it can be excluded from further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.9 5-Ton Manual Chain Hoist with Geared Trolley (XCR-21A/B)

The 5-ton manual chain hoists and geared trolleys XCR-21A and XCR-21B are located in the Auxiliary Building on elevation 374' near column lines K and 8.8 above the Reactor Building Spray Pumps. The hoists and trolleys are shown on Figure 2 along with their safe load paths. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoists XCR-21A and XCR-21B are supplied by the American Chain and Cable Company and are 5-ton capacity hand-operated chain hoists on geared trolleys. The hoists have a 20 foot lift with forged steel shank hooks.[1]

Hoists XCR-21A and XCR-21B are designated to service the Reactor Building Spray Pumps XPP-38A and XPP-38B and associated motors MPP-38A and MPP-38B. XCR-21A and 21B are physically separated by a concrete wall; therefore, an inadvertent drop by either hoist would not affect the redundant reactor building spray pump train. There are no components necessary for safe shutdown or decay heat removal within the safe load paths of hoists XCR-21A and XCR-21B, so these hoists are excluded from further study.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.10 5-Ton Manual Chain Hoist with Geared Trolley (XCR-54A/B/C)

The 5-ton manual chain hoists with geared trolleys XCR-54A, XCR-54B, and XCR-54C are located in the Auxiliary Building on elevation 388' at the column lines N to Q and 7.7 above the Safety Injection Charging Pumps. The hoists and trolleys are shown on Figure 2 along with their safe load paths. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoists XCR-54A, XCR-54B, and XCR-54C are supplied by the American Chain and Cable Company, and are 5-ton capacity, closehead room, hand operated chain hoists on geared trolleys. The hoists have an 8 foot lift with a forged steel shank hook.[1]

Hoists XCR-54A, XCR-54B, and XCR-54C are designated to service Safety Injection Charging Pumps XPP-43A, XPP-43B, and XPP-43C. Inside and near the safe load paths, the Safety Injection Charging Pumps are the only components necessary for the safe shutdown of the plant. The only time a heavyload drop could cause damage to the pumps is when the pumps are being serviced. While they are being serviced, the pumps are isolated from their systems and are replaced by a redundant unit. Each charging/safety injection and hoist is enclosed in a separate concrete cubicle. On this basis hoists XCR-54A, XCR-54B, and XCR-54C are excluded from any further study or concerns.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.11 2-Ton Manual Chain Hoist with Plain Trolley (XCR-23A/B)

The 2-ton manual chain hoists with plain trolleys XCR-23A and XCR-23B are located in the Auxiliary Building on elevation 412' at column lines J to N and 7.7. The hoists and trolleys are shown on Figure 3 along with its safe load paths. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoists XCR-23A and XCR-23B are supplied by the American Chain and Cable Company, and are 2-ton capacity hand operated chain hoists on plain trolleys. The hoists have a 26 foot lift and a forged steel shank hook.[1]

Hoists XCR-23A and XCR-23B are designated to service the Reactor Building Spray Protective Sump Isolation Valve Chambers XSM-4A and XSM-4B, and the Safety Injection Recirculation Sump Isolation Valve Protection Chambers XSM-5A and XSM-5B. Since the sump isolation valves and associated piping do not normally contain radioactive material, a dropped heavy load on the isolation valve and chamber while servicing an adjacent chamber will not result in a radioactive release. The only time the sump isolation valves and associated piping would contain radioactive fluid would be under post-accident condition, where service to the valves would not be possible, or allowed by procedures, and the hoist would not be allowed to operate. Near the north end of the monorail for hoist XCR-23B is a Motor Control Center XMC-1DAZY and an Air Handling Unit for Motor Control Center XAH-32-VL, both of which are necessary for the safe shutdown of the plant. Neither the Motor Control Center nor the Air Handling Unit for the Motor

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

Control Center lie within the normal load path of XCR-23B, and normal operating procedures and separation distance would preclude any damage from a dropped load to either item. However, it is recommended that a trolley stop be placed on the monorail at a distance of 5'-10" from the north end of the monorail.

3.12 8-Ton Manual Hand Chain Hoist with Geared Trolley (XCR-24)

The 8-ton manual chain hoist with geared trolley XCR-24 is located in the Turbine Building on elevation 463' at column lines F and 4 to 5. This hoist and trolley are shown on Figure 11 along with their safe load paths. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoist XCR-24 is supplied by the American Chain and Cable Company, and is an 8 ton capacity hand operated chain hoist with a geared trolley. The hoist has a 20 foot lift and a forged steel shank hook.[1]

Hoist XCR-24 is designated to service the turbine stop valves XVG-2809 A to D. Since the Turbine Building contains no equipment necessary for the plant's safe shutdown or decay heat removal, this hoist can be excluded from further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.13 10-Ton Manual Chain Hoist with Geared Trolley (XCR-25A/B/C/D)

The four 10-ton manual chain hoists and geared trolleys XCR-25A, XCR-25B, XCR-25C, and XCR-25D are located on elevation 412' of the Turbine Building between column lines B to B.9 and 5 to 8. These hoists are shown on Figure 9. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoists XCR-25A thru XCR-25D are manufactured by the American Chain and Cable Company and are 10 ton capacity hand operated chain hoists on geared trolleys. The hoists have 15 foot lifts and forged steel shank hooks.[1]

Hoists XCR-25A thru XCR-25D are designated to service the four Main Condenser Water Boxes. Two hoists service one water box at a time. Since the Turbine Building contains no equipment necessary for the plant's safe shutdown or decay heat removal, these hoists can be excluded from further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.14 4-Ton Manual Chain Hoist with Plain Trolley (XCR-26)

The 4-ton manual chain hoist with a plain trolley XCR-26 is located in the Turbine Building on elevation 412' between column lines F to G.1 and 1 to 3 above the Feedwater Booster Pumps. These hoists are shown in Figure 9. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoist XCR-26 is manufactured by the American Chain and Cable Company, and is a 4-ton capacity, hand operated, chain hoist on a plain trolley. The hoists have a 15 foot lift and a forged steel shank hook.[1]

Hoist XCR-26 is designated to service the Feedwater Booster Pumps XPP-28A through XPP-28D. This hoist can be excluded from further study or concern since the Turbine Building contains no equipment necessary for the plant's safe shutdown or decay heat removal.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.15 5-Ton Electric Hoist with Motor Operated Trolley (XCR-27)

The 5-ton electric hoist and motor operated trolley XCR-27 is located in the Intermediate Building on elevation 436' between column lines G.4 to H.4 and 7.5 to 8.3. The hoist and trolley are shown on Figure 4 along with its safe load path. This monorail and hoist system is designed in accordance with HMI 100, Standard Specifications for Electric Wire Rope Hoists.

Hoist XCR-27 is manufactured by the American Chain and Cable Company, and is a 5-ton capacity, electric cable hoist on a motorized trolley, with a hand held electric controller. The hoist has a 49 foot lift and a forged steel shank hoist.[1]

Hoist XCR-27 is designated to handle power plant equipment through the equipment hatch from elevations 412' and 436' in the Intermediate Building. No safe shutdown equipment is located directly in the path of the hoist. However, several items of safety related equipment are located nearby the path of this hoist if an odd size load such as a steel beam is considered. These include a cable tray near the south side of the hatchway at elevation 420'-0", two 6" chilled water risers near the laydown area at elevation 436'-0", a horizontal run of 16" diameter battery room exhaust duct near the east side of the hatch at elevation 426'-10", and two 2" horizontal chilled water pipe runs at elevation 424'-0" near the east side of the hatchway. Protective guards are presently being designed to alleviate the hazards associated with the cable tray and the 6" chilled water risers.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

The calculated load sway associated with this hoist does not affect either the duct or the chilled water pipe runs. Each of these lines run parallel to the monorail, with the closest point being 6'-6-1/2" from the monorail centerline. The maximum calculated sway at this elevation is 6-1/2" from vertical. A hazard does exist due to uncontrolled load rotation. The concrete wall along the west side of the hatchway will stop the major portion of a load rotation; however, it may not stop all secondary effects. It is recommended that administrative procedures be prepared to include the use of tag lines or that a heavy tarpaulin or net be dropped along the east side of the hatchway to prevent any load rotation in the area of these lines.

3.16 2-Ton Electric Cable Hoist with Motorized Trolley (XCR-28)

The 2-ton electric cable hoist and motorized trolley XCR-28 is located on elevation 463' of the Water Treatment Building between column lines D to D.6 and 10.6. The hoist is shown on Figure 1. This monorail and hoist system is designed in accordance with HMI 100, Standard Specifications for Electric Wire Rope Hoists.

Hoist XCR-28 is supplied by the American Chain and Cable Company, and is a 2-ton capacity, electric cable hoist on a motorized trolley with a hand-held electric controller. The hoist has a 43 foot lift and has a forged steel shank hook.[1]

Hoist XCR-28 is designated to handle containers from the Water Treatment Building's Chemical Storage area. There are no components necessary for safe shutdown or for decay heat removal in the Water Treatment Building. The hoist is excluded from further study or concern on this basis.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.17 2-Ton Hand Operated Hoist with Geared Trolley (XCR-29A/B)

The 2-ton hand operated hoists and geared trolleys XCR-29A and XCR-29B are located in the Diesel Generator Building on elevation 436' between the column lines G.4 to J.1 and column line number 1 above the Diesel Generators. The hoists and trolleys are shown on Figure 4 along with their safe load paths. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoists XCR-29A and XCR-29B are supplied by the American Chain and Cable Company, and are 2-ton capacity, single beam, underhung, hand operated hoists with geared trolleys. The hoists have a 24 foot lift and forged steel shank hooks.[1]

Hoists XCR-29A and XCR-29B are designated to service the two standby emergency diesel generators, XEG-1A-DG and XEG-1B-DG, respectively. The diesel generator, the fuel oil day tank, the air receiver, and on elevation 427', the fuel oil transfer pump are necessary for the safe shutdown of the plant and are within each crane's load path. The only time the four safe shutdown components are in jeopardy from a heavy load drop from hoists XCR-29A and XCR-29B is when a hoist is servicing a diesel generator and associated equipment for maintenance purposes. When one diesel generator train is down for maintenance, the other is completely isolated from it and is capable of operating independently. Each diesel generator is isolated in a separate concrete cubicle. On the basis presented above and because the two diesel generator trains are completely redundant, hoists XCR-29A and XCR-29B are excluded from further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.18 1/2-Ton Hand Chain Hoist and Trolley (XCR-31)

The 1/2-ton hand operated chain hoist and plain trolley XCR-31, manufactured by the American Chain and Cable Company, has a maximum rated capacity less than that defined for a heavy load in this study. On this basis the hoist is not included in this study except for reference and completeness. It is located on elevation 436' of the Intermediate Building near column lines H.4 and 2 to 3, and is shown on Figure 4. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

3.19 2-Ton Hand Chain Hoist With Trolley (XCR-33)

The 2-ton hand operated chain hoist and trolley XCR-33 is located on elevation 412' of the Intermediate Building between column lines G.3 to H.4 and 2 to 3, above the Emergency Feedwater Pump and Turbine Drives. The hoist is shown on Figure 3 along with its safe load path. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoist XCR-33 is supplied by the American Chain and Cable Company, and is a 2-ton capacity, hand operated, chain hoist with a plain trolley. The hoist has a 10 foot lift and a forged steel shank hook.[1]

Hoist XCR-33 is designated to service the Turbine Driven Emergency Feedwater Pump XPP-8-EF. The pump and its turbine driver are within the hoist's safe load path and are necessary for the plant's safe shutdown. The only time the pump and driver are in jeopardy of a heavy load drop is when the emergency feedwater pump has already been isolated for maintenance. On the basis given above and since the Turbine Driven Emergency Feedwater Pump is redundant with the two Motor Driven Emergency Feedwater Pumps which are physically separated from the turbine driven Emergency Feedwater Pump and are not serviced by XCR-33, the hoist can be excluded from further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.20 1-Ton Electric Cable Hoist and Trolley (XCR-34)

The 1-ton electric cable hoist and plain push type trolley XCR-34, supplied by the American Chain and Cable Company, has a maximum rated capacity less than that defined for a heavy load in this study. On this basis the hoist is not included in this study except for reference and completeness. It is located at elevation 436' of the Reactor Building over the Tendon Access Gallery, and can be found on Figure 4. This monorail and hoist system is designed in accordance with HMI 100, Standard Specifications for Electric Wire Rope Hoists.

3.21 20-Ton Electric Cable Hoist with Motorized Trolley (XCR-36)

The 20-ton electric cable hoist and motorized trolley XCR-36 is located in the Drumming Station on elevation 436' between column lines P to R and 6.6 to 8.8. The hoist and trolley are shown on Figure 4 along with its safe load path. This monorail and hoist system is designed in accordance with HMI 100, Standard Specifications for Electric Wire Rope Hoists.

Hoist XCR-36 is supplied by the American Chain and Cable Company, and is a 20-ton capacity, electric cable hoist with an electric motorized trolley. The hoist has a 25-foot lift and a forged steel shank hook.[1]

Hoist XCR-36 is designated to handle low and high level radiation shipping casks. There are no components necessary for the plant's safe shutdown or decay heat removal on elevation 463' and within the hoists safeload path. Below hoist XCR-36, however, on elevation 412' are the Spent Fuel Pool Cooling Pumps, XPP-32A and XPP-32B. These pumps are classified as Safety Class 2b. A study of the effects of dropping a Radwaste Cask on the floor of elevation 436' of the Drumming Station above the Spent Fuel Cooling Pumps (Appendix A) indicates that the floor structure would withstand the drop impact with no resulting damage to the Spent Fuel Cooling Pumps. The Radwaste Cask contains radioactive material. The potential effluent releases from a dropped Radwaste Cask would result in insignificant offsite dosage due to the allowable limits on radioactive material contained in a shipping cask and its form as required by the appropriate Federal Regulations for the Transportation of Hazardous Material, 49 CFR 170 through 189 and 10 CFR 71.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.22 10-Ton Hand Chain Hoists with Geared Trolley (XCR-40A/B/C)

The 10-ton hand chain hoists and geared trolleys XCR-40A, XCR-40B, and XCR-40C are located on elevation 436' of the Intermediate Building between column lines H.4 to J.1 and 2 to 8 above the Main Steam Isolation Valves. The hoists and valves are shown on Figure 4 along with their safe load paths. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoists XCR-40A, XCR-40B, and XCR-40C are supplied by the American Chain and Cable Company, and are 10-ton capacity, manually operated chain hoists. The hoists have a 20-foot lift and a forged steel shank hook.[1]

Hoists and trolleys XCR-40A, XCR-40B, and XCR-40C, along with a transfer rail, are designated for servicing the Main Steam Isolation Valves, XVM-2801 A through C. The Component Cooling Heat Exchanger, XHE-2B-CC, the Component Cooling Pumps, XPP-1A through C, and the Motor Driven Feedwater Pumps, XPP-21A and XPP-21B are located directly below the hoists and trolleys on elevation 412' of the Intermediate Building. A study of the effects of dropping a Main Steam Isolation Valve on the floor of elevation 436' of the Intermediate Building above the indicated equipment (Appendix A) has indicated that the floor structure would withstand the drop impact with no resulting damage to the safe shutdown/decay heat removal equipment below. The study was very conservative considering that the hoists would not be utilized to lift and move an entire valve assembly (including the valve body) at one time, as the study assumed.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

Two vertical nuclear safety-related service water risers are located approximately three (3) feet from the end of the XCR-40B monorail. Calculations were performed that show the maximum amount of load sway for these hoists will not exceed three (3) inches from the vertical. This calculation is based on data from the hoist manufacturer, a chain overhaul of 120 ft/min., and the hoist hitting the monorail stops. Therefore, the service water risers would not be affected. This information, combined with the fact that the hoists do not handle odd sized loads or operate unless the plant is in cold shutdown, is sufficient to eliminate these hoists from further study.

3.23 10-Ton Bridge Crane and Electric Cable Hoists (XCR-42)

The 10-ton bridge crane and electric cable hoist XCR-42 is located in the Hot Machine Shop at elevation 436' between column lines R.2 to S and 11.6 to 7.8. The hoist is shown on Figure 4.

Crane XCR-42 is supplied by the American Chain and Cable Company, and both the crane and hoist have a capacity of 10 tons. The crane is an underhung, single beam, motor driven, center drive crane. The crane has a 24-foot lift and a forged steel shank main and safety hook.[1] There are pushbutton controls for both the crane and hoist for the full length travel of the bridge. The crane and hoist are designed in accordance with CMAA Specification 70 for Class C indoor service, and ANSI B30.2, Chapter 2-1.

Crane and hoist XCR-42 are designated to handle loads in the Hot Machine Shop. The safe load path is defined as the Hot Machine Shop which contains no components necessary for the safe shutdown of the plant or decay heat removal, and on this basis can be excluded from any further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.24 10-Ton Bridge Crane and Electric Cable Hoist (XCR-43)

The 10-ton bridge crane and electric cable hoist XCR-43 is located in the Service Building and essentially encompasses the Service Building Machine Shop. The crane is shown on Figure 1.

Crane XCR-43 is supplied by the American Chain and Cable Company, and both the crane and hoist have a 10-ton capacity. The crane is a top running, double beam, motor driven, center drive crane. The crane has an 18-foot 11-inch lift and a forged steel shank main and safety hook.[1] There are pushbutton controls for the crane and hoist for the full length travel of the bridge. The crane and hoist are designed in accordance with CMAA Specification 70 for Class C indoor service, and ANSI B30.2, Chapter 2-1.

Crane and hoist XCR-43 are designed for General Service Building application in the Service Building Machine Shop. The crane can be excluded from any further study or consideration since the Service Building contains no equipment necessary for either safe shutdown or decay heat removal.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.25 3-Ton Bridge Crane with Electric Cable Hoist (XCR-46)

The 3-ton bridge crane and electric cable hoist XCR-46 is located on elevation 463' of the Auxiliary Building between column lines P to Q and 8.8 to 11.5. The crane, associated monorail, and safe load path are shown on Figure 5. The safe load path encompasses the area of the Chemical Volume Control System's Concrete Filter Plugs, the area under the associated monorail, and the Filter Hatch to Drumming Station.

Crane, hoist, and monorail XCR-46 are supplied by the American Chain and Cable Company. The crane and hoist are each 3-ton capacity. The crane is an underhung, single beam, motor driven, center driven type crane, and the hoist is an electric cable hoist. Along with the crane is an associated monorail that can interlock with the crane so that the hoist can transfer filter plugs to the Filter Hatch. The crane and hoist are controlled remotely to remove the operator from the potentially radioactive filter plugs. The crane is designed in accordance with CMAA Specification 70 for Class C indoor service, and ANSI B30.2, Chapter 2-1.

Crane XCR-46 is designated to remove the concrete plugs and spent filter cartridges from their housing and transport the spent filter and cask to the Filter Hatch. The concrete plugs and spent filter cartridges are below the heavy load weight limit. If an inadvertent drop of a radioactive filter occurs, the possible effluent release would result in insignificant offsite doses due to the small amount of radioactive material contained in the filters, and its low level radioactive nature.

The only safety related equipment in the vicinity of the hoist is a cable tray which runs parallel to the monorail. The tray itself is located away from the path of the hoist; however, the tray supports are located 30-1/2" from the monorail. The tray is ceiling-supported and the bottom of the support is 3'-10" below the bottom of the monorail.

The shipping casks have a 20" square base and are carried from the cask centerline. A calculation was performed to determine the maximum amount of load sway for XCR-46. The calculation assumed that the load was fully extended, the trolley was travelling at full speed, and the hoist came to a sudden stop. This results in a load sway of 9 inches in the direction of trolley travel at the floor 12'-9" below the monorail. Since the load would have to sway perpendicular to the direction of travel to strike the supports, a circular load swing was assumed. This places the most outward corner of the cask a distance of 23" from the centerline of the monorail at floor elevation. The bottom of the tray supports are 8'-11" above the floor and well out of the sway path.

Several items of safety related equipment are located on the floors below XCR-46. These are listed in Table 3-1. A structural analysis of the floor directly below XCR-46 will be performed to determine the structural integrity of the floor in case of a 3 ton load drop. From previous, similar analysis situations, it is felt that the 2 foot thick concrete floor will be capable of withstanding the load without any substantial damage.

3.26 10-Ton Bridge Crane and Electric Cable Hoist (XCR-47)

The 10-ton bridge crane and electric cable hoist, XCR-47, are located in the Drumming Station at elevation 447' between column lines P to R and 8.8 to 9.5. The crane and hoist are shown on Figure 4 along with its safe load path which encompases the low level waste storage area.

Crane XCR-47 is supplied by the American Chain and Cable Company. The crane and hoist are both rated for a 10-ton capacity and the unit has a 14 foot lift.[1] The crane is an underhung, single beam, motor driven, center drive crane, and the hoist is an electric cable type with a forged steel shank hook. The crane and hoist are controlled remotely with a control panel to remove the operator from close proximity of the low level waste storage area while operating the crane. The crane is designed in accordance with CMAA Specification 70 for Class C indoor service, and ANSI B30.2, Chapter 2-1.

Crane XCR-47 is used to handle shielded and unshielded low level radioactive waste storage containers in the storage area. The potential effluent release from a dropped cask would result in insignificant offsite doses due to the low level nature of the material and the amount of allowable radioactive material in each cask.

No safe shutdown or decay heat removal equipment is located in the immediate vicinity of XCR-47: however, several safety related pipelines are located on the floors below. These lines are in no

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

danger from a heavy load drop. A study previously conducted for this vicinity of the Intermediate Building (presented in Appendix A) showed that dropping a 20-ton load on the floor of the Intermediate Building at elevation 436'-0" would not result in damage to the floor. On this basis, XCR-47 can be eliminated from further study or concerns.

3.27 1-1/2 Ton Hand Chain Hoist and Plain Trolley (XCR-48)

The 1-1/2 ton hand chain hoist with plain trolley, XCR-48, is located on elevation 412' of the Turbine Building between column lines B.8 to D and 12 above the Instrument and Service Air Compressors. The hoist is shown on Figure 9. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Hoist XCR-48 is supplied by the American Chain and Cable Company, and is a 1-1/2 ton capacity, manually operated, chain hoist on a plain trolley. The hoist has a 17 foot lift and a forged steel shank hook.[1]

Hoist and trolley XCR-48 service the Instrument and Service Air Compressor, XAC-3A and XAC-3B, which are not necessary for safe shut down or decay heat removal. On this basis XCR-48 can be excluded from further study or concern.

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

3.28 <u>10-Ton Bridge Crane and Electric Cable Hoists (XCR-50, XCR-51)</u>

The 10-ton bridge crane, XCR-51, and electric cable hoist, XCR-50, are located on elevation 436' of the Service Water Intake Screen and Pump House directly above and behind the Service Water Pumps. The crane and hoist are shown on Figure 8. The safe load path, also shown on Figure 8, includes the complete service area behind the pumps and under the monorails over each Service Water Pump.

Crane XCR-51 and hoist XCR-50 are supplied by the American Chain and Cable Company. The crane and hoist are both rated for a 10-ton capacity, and have a 57 foot lift.[1] The crane is an underhung, single beam, hand operated crane, and the hoist is an electric cable hoist with a pushbutton control station and a lifting beam. Three monorails are associated with the crane and hoists, one over each Service Water Pump, that can interlock with the crane. The hoist and crane are designed in accordance with CMAA Specification 70 Class C indoor service, and ANSI B30.2, Chapter 2-1.

Crane XCR-51 and hoist XCR-50 are designated to service the Service Water Pumps, XPP-39A through C, and the Traveling Screens, XRS-2A through C. The Service Water Pumps are necessary for the safe shutdown of the plant. Each pump is contained within its own concrete cubicle. The only time the crane and hoist are in operation is when an associated pump and screen are being serviced. When the pump and screen are being serviced they are isolated from the Service Water System, and at the time are no longer necessary for the plant's safe shutdown. The three Service Water Pumps have a 2 out of 3 redundancy. Due to space limitations and physical separation by concrete walls, it is

1. The lift as given is the maximum from the eye of the hook to the top of the beam; the actual lift as installed may be equal or less than this maximum.

physically impossible for the hoist to travel over an operating Service Water Pump and Traveling Screen while carrying a designated heavy load.

Several service water discharge lines are located on the elevations below the floor of XCR-51. A structural analysis of the floor directly below XCR-51 will be performed to determine the structural integrity of the case of a 10 ton load drop.

3.29 2-Ton Twin Hook Extension Hoist (XCR-53A/B/C)

The 2-ton twin hook extension hoists XCR-53A, XCR-53B, and XCR-53C are located in the Reactor Building at elevation 475' on the Loop B Steam Generator Wall. The safe load path is the area covered by the CRDM Cable Support Structures and the space directly above it. The three hoists and the safe load path are shown on Figure 5.

Hoists XCR-53A, XCR-53B, and XCR-53C are supplied by P&H Harnischfeger Company. Each hoist has twin hooks rated at 2-ton. The hoists are equipped with a handwheel for manual operation, and are capable of an 18 foot lift.

The three hoists are used to lift the hinged CRDM Cable Support Structures through a defined arc path during refueling or maintenance outages. Since the hoists are only used during cold shutdown, the hoists can be excluded from any further study or concern.

3.30 1-Ton Jib Crane - Rad Waste Package (XRW-11)

A one-ton capacity jib crane, XRW-11, is furnished as part of the Rad Waste Package. Since this crane's rated maximum capacity is under the heavy load limit of this study it is not considered further, and is included herein only for reference and completeness. The one-ton jib crane is located in the Drumming Station at elevation 436' at column lines Q and 7.7. The load path of this excluded item is shown on Figure 4.

3.31 3-Ton Jib Crane - Rad Waste Package (XRW-13, XCR-46)

A 3-ton jib crane, XRW-13, is furnished as part of the Rad Waste Package in the same area as hoist XCR-36. The crane is at elevation 436' of the Drumming Station between column lines Q and 7.8 to 8.7. The jib crane and its safe load path are shown on Figure 4.

Jib crane XRW-13 has a 3-ton capacity with an electric cable hoist supplied by the American Chain and Cable Company. The hoist utilizes a 3-ton load beam as a handling device. The hoist is controlled by a pushbutton pendant station. Crane XRW-13 is designed in accordance with CMAA Specification 70 and ANSI B30.2, Chapter 2-1.

Jib crane XRW-13 is designated to handle the spent Chemical Volume and Control System (CVCS) filters and their storage casks that were lowered through the filter hatch from elevation 463' by hoist XCR-46 and places them in temporary storage. The potential effluent release due to an inadvertent drop of a spent filter and storage cask would result in insignificant offsite doses due to the small amount of radioactive material contained in the filter and its low level nature.

3.32 Reactor Building Equipment Access Hatch Crane

The Reactor Building Equipment Hatch has a permanent crane arm attached to it at elevation 463' of the Reactor Building. This crane arm is used to swing the equipment access hatch door out of the hatch opening along a guide track when necessary. By definition of this report, this crane can be excluded from further study since it is not an overhead handling device. The load path of this excluded item is shown on Figure 5.

3.33 5-Ton Hand Chain Hoist (XCR-40)

XCR-40 is a 5-ton hand chain hoist with a geared trolley located at elevation 436'-0" of the Intermediate Building between column lines H.4 to H.7 and 5.9 to 7.5. The hoist is shown on Figure 4, along with its safe load path. The hoist and trolley is designated for servicing Main Steam Isolation Valve XVM-2801A. This monorail and hoist system is designed in accordance with HMI 200, Standard Specifications for Hand Operated Chain Hoists.

Component Cooling Water Pump XPP-1B-CC, several chilled water pipes, and several essential duct runs are located directly below floor elevation 436' in the load path of XCR-40. A study of the effects of dropping a Main Steam Isolation Valve on the floor at elevation 436' of the Intermediate Building above the indicated equipment (Appendix A) has indicated that the floor structure would withstand the drop impact with no resulting damage to the safe shutdown/decay heat removal equipment below. The study was very conservative considering that the hoists would not be utilized to lift the complete valve assembly (including valve body) at one time, as the study assumed.

3.34 One-Ton Jib Cranes and Electric Chain Hoists (XCR-55, XCR-56, XCR-57, and XCR-58)

XCR-55, XCR-56, XCR-57, and XCR-58 are one-ton jib cranes located within the Reactor Building. These cranes are shown on Figure 5.

XCR-55 is located at elevation 463'-0" near Steam Loop A. XCR-56 is located at elevation 463'-0" near Steam Loop B. XCR-57 is located at elevation 463'-0" near Steam Loop C. XCR-58 is located at elevation 463'-0" near Steam Loop B.

Each jib crane is provided with a one-ton electric chain hoist and motorized trolley. The hoists are intended to handle miscellaneous loads during maintenance outages. These cranes are being excluded from further study on the basis that they only handle loads lighter than the 2500 lb minimum required by NUREG-0612.

3.35 1/2-Ton Hoist (XCR-60)

XCR-60 is a 1/2-ton manual chain hoist located at elevation 485'-0" in the Auxiliary Building near Boric Acid Tank A. The hoist is shown on Figure 5. This crane is being excluded from further study since the hoist's rated capacity is less than the 2500 lb minimum. The hoist has been included herein for reference and completeness.

3.36 1/4-Ton Jib Crane With Electric Hoist (XCR-61)

XCR-61 is a 1/4-ton jib crane located at elevation 457'-0" of the Control Building. The jib crane is fitted with a 1/4-ton electric hoist designated for lifting various control equipment. The rated capacity of the hoist is less than the heavy load established for this report; therefore, it can be excluded from further study.

TABLE 3-1

HEAVY LOADS VS. IMPACT AREA

HAZARD ELIMINATION CATEGORIES (as defined for each overhead lifting device)

a. Crane travel for this area/load combination prohibited by electrical interlocks or mechanical stops.

b. System redundancy and separation precludes loss of capability of system to perform its safety-related function following load drop in this area.

c. Site-specific considerations eliminate the need to consider equipment combination.

d. The likelihood of handling system failures for this load is extremely small.

e. Analysis demonstrates that crane failure and load drop will not damage safety-related equipment.

f. Load handled is less than the minimum required by NUREG-0612.

g. Administrative procedures govern this hazard.

h. Protective devices to be installed.

TABLE 3-1 (Continued)

Overhead Lifting Device: Reactor Cavity Manipulator Crane, XCR-1

Impact Area: Elevation 463' above Reactor Vessel Cavity and Refueling Canal, Reactor Building

Figures: 5, 6, and 7

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Spent and New Fuel Assembly and Handling Tool 2500 lbs.	Reactor Cavity	463'	c,f	See Section 3.1

TABLE 3-1 (Continued)

Overhead Lifting Device: Spent Fuel Pit Bridge Crane, XCR-2

Impact Area: Elevation 463', column lines Q.5 to R.5 and 2.5 to 2.6, Fuel Handling Building

Figures: 5 and 7

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Spent Fuel Assembly and Handling Tool 2500 lbs.	Spent Fuel Rod	412' and 463'	c,f	See Section 3.2

TABLE 3-1 (Continued)

Overhead Lifting Device: Fuel Handling Building Crane, XCR-3; Fuel Transfer Canal Gate Hoist, XCR-49

Impact Area: Elevation 463', column lines Q.5 to S and 2.5 to 4.91, Fuel Handling Building

Figures: 5 and 7

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
XCR-3:				
1. New Fuel Shipping Container and Vendor Supplied Lifting Device 6600 lbs.	Spent Fuel Pool	412' to 463'	d	See Section 3.3
2. Spent Fuel Shipping Cask and Vendor-Supplied Lifting Device (later)	Spent Fuel Pool	412' to 463'	d	See Section 3.3
3. Irradiated Specimen Shipping Cask and Vendor-Supplied Lifting Device (later)	Spent Fuel Pool	412' to 463'	d	See Section 3.3
XCR-49				
Canal Gates and Two Part Sling Cable 4500 lbs.	Spent Fuel Pool	412' to 463'	d	See Section 3.3

TABLE 3-1 (Continued)

Overhead Lifting Device: Reactor Building Polar Crane, XCR-4

Impact Area: Elevation 552', Reactor Building

Figures: 5, 6, and 7

Designated Heavy Load and Weight	Safe Shutdown/Decay* Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. CRDM Missle Shield 54,000 lbs.	1. Reactor Vessel, Reactor Vessel Nozzles, and Associated Piping	408' to 437' 3/4"	e	Section 3.4 and Appendix B
2. Reactor Vessel Head Assembly 268,000 lbs	2. Steam Generators	430' 4-3/4" to 514'	c,e	Section 3.4 and Appendix B
3. Reactor Vessel Head Lifting Rig 21,000 lbs	3. Pressurizer	430' 9" to 488" 6"	c,e	Section 3.4 and Appendix B
4. Upper Internals and Internals Lifting Rig 92,000 lbs	4. Reactor Building Cooling Units, Associated Fans, and Cooling Coils	514'	c	Section 3.4
5. Lower Internals and Internals Lifting Rig 268,000 lbs				
6. ISI Tool and Westinghouse-Supplied Lifting Device 20,000 lbs				

TABLE 3-1 (Continued)

Overhead Lifting Device: Reactor Building Polar Crane, XCR-4

Impact Area: Elevation 552', Reactor Building

Figures: 5, 6, and 7

Designated Heavy Load and Weight	Safe Shutdown/Decay* Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
7. RCP Internals 48,000 lbs				
8. RCP Casing and Lifting beam 52,000 lbs				
9. RCP Motor 77,140 lbs				
10. RV Studs, Nuts, and Washer Stand 8500 lbs				
11. Equipment Bridge 4000 lbs				

* All loads and safe shutdown/decay heat removal equipment combinations were considered for each of the eleven (11) heavy loads listed above.

TABLE 3-1 (Continued)

Overhead Lifting Device: Turbine Building Crane, XCR-17

Impact Area: Elevation 463', column lines A to F and 1 to 12, and 436' elevation open to Equipment Hatches from 463', Turbine Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
General Electric Turbine Generator and Associated Power Plant Equipment ≤ 220 ton	None	N/A	c	See Section 3.5

TABLE 3-1 (Continued)

Overhead Lifting Device: 10-Ton Electric Cable Hoist and Motor Operated Trolley, XCR-18

Impact Area: Elevation 436', column lines 9.5 and L, through Equipment Hatch 374' to 436', Auxiliary Building - South

Figures: 2, 3, and 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Power Plant Equipment ≤ 10 ton	None	N/A	c	See Section 3.6

TABLE 3-1 (Continued)

Overhead Lifting Device: 7.5-Ton Electric Cable Hoist and Motor Operated Trolley, XCR-19

Impact Area: Elevation 485', column lines P and 6.6, through Equipment Hatch elevation 388' through 485', Auxiliary Building - North

Figures: 2 through 6

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Power Plant Equipment ≤ 7.5 tons	Cable Tray	476'-6"	g	See Section 3.7
	Cable Tray	471'-11"	g	
	Cable Tray	428'-3"	e	
	16" Service Water Pipe	451'-6"	e	

TABLE 3-1 (Continued)

Overhead Lifting Device: 5-Ton Hand Chain Hoist and Plain Trolley, XCR-20A and XCR-20B

Impact Area: Elevation 374', column lines K and 8.8, Auxiliary Building - South

Figure: 2

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. RHR Pumps 4400 lbs	RHR Pump and Motor	374'	b	See Section 3.8
2. RHR Pump Motor 3200 lbs	RHR Pump and Motor	374'	b	See Section 3.8

TABLE 3-1 (Continued)

Overhead Lifting Device: 5-Ton Manual Chain Hoist with Geared Trolley, XCR-21A and XCR-21B

Impact Area: Elevation 374', column lines K and 8.8, Auxiliary Building - South

Figure: 2

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. RB Spray Pump 5400 lbs.	RB Spray Pump and Motor	374'	b	See Section 3.9
2. RB Spray Pump Motor 5880 lbs.	RB Spray Pump and Motor	374'	b	See Section 3.9

TABLE 3-1 (Continued)

Overhead Lifting Device: 5-Ton Manual Chain Hoist with Geared Trolley, XCR-54 A, B, & C

Impact Area: Elevation 388', column lines M to Q and 7.7, Auxiliary Building - North

Figure: 2

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. SI Charging Pump 7500 lbs.	SI Charging Pump Assembly	388'	b	See Section 3.10
2. SI Charging Pump Base 6000 lbs.	SI Charging Pump Assembly	388'	b	See Section 3.10
3. SI Charging Pump Gear 2100 lbs.	SI Charging Pump Assembly	388'	b	≤ 2500 lbs See Section 3.10
4. SI Charging Pump Motor 6700 lbs.	SI Charging Pump Assembly	388'	b	See Section 3.10

TABLE 3-1 (Continued)

Overhead Lifting Device: 2-Ton Manual Chain Hoist with Plain Trolley, XCR-23A and XCR-23B

Impact Area: Elevation 412', column lines J to N and 7.7, Auxiliary Building

Figure: 3

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
RB Spray and SI Recirculation Sump Isolation Chamber Tops 3000 lbs.	1. Motor Control Center	412'	a,c	See Section 3.11
	2. Air Handling Unit for Motor Control Center	412'	a,c	See Section 3.11

TABLE 3-1 (Continued)

Overhead Lifting Device: 8-Ton Manual Hand Chain Hoist with Geared Trolley, XCR-24

Impact Area: Elevation 463', column lines F and 4 to 5, Turbine Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Main Steam Stop Valves Parts ≤ 8 ton	None	N/A	c	See Section 3.12

TABLE 3-1 (Continued)

Overhead Lifting Device: 10-Ton Manual Chain Hoist with Geared Trolley, XCR-25A, B, C, and D

Impact Area: Elevation 412', column lines B to B.9 and 5 to 8, Turbine Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Main Condenser Water Box	None	N/A	c	See Section 3.13 2 hoist service one water box

TABLE 3-1 (Continued)

Overhead Lifting Device: 4-Ton Manual Chain Hoist with Plain Trolley, XCR-26

Impact Area: Elevation 412', column lines F to G.1 and 1 to 3, Turbine Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. Feedwater Booster Pump 7800 lbs.	None	N/A	c	See Section 3.14
2. Feedwater Booster Pump Driver 8500 lbs.	None	N/A	c	See Section 3.14
3. Feedwater Boster Pump Bedplate 5900 lbs.	None	N/A	c	See Section 3.14

TABLE 3-1 (Continued)

Overhead Lifting Device: 5-Ton Electric Hoist with Motor Operated Trolley, XCR-27

Impact Area: Elevation 436', column lines G.4 to H.4 and 7.5 to 8.3, 412' elevation open to Equipment Hatch, Intermediate Building - West

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Power Plant Equipment ≤ 5 Ton	Cable Tray	420'-0"	h	See Section 3.15
	6" Chilled Water Line	436'-0"	h	
	16" Dia BS Duct	426'-10"	h	
	2" Chilled Water Line	424'-0"	h	

TABLE 3-1 (Continued)

Overhead Lifting Device: 2-Ton Electric Cable Hoist with Motorized Trolley, XCR-28

Impact Area: Elevation 463', column lines D to D.6 and 10.6, Water Treatment Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Chemical Storage Containers ≤ 2 ton	None	N/A	c	See Section 3.16

TABLE 3-1 (Continued)

Overhead Lifting Device: 2-Ton Hand Operated Hoist with Geared Trolley, XCR-29A and XCR-29B

Impact Area: Elevation 436', column lines G.4 to J.1 and 1, Diesel Generator Building

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Diesel Generator Parts ≤ 2 Ton	1. Diesel Generator	436'	b	See Section 3.17
	2. Fuel Oil Day Tank	436'	b	See Section 3.17
	3. Air Receiver	436'	b	See Section 3.17
	4. Fuel Oil Transfer Pump	427'	b	See Section 3.17

TABLE 3-1 (Continued)

Overhead Lifting Device: 1/2-Ton Hand Chain Hoist and Trolley, XCR-31

Impact Area: Elevation 436', column lines H.4 and 2 to 3, Intermediate Building - East

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
None	N/A	N/A	N/A	See Section 3.18

TABLE 3-1 (Continued)

Overhead Lifting Device: 2-Ton Hand Chain Hoist with Trolley, XCR-33

Impact Area: Elevation 412', column lines G.3 to H.4 and 2 to 3, Intermediate Building - East

Figure: 3

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. Turbine-Driven Emergency Feedwater 3000 lbs.	Turbine-Driven Emergency Feedwater Pump Assembly	412'	b	See Section 3.19
2. Turbine-Driven Emergency Feedwater Pump Base Plate 2400 lbs.	Turbine-Driven Emergency Feedwater Pump Assembly	412'	b	See Section 3.19
3. Turbine-Driven Emergency Feedwater Pump Driver 3260 lbs.	Turbine-Driven Emergency Feedwater Pump Assembly	412'	b	See Section 3.19

TABLE 3-1 (Continued)

Overhead Lifting Device: 1-Ton Electric Cable Hoist and Trolley, XCR-34

Impact Area: Elevation 436', Tendon Access Gallery, Reactor Building

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
None	N/A	N/A	N/A	See Section 3.20

TABLE 3-1 (Continued)

Overhead Lifting Device: 20-Ton Electric Cable Hoist with Motorized Trolley, XCR-36

Impact Area: Elevation 436', column lines P to R and 6.6 to 8.8, Auxiliary Building - North (Drumming Station)

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Radwaste Facility Equipment ≤ 20 Ton	Spent Fuel Pit Cooling Pumps	412'	e	See Section 3.21

TABLE 3-1 (Continued)

Overhead Lifting Device: 10-Ton Hand Chain Hoists and Geared Trolley, XCR-40A, B, and C

Impact Area: Elevation 436', column lines H.4 to J.1 and Z to 8, Intermediate Building

Figures: 3 and 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Main Steam Isolation Valve Parts ≤ 4500 lbs	1. Component Cooling Heat Exchanger	412'	e	See Section 3.22
	2. Component Cooling Pumps	412'	e	See Section 3.22
	3. Motor Driven Feedwater Pumps	412'	e	See Section 3.22

TABLE 3-1 (Continued)

Overhead Lifting Device: 10-Ton Bridge Crane and Electric Cable Hoists, XCR-42

Impact Area: Elevation 436', column lines R.2 to S and 7.8 to 11.6, Hot Machine Shop

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Hot Machine Shop Application ≤ 10 Ton	None	N/A	c	See Section 3.23

TABLE 3-1 (Continued)

Overhead Lifting Device: 10-Ton Bridge Crane and Electric Cable Hoist, XCR-43

Impact Area: Service Building Machine Shop

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Service Building Application ≤ 10 Ton	None	N/A	c	See Section 3.24

TABLE 3-1 (Continued)

Overhead Lifting Device: 3-Ton Bridge Crane and Electric Cable Hoist, XCR-46

Impact Area: Elevation 463', column lines P to Q and 8.8 to 11.5, through equipment hatch to Drumming Station Elevation 436', Auxiliary Building - North

Figures: 4 and 5

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. Concrete Plugs 1770 lbs				See Section 3.25 ≤ 2500 lbs.
2. Filters and Cartridges negligible				See Section 3.25 ≤ 2500 lbs.
3. Storage Casks 2590 lbs.			c,e	See Section 3.25
	2" CS Line	449'-0"	e	
	2" CS Line	448'-3-3/4"	e	
	2" CS Line	447'-9"	e	
	2" CS Line	437'-6"	e	
	8105-CS	437'-6"	e	
	HCV-186-CS (valve)	447'-9"	e	
	2" CS Line	427'-0"	e	
	2" CS Line	428'-8"	e	
	Cable Tray	431'-11"	e	
	Cable Tray	430'-4"	e	
	Cable Tray	430'-4"	e	

TABLE 3-1 (Continued)

Overhead Lifting Device: 10-Ton Bridge Crane and Electric Cable Hoist, XCR-47

Impact Area: Elevation 447', column lines P to R and 8.8 to 9.5, Drumming Station

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Shielded and Unshielded Rad Waste Containers ≤ 10 Ton	2" CS Line	427'-0"	e	See Section 3.26
	2" CS Line	428'-0"	e	
	2" CS Line	428'-8"	e	
	Cable Tray	431'-5"	e	
	Cable Tray	430'-4"	e	
	Cable Tray	430'-4"	e	

TABLE 3-1 (Continued)

Overhead Lifting Device: 1 1/2-Ton Hand Chain Hoist and Plain Trolley, XCR-48

Impact Area: Elevation 412', Column Lines B.8 to D and 12, Turbine Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Instrument and Air Compressor Assembly Parts ≤ 1-1/2 Ton	None	N/A	c	See Section 3.27

TABLE 3-1 (Continued)

Overhead Lifting Device: 10-Ton Bridge Crane and Electric Cable Hoists, XCR-51 and XCR-50

Impact Area: Elevation 436', Service Water Intake Screen and Pump House

Figure: 8

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. Service Water Traveling Screen Parts ≤ 10 Ton	Service Water Traveling Screen and Pump Assembly	436'	b	See Section 3.28
2. Service Water Pump 14,000 lbs.	Service Water Traveling Screen and Pump Assembly	436'	b	See Section 3.28
3. Service Water Pump Motor 15,650 lbs.	Service Water Traveling Screen and Pump Assembly	436'	b	See Section 3.28

TABLE 3-1 (Continued)

Overhead Lifting Device: 2-Ton Twin Hook Extension Hoist, XCR-53A, B, and C

Impact Area: Elevation 475', Reactor Building

Figure: 5

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
CRDM Cable Support Structure	None	N/A	c	See Section 3.29

TABLE 3-1 (Continued)

Overhead Lifting Device: 1-Ton Jib Crane, XRW-11

Impact Area: Elevation 436', column lines Q and 7.7, Auxiliary Building - North (Drumming Station)

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
None	N/A	N/A	f	See Section 3.30

TABLE 3-1 (Continued)

Overhead Lifting Device: 3-Ton Jib Crane, XRW-13

Impact Area: Elevation 436', column lines Q and 7.8 to 8.7, Drumming Station

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
1. Concrete Plugs 1770 lbs.	None	N/A	c,e	See Section 3.31 ≤ 2500 lbs.
2. Spent Filters and Cartridges Negligible	None	N/A	c,e	See Section 3.31 ≤ 2500 lbs.
3. Storage Casks 2590 lbs.	None	N/A	c,e	See Section 3.31
4. Storage Casks and Lifting Beam 3940 lbs.	None	N/A	c,e	See Section 3.31

TABLE 3-1 (Continued)

Overhead Lifting Device: Reactor Building Equipment Access Hatch Crane

Impact Area: Elevation 413', Reactor Building

Figure: 5

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
None	N/A	N/A	c	See Section 3.32

TABLE 3-1 (Continued)

Overhead Lifting Device: 5-ton Hand Chain Hoist and Geared Trolley, XCR-40

Impact Area: Elevation 436', column lines H4 to H7 and 5.9 to 7.5, Intermediate Building

Figure: 4

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
Main Steam Isolation Valve Pieces	1. Component Cooling Heat Exchanger	412'	e	See Section 3.33
	2. Component Cooling Pumps	412'	e	
	3. Motor Driven Feedwater Pumps	412'	e	

TABLE 3-1 (Continued)

Overhead Lifting Device: One-Ton Jib Crane and Electric Chain Hoist, XCR-55

Impact Area: Elevation 463' Reactor Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
N/A	N/A	N/A	f	See Section 3.34

TABLE 3-1 (Continued)

Overhead Lifting Device: One-Ton Jib Crane and Electric Chain Hoist, XCR-56

Impact Area: Elevation 463' Reactor Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
N/A	N/A	N/A	f	See Section 3.34

TABLE 3-1 (Continued)

Overhead Lifting Device: One-Ton Jib Crane and Electric Chain Hoist, XCR-57

Impact Area: Elevation 463' Reactor Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
N/A	N/A	N/A	f	See Section 3.34

TABLE 3-1 (Continued)

Overhead Lifting Device: One-Ton Jib Crane and Electric Chain Hoist, XCR-58

Impact Area: Elevation 463' Reactor Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
N/A	N/A	N/A	[illegible]	See Section 3.34

TABLE 3-1 (Continued)

Overhead Lifting Device: 1/2-Ton Manual Chain Hoist, XCR-60

Impact Area: Elevation 485' Auxiliary Building

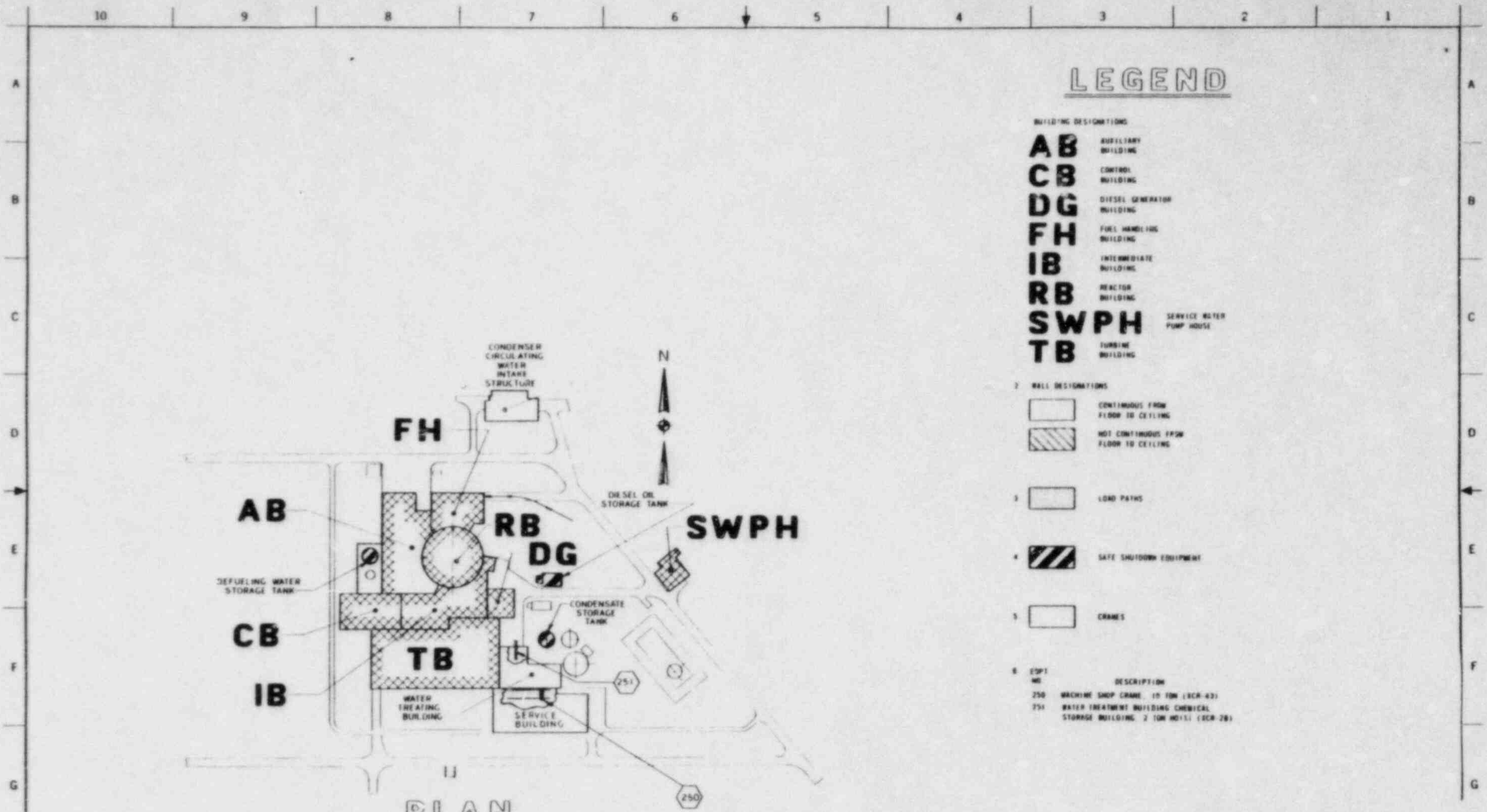
Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
N/A	N/A	N/A	f	See Section 3.36

TABLE 3-1 (Continued)

Overhead Lifting Device: 1/4-Ton Jib Crane and Electric Chain Hoist, XCR-61

Impact Area: Elevation 457'-0" Control Building

Designated Heavy Load and Weight	Safe Shutdown/Decay Heat Removal Equipment	Elevation of Equipment	Hazard Elimination Category	Section Reference (Remarks)
N/A	N/A	N/A	f	See Section 3.35

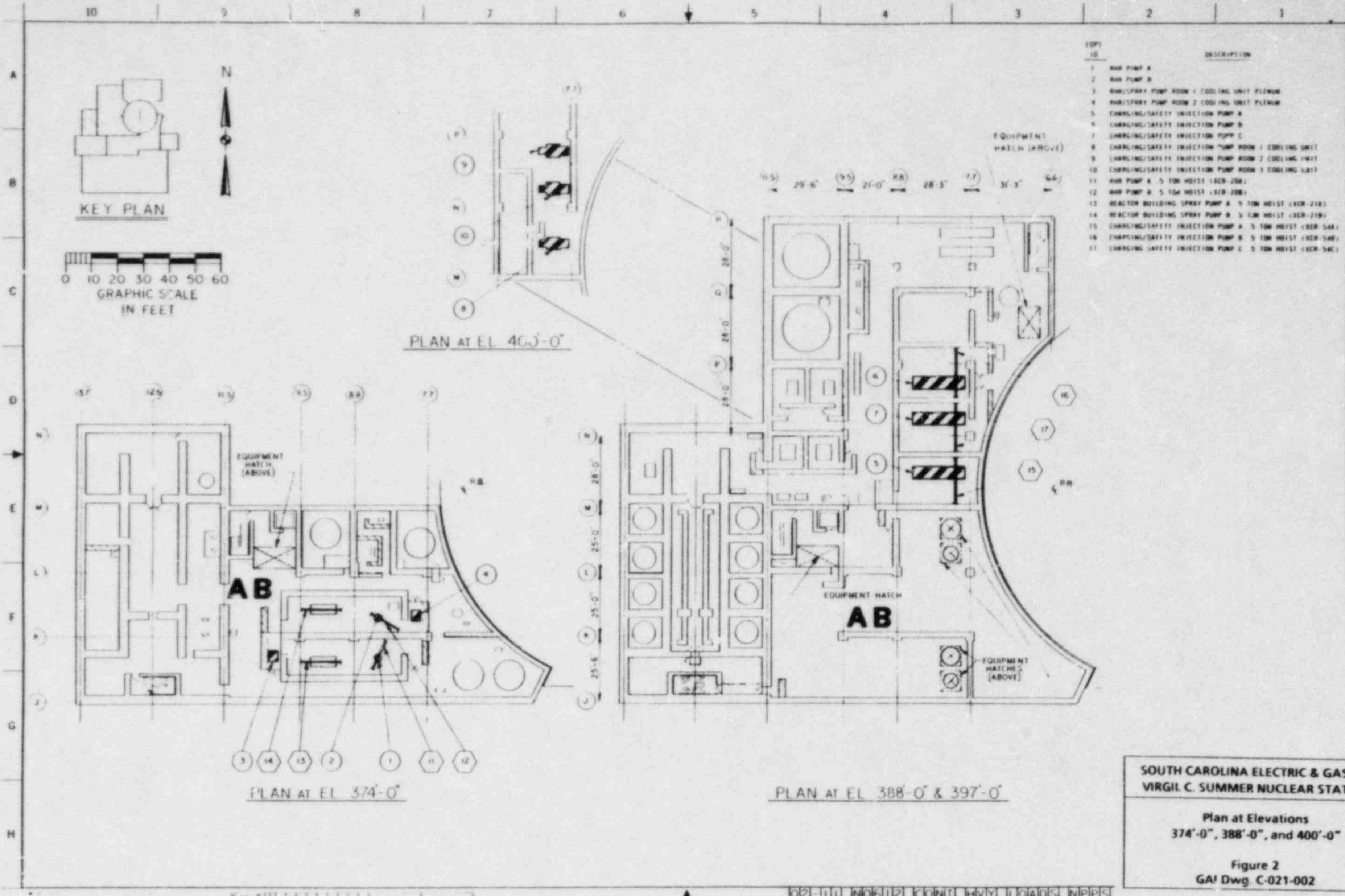


SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Site Plan

Figure 1
GAI Dwg. C-021-001

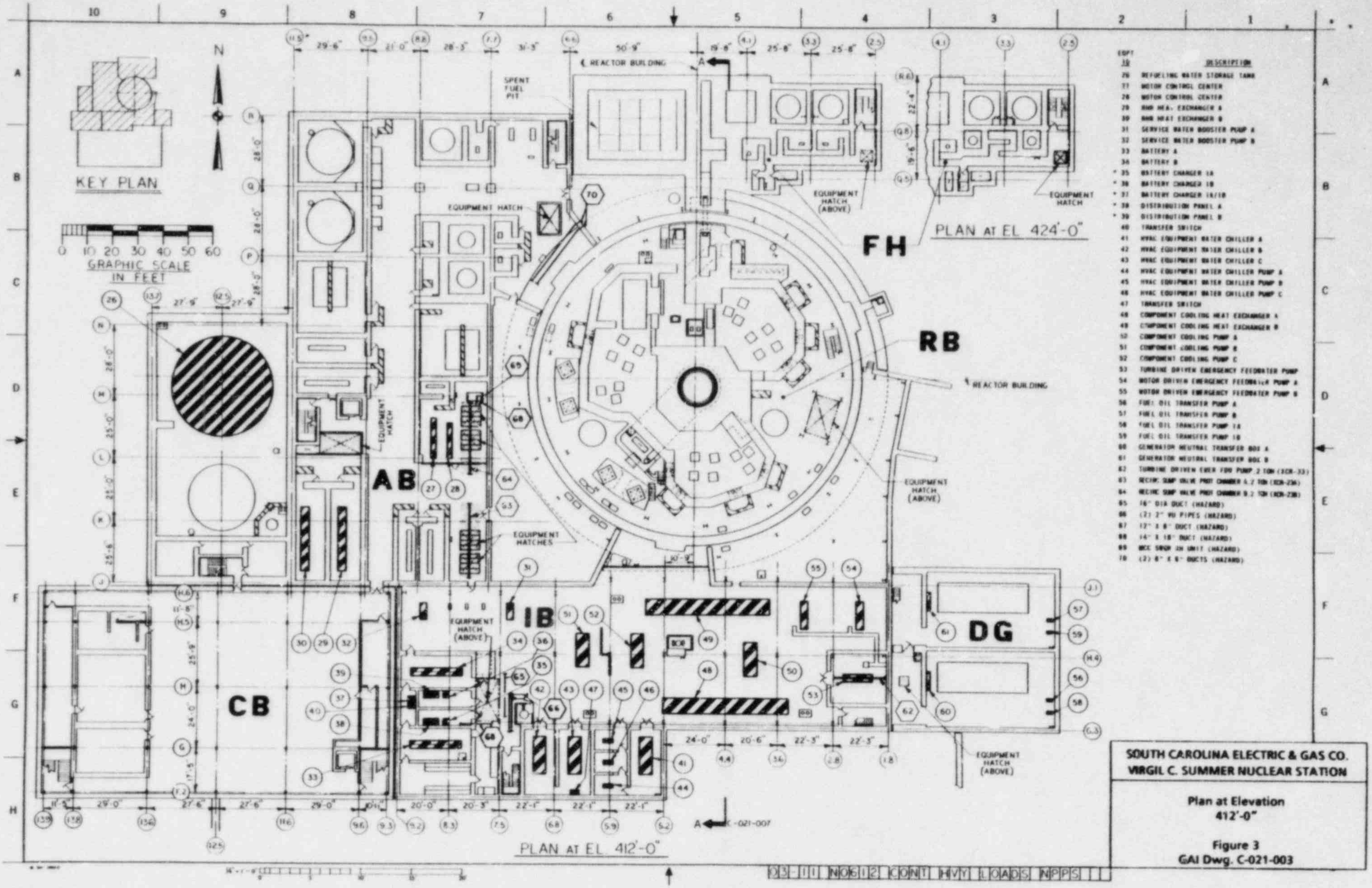
01-11 NO612 CONT HVY LOADS NPPS



SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Plan at Elevations
374'-0", 388'-0", and 400'-0"

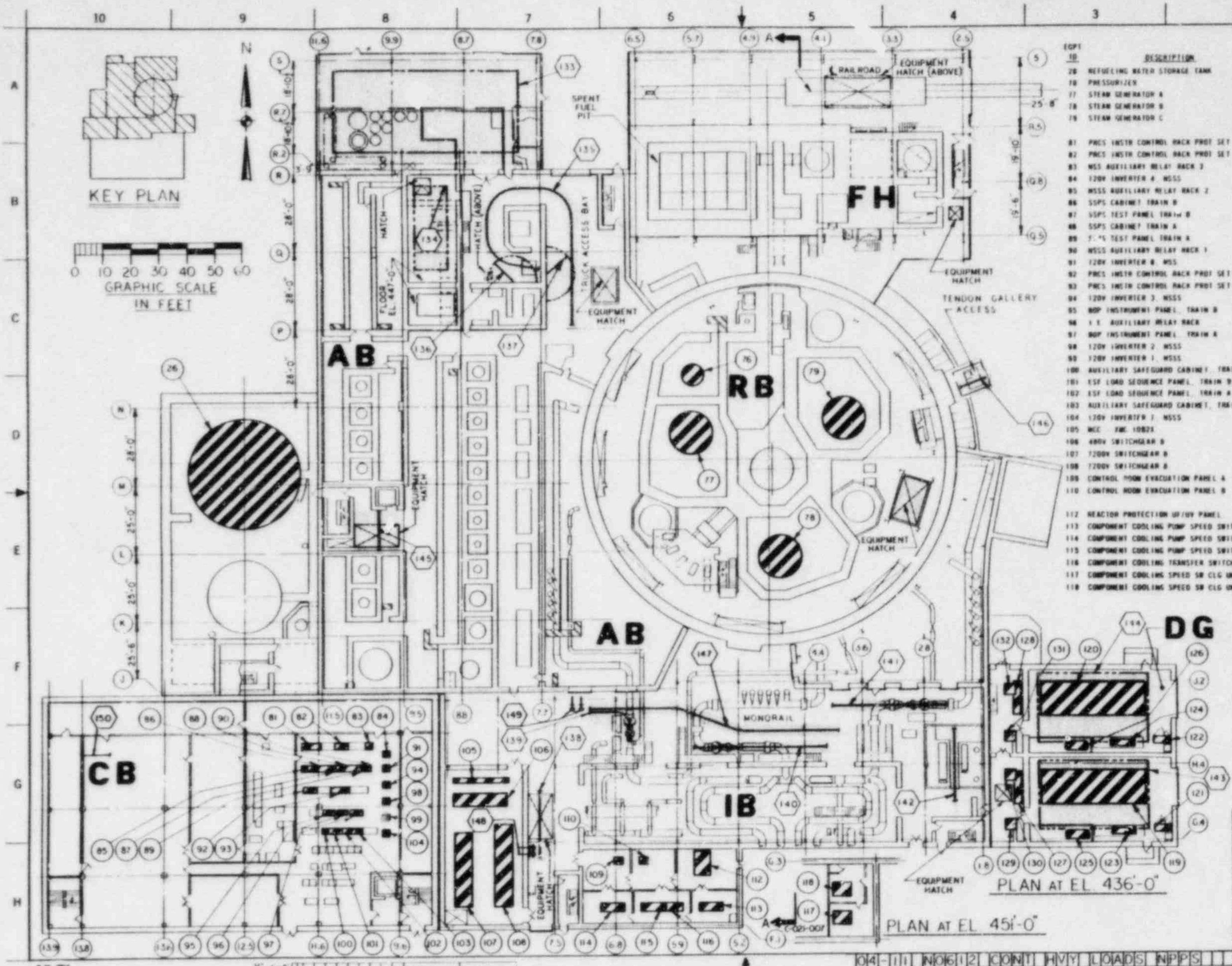
Figure 2
GAI Dwg. C-021-002



SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Plan at Elevation
412'-0"

Figure 3
GAI Dwg. C-021-003

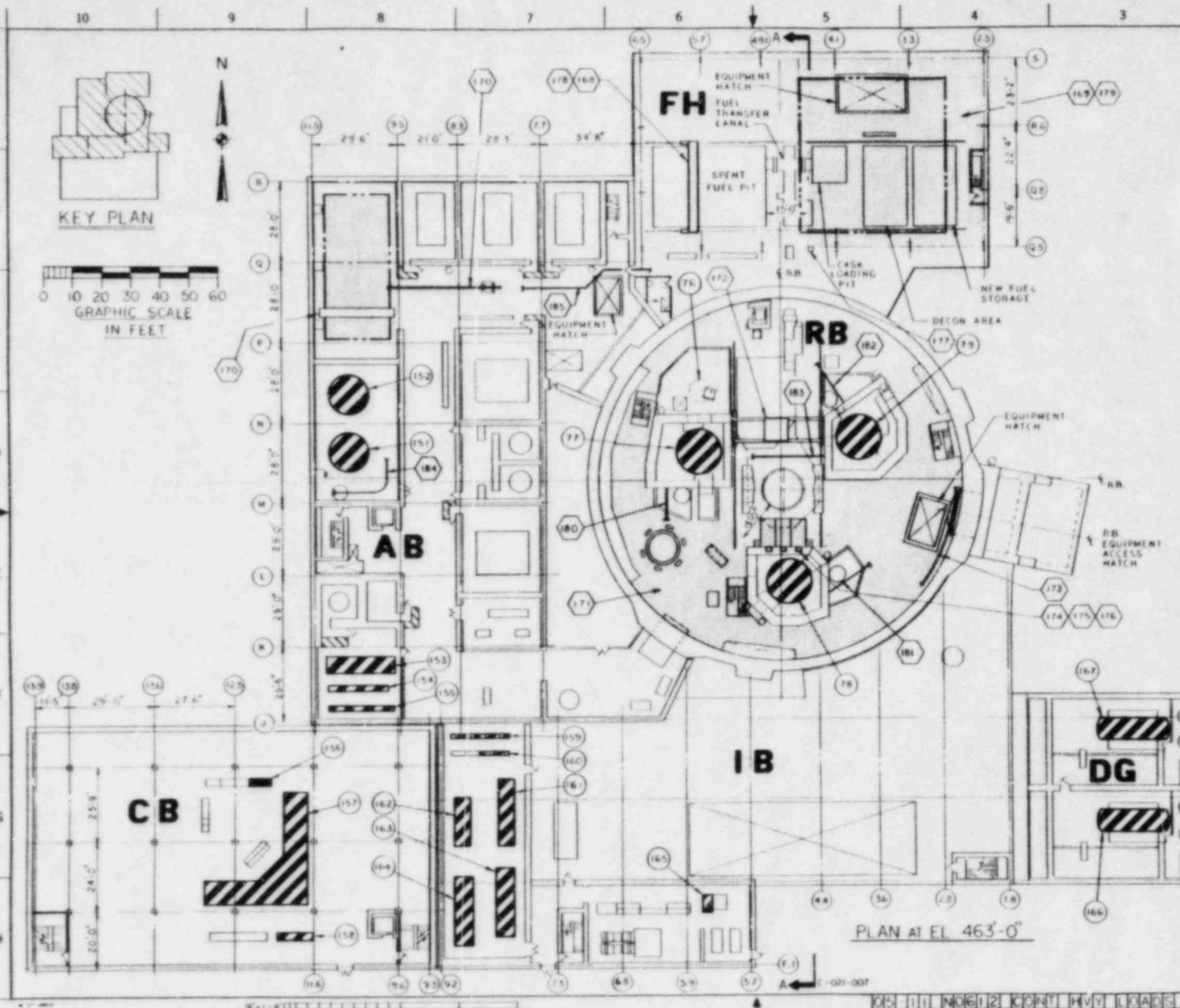


EQPT ID	DESCRIPTION
28	REFUELING WATER STORAGE TANK
76	PRESSURIZER
77	STEAM GENERATOR A
78	STEAM GENERATOR B
79	STEAM GENERATOR C
81	PRCS INSTR CONTROL RACK PROT SET III
82	PRCS INSTR CONTROL RACK PROT SET IV
83	NSS AUXILIARY RELAY RACK 3
84	120V INVERTER 4, NSSS
85	NSSS AUXILIARY RELAY RACK 2
86	SSPS CABINET TRAIN B
87	SSPS TEST PANEL TRAIN B
88	SSPS CABINET TRAIN A
89	SSPS TEST PANEL TRAIN A
90	NSSS AUXILIARY RELAY RACK 1
91	120V INVERTER B, NSS
92	PRCS INSTR CONTROL RACK PROT SET I
93	PRCS INSTR CONTROL RACK PROT SET II
94	120V INVERTER 3, NSSS
95	BOP INSTRUMENT PANEL, TRAIN B
96	I.E. AUXILIARY RELAY RACK
97	BOP INSTRUMENT PANEL, TRAIN A
98	120V INVERTER 2, NSSS
99	120V INVERTER 1, NSSS
100	AUXILIARY SAFEGUARD CABINET, TRAIN B
101	ESF LOAD SEQUENCE PANEL, TRAIN B
102	ESF LOAD SEQUENCE PANEL, TRAIN A
103	AUXILIARY SAFEGUARD CABINET, TRAIN A
104	120V INVERTER 7, NSSS
105	MCC - XMC 1082X
106	480V SWITCHGEAR B
107	7200V SWITCHGEAR B
108	7200V SWITCHGEAR A
109	CONTROL ROOM EVACUATION PANEL A
110	CONTROL ROOM EVACUATION PANEL B
112	REACTOR PROTECTION UF/UV PANEL
113	COMPONENT COOLING PUMP SPEED SWITCH A
114	COMPONENT COOLING PUMP SPEED SWITCH B
115	COMPONENT COOLING PUMP SPEED SWITCH C
116	COMPONENT COOLING TRANSFER SWITCH
117	COMPONENT COOLING SPEED SW CLG UNIT A
118	COMPONENT COOLING SPEED SW CLG UNIT B
119	DIESEL GENERATOR A
120	DIESEL GENERATOR B
121	GENERATOR LOCAL CONTROL PANEL A
122	GENERATOR LOCAL CONTROL PANEL B
123	AIR RECEIVERS, GENERATOR A
124	AIR RECEIVERS, GENERATOR B
125	FUEL OIL DAY TANK A
126	FUEL OIL DAY TANK B
127	EXCITER CONTROL PANEL A
128	EXCITER CONTROL PANEL B
129	DIESEL GENERATOR A, SUPPLY FAN A
130	DIESEL GENERATOR A, SUPPLY FAN B
131	DIESEL GENERATOR B, SUPPLY FAN A
132	DIESEL GENERATOR B, SUPPLY FAN B
133	HOT MACH SHOP CRANE, 10 TON (XCR-42)
134	LOW LVL WASTE STOR CRN, 10 TON (XCR-47)
135	RADWASTE FACILITY CRN 20 TON (XCR-36)
136	JIB CRANE, 3 TON (XRB-13-MD)
137	JIB CRANE, 1 TON (XRB-11-MD)
138	EQUIPMENT HATCH, 5 TON (XCR-27)
139	MAIN STM ISLN VALVE A 10 TON (XCR-40)
140	MAIN STM ISLN VALVE B 10 TON (XCR-40A)
141	MAIN STM ISLN VALVE C 10 TON (XCR-40C)
142	CHEMICAL STORAGE, 1/2 TON (XCR-31)
143	DSL GEN BLDG CRANE A 2 TON (XCR-29A)
144	DSL GEN BLDG CRANE B 2 TON (XCR-29B)
145	EQUIPMENT HATCH, 10 TON (XCR-18)
146	TENDON GALL ACS HATCH 1 TON (XCR-34)
147	TRANSFER MONORAIL (XCR-40B)
148	(2) 8" VU PIPES (HAZARD)
149	(2) 10" SW PIPES (HAZARD)
150	JIB CRANE (XCR-61)

SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Plan at Elevation
436'-0"

Figure 4
GAI Dwg. C-021-004

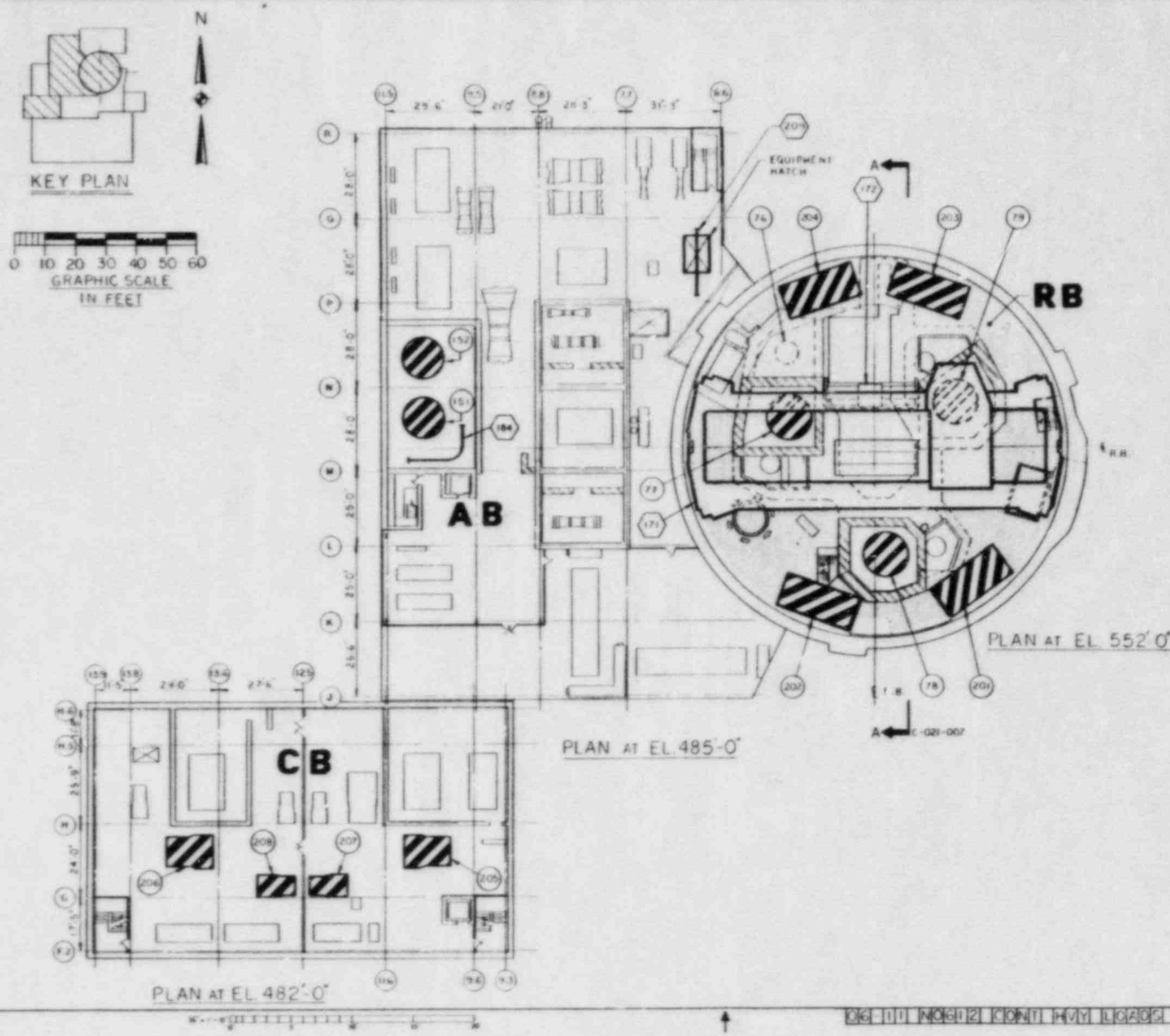


EQPT ID	DESCRIPTION
76	PRESSURIZER
77	STEAM GENERATOR A
78	STEAM GENERATOR B
79	STEAM GENERATOR C
151	BORIC ACID TANK A
152	BORIC ACID TANK B
153	480V SWITCHGEAR
154	MCC XMC1DB2Y
155	MCC XMC1DB2Y
156	NIS CONSOLES I, II, III, AND IV
157	MAIN CONTROL BOARD
158	HVAC CONTROL BOARD
159	MCC XMC1DA2X
160	MCC XMC1DA2X
161	480V SWITCHGEAR
162	480V SWITCHGEAR
163	7200V SWITCHGEAR
164	7200V SWITCHGEAR
165	REACTOR TRIP SWITCHGEAR
166	DIESEL GENERATOR A EXHAUST SILENCER
167	DIESEL GENERATOR B EXHAUST SILENCER
168	SPENT FUEL PIT BRIDGE CRANE (XCR-002)
169	FUEL HANDLING BUILDING CRANE (XCR-003) LOAD PATH
170	FILTER HANDLING CRANE 3 TON HOIST (XCR-48)
171	REACTOR BUILDING POLAR CRANE (XCR-004) LOAD PATH
172	REACTOR CAVITY MANIPULATOR CRANE (XCR-001)
173	REACTOR BUILDING EQUIPMENT ACCESS HATCH HEAD (B/W SC-4)
174	CRDM CABLE SUPPORT PLATFORM A 2 TON (XCR-53A)
175	CRDM CABLE SUPPORT PLATFORM A 2 TON (XCR-53B)
176	CRDM CABLE SUPPORT PLATFORM A 2 TON (XCR-53C)
177	NEW FUEL ELEVATOR WINCH (XCR-45)
178	PROTEX CABLE REEL (XCR-18) PART OF XCR-002
179	FUEL TRANSFER CANAL GATES 3 TON HOIST (XCR-40) PART OF XCR-003
180	JIB CRANE (XCR-55)
181	JIB CRANE (XCR-56)
182	JIB CRANE (XCR-57)
183	JIB CRANE (XCR-58)
184	(XCR-60)
185	8" X 6" DUCT (HAZARD)
	10" X 4" DUCT (HAZARD)
	12" X 8" DUCT (HAZARD)

SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Plan at Elevation
463'-0"

Figure 5
GAI Dwg. C-021-005



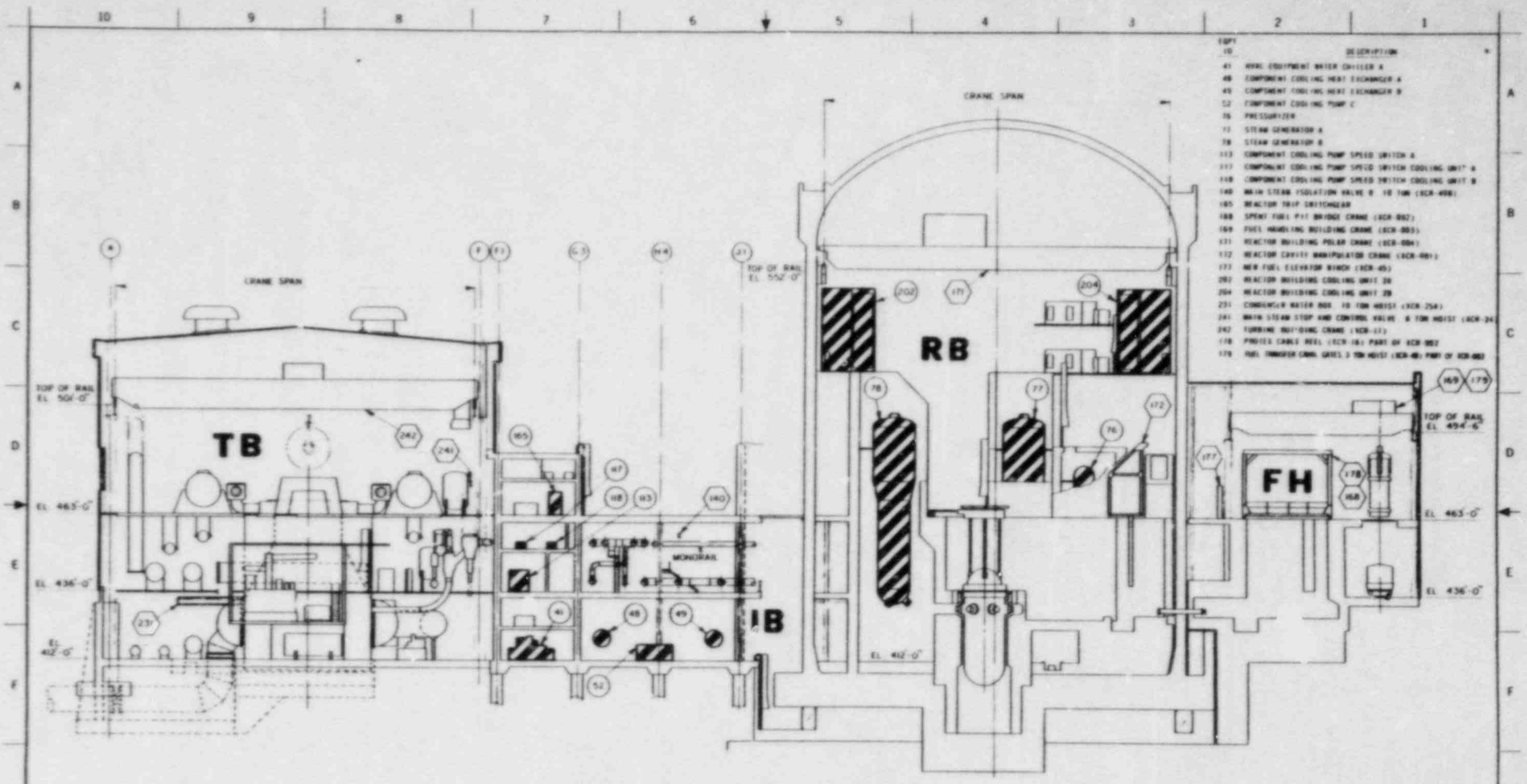
EQPT ID	DESCRIPTION
76	PRESSURIZER
77	STEAM GENERATOR A
78	STEAM GENERATOR B
79	STEAM GENERATOR C
151	BORIC ACID TANK A
152	BORIC ACID TANK B
171	REACTOR BUILDING POLAR CRANE (XCR-004)
172	REACTOR CAVITY MANIPULATOR CRANE (XCR-001)
201	REACTOR BUILDING COOLING UNIT 1A
202	REACTOR BUILDING COOLING UNIT 2A
203	REACTOR BUILDING COOLING UNIT 1B
204	REACTOR BUILDING COOLING UNIT 2B
205	CONTROL ROOM NORMAL SUPPLY AIR PLENUM A
206	CONTROL ROOM NORMAL SUPPLY AIR PLENUM B
207	RELAY ROOM SUPPLY PLENUM A
208	RELAY ROOM SUPPLY PLENUM B
209	AUXILIARY BLDG EQUIPMENT HATCH 7.5 TON CRANE (XCR-19)
184	(XCR- 60)

SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Plan at Elevations
485'-0", 482'-0", and 552'-0"

Figure 6
GAI Dwg. C-021-006

06 11 NO612 CONT HVY LOADS NPPS



SECTION A-A LOOKING WEST

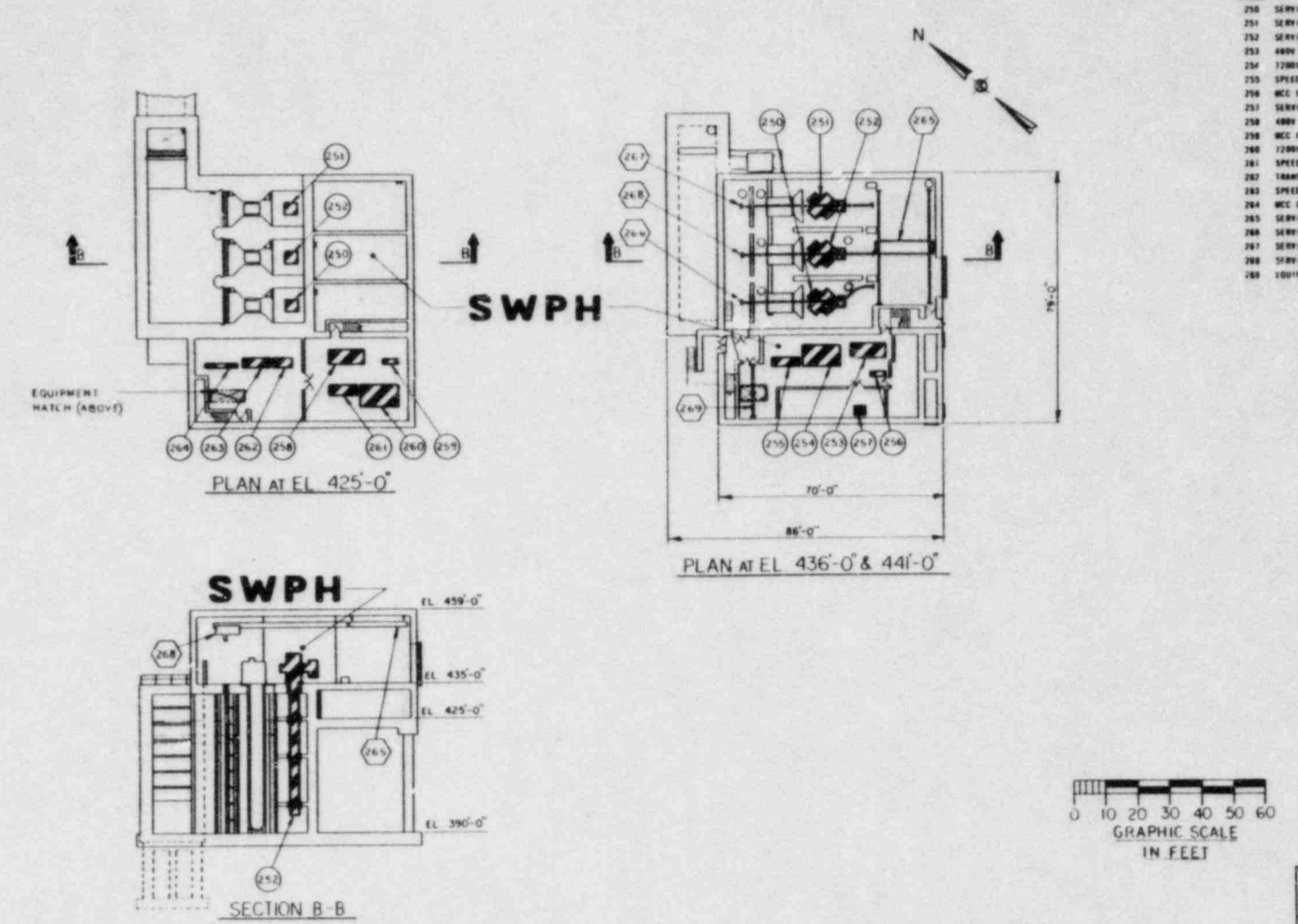
SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

General Section A-A - Looking West

Figure 7
GAI Dwg. C-021-007

07-11 NO612 CONT HVY LOADS NPPS

EQPT ID	DESCRIPTION
250	SERVICE WATER PUMP A
251	SERVICE WATER PUMP B
252	SERVICE WATER PUMP C
253	480V SWITCHGEAR B
254	7200V SWITCHGEAR B
255	SPEED SELECTOR SWITCH
256	MCC XMC1EB1X
257	SERVICE WATER PUMP HOUSE SUPPLY FANS (T AND B)
258	480V SWITCHGEAR A
259	MCC XMC1EA1X
260	7200V SWITCHGEAR
261	SPEED SWITCH
262	TRANSFER SWITCH
263	SPEED SWITCH
264	MCC XMC1EC1
265	SERVICE WATER PUMP HOUSE TRANSFER RAIL, 10 TON HOIST (XCR-51)
266	SERVICE WATER PUMP A, 10 TON HOIST (XCR-50)
267	SERVICE WATER PUMP B, 10 TON HOIST (XCR-50)
268	SERVICE WATER PUMP C, 10 TON HOIST (XCR-50)
269	EQUIPMENT HATCH, 2 TON MONORAIL



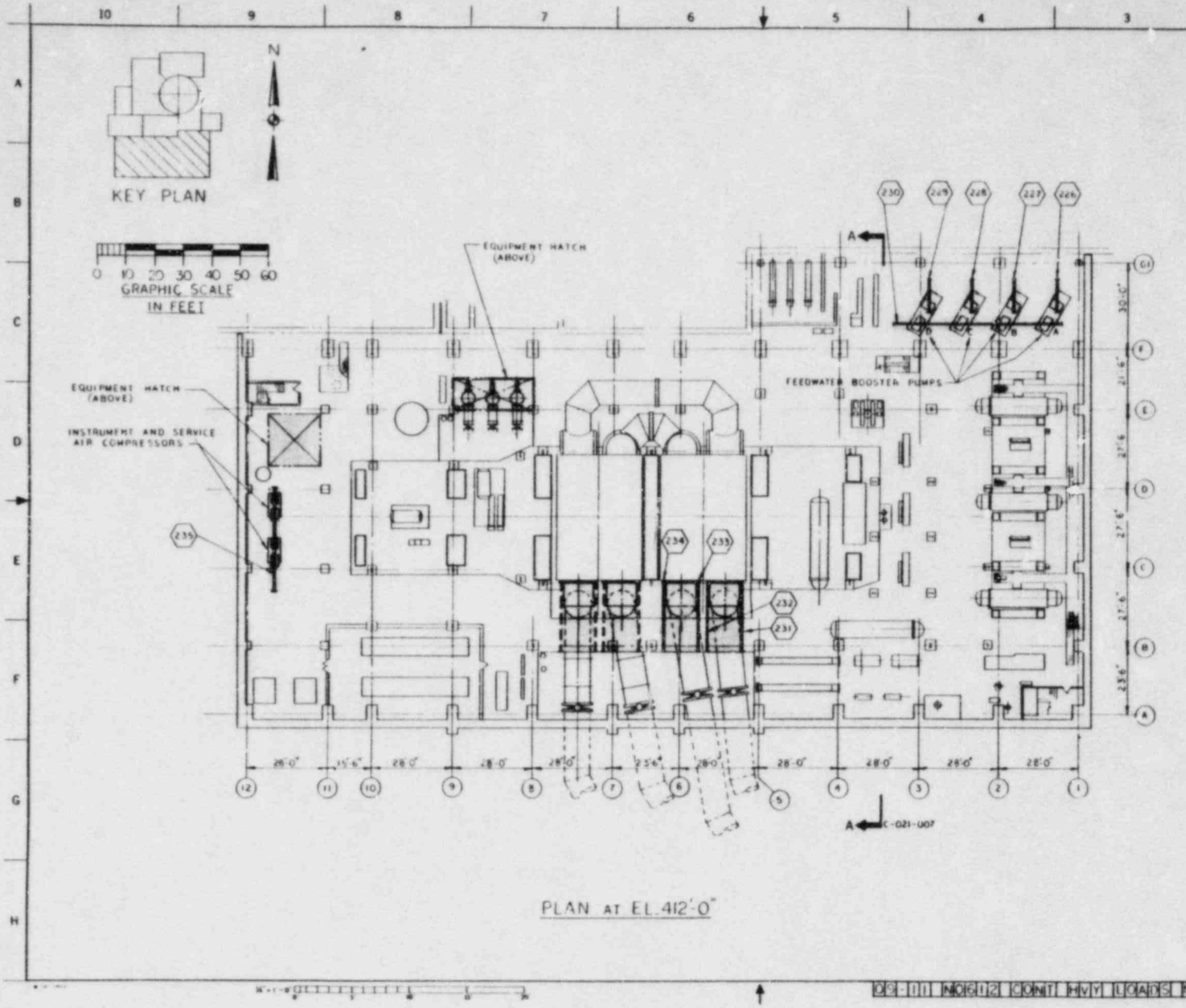
SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Service Water Pump House

Figure 8
GAI Dwg. C-021-008

08-111 NO612 CONT HVY LOADS NPPS

EQPT ID	DESCRIPTION
226	FEEDWATER BOOSTER PUMP A. 4 TON HOIST (XCR-28)
227	FEEDWATER BOOSTER PUMP B. 4 TON HOIST (XCR-28)
228	FEEDWATER BOOSTER PUMP C. 4 TON HOIST (XCR-28)
229	FEEDWATER BOOSTER PUMP D. 4 TON HOIST (XCR-28)
230	FEEDWATER BOOSTER PUMPS A THRU D. 4 TON HOIST (XCR-28)
231	CONDENSER WATER BOX. 10 TON HOIST (XCR-25A)
232	CONDENSER WATER BOX. 10 TON HOIST (XCR-25B)
233	CONDENSER WATER BOX. 10 TON HOIST (XCR-25C)
234	CONDENSER WATER BOX. 10 TON HOIST (XCR-25D)
235	INSTRUMENT AND SERVICE AIR COMPRESSOR. 1-1/2 TON HOIST (XCR-48)

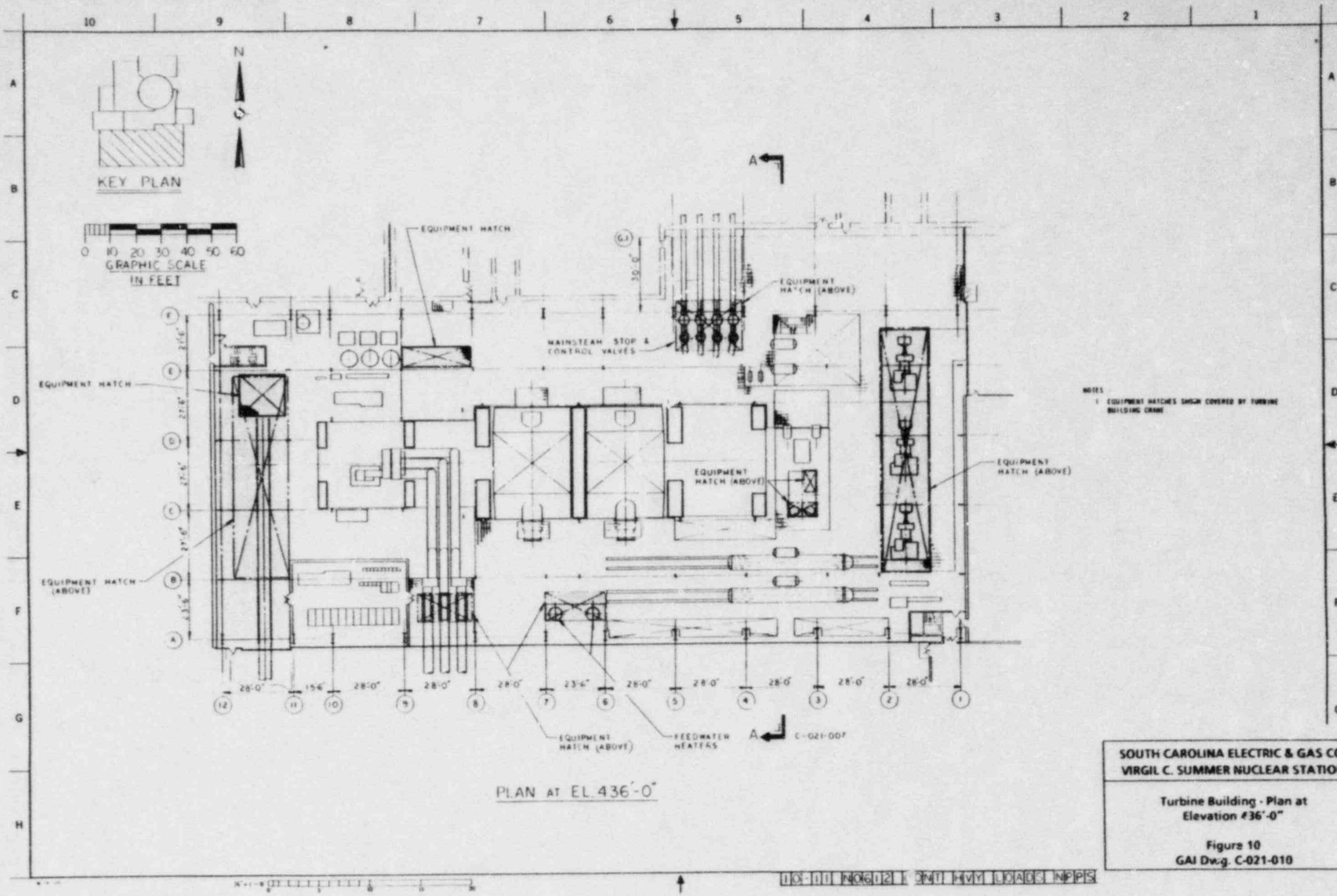


SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Turbine Building - Plan at Elevation 412'-0"

Figure 9
GAI Dwg. C-021-009

09-11 NO612 CONT HVY LOADS NPPS

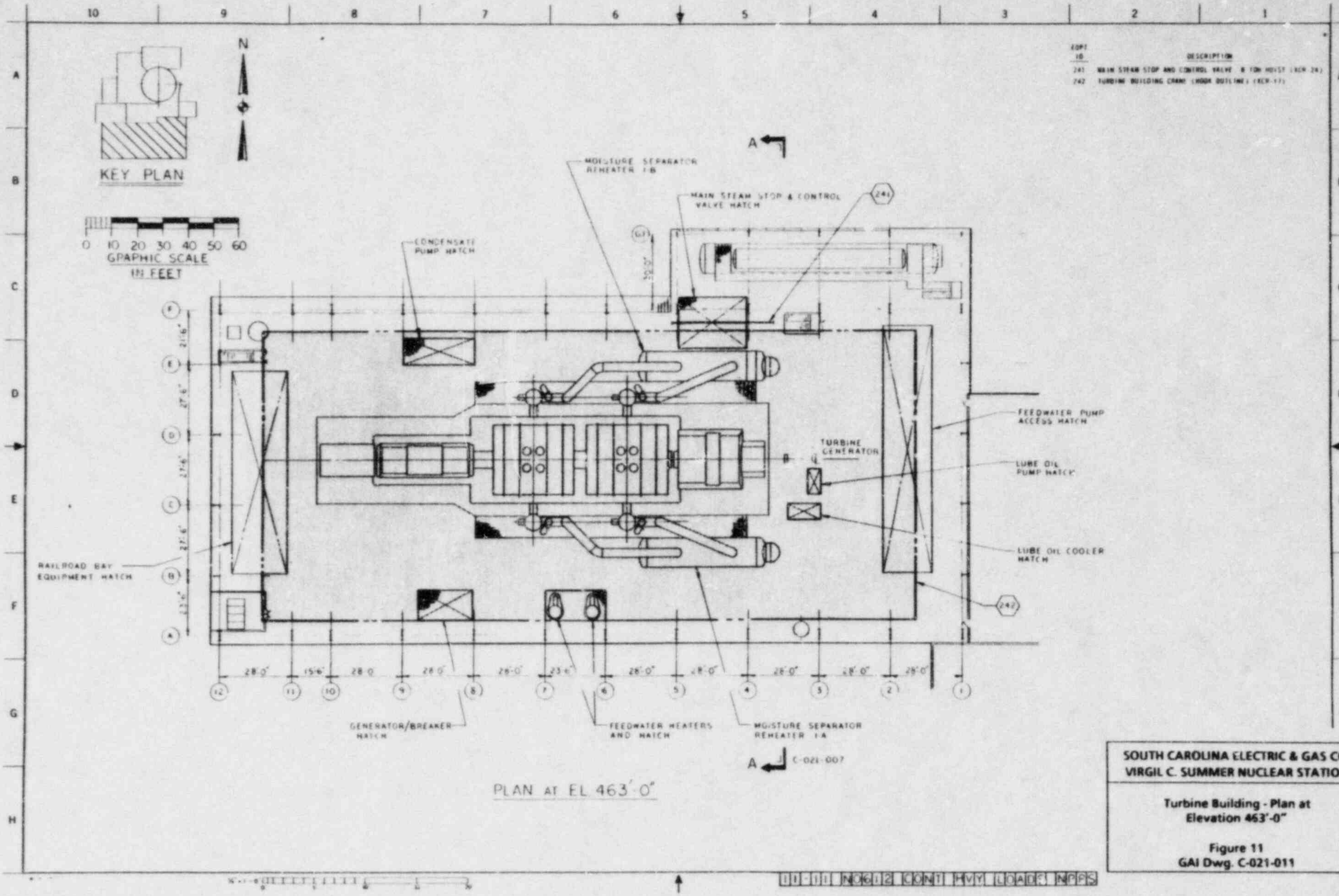


SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Turbine Building - Plan at
Elevation 436'-0"

Figure 10
GAI Dwg. C-021-010

10-11 NO612 CNT HVY LOADS NPPS



SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Turbine Building - Plan at Elevation 463'-0"

Figure 11
GAI Dwg. C-021-011

4.0 CODE AND STANDARD COMPLIANCE

4.1 CRANE DESIGN

As stated in NUREG-0612, Section 5.1.1 and Enclosure 3 of D. G. Eisenhut's December 22, 1980 letter, it should be verified that crane design complies with the guidelines of CMAA Specification 70 and Chapter 2-1 of ANSI B30.2. As already stated in the individual overhead handling device descriptions, each device design was required by the original Purchasing Specification to adhere to the guidelines of the above standards, and each supplier adhered to the standards quoted above to the extent to which they were applicable.

4.2 LIFTING DEVICES

The lifting devices at the Virgil C. Summer Nuclear Station are grouped into two general categories: special lifting devices and slings. These lifting devices do not comply with either the requirements of ANSI N14.6-1978, "Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More Nuclear Material," or ANSI B30.9-1971, "Slings". Alternate methods for demonstration of equivalency are provided by a detailed inspection and testing program. Maintenance procedures have been developed to perform frequent and periodic inspection, which include visual and non-destructive examination of critical surfaces. Periodic load tests are performed to verify structural adequacy of the special lifting devices. All rigging and lifting devices are controlled and maintenanced using the plants computerized preventative maintenance program (CHAMPS). Existing inspection and maintenance procedures are outlined in the Virgil C. Summer's Nuclear Station Operations Mechanical Maintenance Procedure MMP-165.8, "Use and Control of Rigging Equipment".

4.2.1 Special Lifting Devices for Reactor Vessel Servicing

Several special lifting devices are provided at the Virgil C. Summer Nuclear Station for servicing reactor vessel components. These devices include the reactor vessel head lift rig, the reactor vessel internals lift rig, the load cell, and load cell linkage.

An evaluation of the acceptability of the reactor vessel head lift rig, reactor vessel internals lift rig, load cell, and load cell linkage has been performed (see Westinghouse WCAP 10233). The evaluation included a stress report and a critical items list prepared in accordance with ANSI N14.6-1978.

The following conclusions resulted from the evaluation:

1. Design, fabrication, and quality assurance of these special lift devices are generally in agreement with ANSI N14.6.

2. The ANSI N14.6 criteria for stress limits associated with certain stress design factors for tensile and shear stresses are adequately satisfied.

3. The application of the ANSI N14.6 criteria for stress design factor of 3 and 5 are only for shear and tensile loading conditions. Other loading conditions are analyzed to other appropriate criteria.

4. These special lift devices are not in strict compliance with the ANSI N14.6 requirements for acceptance testing, maintenance, and verification of continuing compliance.

5. In lieu of the requirement of ANSI N14.6, Section 5.2.1, requiring an initial acceptance load test prior to use equal to 150 percent of the maximum load, the 125 percent of

maximum load test that was performed is considered to meet the intent of the load test requirement.

6. The non-destructive testing of the lifting device welds as required by ANSI N14.6 is not performed because:

   a. The items that are welded remain assembled and cannot be misused for any other lift other than their intended function.

   b. All tensile and shear stresses in the welds are within the allowable stress.

   c. Access to the welds for surface examination is difficult. These rigs are in containment and some contamination is present.

   d. To perform non-destructive tests would require:

      (1) Removal of paint around the area to be examined which is contaminated.

      (2) Performance of either magnetic particle inspection or liquid penetrant inpsection and

      (3) Repainting after testing is completed.

      (4) Cleanup of contaminated items.

   e. Performing non-destructive tests on these welds every refueling would increase the critical path refueling time.

7. Dimensional checking as required by ANSI N14.6 is not performed since these lifting rig structures are large (about

13 feet diameter by 43 feet high) and the results of dimensional checking would always be questionable. Other checks on critical load path parts, such as pins, are also not included since an examination of these items would require disassembly of the special lift devices.

The following recommendations resulting from the evaluation address the areas of ANSI N14.6 which are incompatible with the special lifting devices for reactor vessel servicing and which are considered most important in demonstrating the continued reliability of these devices.

1. The stresses determined in the evaluation, although higher than the ANSI N14.6 allowables, are considered acceptable since:

    a. The design weight used in the stress calculations is based on the weight of the lower internals. The lower internals are only removed when a periodic inservice inspection of the vessel is required (once/10 years).

    b. Normal use of the rig is for moving the upper internals which weigh less than one-half of the lower internals. The design weight is based on lifting the lower internals. Thus, all the stresses could be reduced by approximately 50 percent and considered well within the ANSI N14.6 criteria for stress design factors.

    c. Prior to removal of the lower internals, all fuel is removed. Thus, the concern for handling over fuel is non-existent in this particular case.

2. SCE&G maintenance procedures should include consideration of ANSI N14.6 Sections 5.1.3 through 5.1.8. These sections include requirements for: scheduled periodic testing;

special identification and marking; maintenance, repair, testing and use. Westinghouse remarks on addressing these sections are listed in Attachment A, Appendix B, Items 5, 6, and 7 of WCAP-10233.

3. SCE&G maintenance procedures should be revised to include the following in lieu of ANSI N14.6 Section 5.3 which requires, annually, either a 150 percent maximum load test or dimensional, visual and non-destructive testing of major load carrying welds and critical areas.

a. Reactor Vessel Head Lift Rig

Prior to use and after reassembly of the spreader assembly, lifting lug, and upper lifting legs to the upper portion of the lift rig, visually check all welds. Raise the vessel head slightly above its support and hold for 10 minutes. During this time, visually inspect the sling block lugs to the lifting block welds, and spreader lug to spreader arm weld. If no problems are apparent, continue to lift, monitoring the load cell readout at all times.

b. Reactor Vessel Internals Lift Rig

Prior to use, visually inspect the rig components and welds while on the storage stand for signs of cracks or deformation. Check all bolted joints to ensure that they are tight and secure. After connection to the upper or lower internals, raise the assembly slightly off its support and hold for 10 minutes. During this time, visually inspect the sling block lugs to the lifting block welds. If no problems are apparent, continue to lift, monitoring the load cell readout at all times.

4. A periodic non-destructive surface examination of critical welds and/or parts should be performed once every ten years as part of an inservice inspection outage.

4.2.2 Slings

Dynamic load calculations were performed on each hoist to determine loading characteristics. The calculations were conducted in accordance CMAA Specification No. 70, 1983 Edition, Paragraph 3.3.2.1.1.1.4.2. The results of these calculations are presented in Table 4-1. The dynamic load associated with each electrified hoist was found to be 15% or less in all cases due to generally slow hoisting speeds. Dynamic load characteristics for manual hoists have not been established by the applicable code, HMI 200. To establish an analysis criteria for these hoists and apply CMAA Specification No. 70 Standard, it was necessary to determine the maximum instantaneous lifting speed. The maximum chain overhaul speed established for these hoists was 90 fpm which results in extremely slow hoisting speeds and negligible dynamic loading forces. It is felt that this method complies with the intent of Guideline 5 of NUREG-0612. The lifting devices were excluded from further study on the basis that all hazards to essential shutdown equipment were eliminated by the methods previously discussed in this report.

4.3 INSPECTION, TESTING, AND MAINTENANCE

Cranes and rigging equipment are maintained, tested, and inspected to the requirements of ANSI B30.2, Chapter 2-1. The crane and rigging equipment are scheduled for the specific maintenance tasks by the plant's computerized history and maintenance program (CHAMPS).

TABLE 4-1

RESULTS OF IMPACT LOADING CALCULATIONS

CRANE TAG NO.	RATED CAPACITY (TONS)	LIFTING SPEED (FPM)	ACTUAL IMPACT LOAD (TONS)	ALLOWABLE IMPACT LOAD (TONS)
XCR-3 (MAIN HOIST)	125	6	3.75	18.75
XCR-3 (AUX. HOIST)	25	27	3.38	3.75
XCR-4 (MAIN HOIST)	360	4.2	7.56	54.00
XCR-4 (AUX. HOIST)	25	27	3.38	3.75
XRW-13	3	22	0.33	0.45
XCR-18	10	20	1.00	1.50
XCR-19	7.5	20	0.75	1.13
XCR-20	5	0.45	0.01	0.75
XCR-21	5	0.45	0.01	0.75
XCR-23	2	1.67	0.02	0.30
XCR-27	5	22	0.55	0.75
XCR-28	2	20	0.20	0.30
XCR-29	2	1.67	0.02	0.30
XCR-33	2	1.67	0.02	0.30
XCR-36	20	10	1.00	3.00
XCR-40	10	0.23	0.01	1.50
XCR-42	10	20.7	1.00	3.00
XCR-46	3	22	0.33	0.45
XCR-47	10	11	0.55	1.50
XCR-49	3	30	0.45	0.45
XCR-50	10	20	1.00	1.50
XCR-51	10	0.23	0.01	1.50
XCR-53	2	1.67	0.02	0.30
XCR-54	5	0.45	0.01	0.75

4.4 CRANE OPERATOR TRAINING

Nuclear Operations at the Virgil C. Summer Nuclear Station conducts an extensive training program for its crane operators and riggers which meets or exceeds all the requirements of Chapter 2-3 of ANSI B30.2. The Nuclear Operations Maintenance group at the plant conducts a program for the crane operators and riggers entitled "Basic Operator and Rigger Training Program" which covers the following topics:

a) OPERATIONAL SAFETY PRACTICES AND PREVENTATIVE INSPECTION AND MAINTENANCE
b) WRIGHT WIRE ROPE ELECTRIC HOIST
c) ANSI B30.16 - 1973, "OVERHEAD HOIST"
d) SPECIFICATIONS FOR ELECTRIC OVERHEAD TRAVELING CRANES C.M.A.A. #70
e) WHITING OVERHEAD CRANE - P&H OVERHEAD CRANE
f) MMP 165.3, "TURBINE BUILDING CRANE INSPECTION AND MAINTENANCE PROCEDURE"
g) MMP 165.7, "MAINTENANCE OF THE REACTOR BUILDING POLAR AND FUEL HANDLING BUILDING CRANES"
h) NUREG-0554, "SINGLE-FAILURE-PROOF CRANES FOR NUCLEAR POWER PLANTS"
i) ANSI B30.2.0-1976, "OVERHEAD AND GANTRY CRANES"
j) OSHA 1910.179, "OVERHEAD AND GANTRY CRANES"
k) INSTRUCTION MANUAL MANIPULATOR CRANE
l) SPENT FUEL BRIDGE CRANE
m) ANSI B30.9-1971, "SLINGS"
n) MMP 165.8, "USE AND CONTROL OF RIGGING EQUIPMENT"
o) ANSI B30.10-1975, "HOOKS"
p) GMP-100.011, "CRANE OPERATIONS - REACTOR BUILDING"
q) GMP-100.012, "CRANE OPERATIONS - FUEL HANDLING BUILDING"
r) GMP-100.013, "CRANE OPERATIONS - AUXILIARY BUILDING"
s) GMP-100.014, "CRANE OPERATIONS - INTERMEDIATE BUILDING"
t) GMP-100.015, "MISCELLANEOUS CRANE OPERATIONS"

u) MMP-500.005, "REACTOR VESSEL HEAT REMOVAL AND INSTALLATION"

v) MMP-500.006, "REACTOR VESSEL INTERNALS REMOVAL/REINSTALLATIONS"

w) INSTRUCTION OF CRANES:

1) Wright Electric Hoist 3/20 Tons
2) P&H-Turbine Building 220/30 Tons
3) Polar Crane-Reactor Building 360/25 Tons
4) Manipulator Crane-Reactor Building
5) Whiting Overhead Crane-Fuel Handling Building 125/25 Tons
6) Spent Fuel Bridge Crane-Fuel Handling Building

The crane operator and rigger training programs include in-class written examinations and in-plant examinations for practical application. After a crane operator or rigger becomes qualified by the training program, an annual physical examination and a biennial retraining and requalification of the crane operators and riggers are required.

5.0 PROCEDURES

Since the Virgil C. Summer Nuclear Station is in commercial operation, most procedures for handling heavy loads with overhead handling devices have been developed. Currently maintenance procedures are developed to encompass overhead handling systems with respect to the safe load paths. Where safe load paths can not be established, special lifting procedures are developed, and where possible special lifting instructions are incorporated into specific component maintenance procedures. Any deviation from established safe load paths is enforced by established procedures.

Procedures have been transmitted from Westinghouse Electric Corporation to South Carolina Electric and Gas Company for the handling of new and spent fuel, refueling, and for the operation of refueling equipment. These procedures have been reviewed and placed into a standard format prior to issuance and use.

The individual overhead handling device descriptions in Section 3.0 indicate where procedures have been developed to minimize the possibility of an inadvertant heavy load drop.

APPENDIX A

STRUCTURAL ANALYSIS OF DROPPED HEAVY LOADS

APPENDIX A

STRUCTURAL ANALYSIS OF DROPPED HEAVY LOADS

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APPENDIX A

STRUCTURAL ANALYSIS OF DROPPED HEAVY LOADS

A.1 INTRODUCTION

An evaluation of the hypothetical heavy-load drop accidents has been made to demonstrate compliance with Criteria III and IV of NUREG 0612, Section 5.1. Appendix A presents a summary of the results.

Two (2) potential drop areas have been identified requiring structural evaluation to determine if the floor slabs and support systems adequately protect the identified targets. The floor slabs evaluated are in the Intermediate Building at elevation 436' bounded by Column Lines J1 and H4 between lines 2 and 8 (Figure 4), and in the drumming station and truck bay of the Auxiliary Building at elevation 436' bounded by Column Lines P and R between lines 6.6 and 8.8 (Figure 4).

The calculation method adopted uses the energy absorption concept with conservative assumptions. By comparing the ultimate energy absorption capacity of the slab with the kinetic energy at impact of the falling object, it can be determined whether the dropped object can be prevented from striking the designated target.

A.1.1 INITIAL CONDITIONS

A.1.1.1 Case A: Intermediate Building

Target: The safe-shutdown equipment to be protected in this area are Component Cooling Heat Exchanger XHE-2B-CC, Component Cooling Pumps XPP-1A, B, and C-CC, and Motor Driven Feedwater Pumps XPP-21A and B. All of these are located at elevation 412'.

Load: The postulated dropping object is a main steam isolation valve weighing 27,250 lbs. with a dropping height of 20 feet. The approximate overall dimensions of the valve are: 14 feet in length and 4 feet in diameter. The dropping valve may strike the target slab in any location or orientation. However, it has been determined that the valve hitting vertically on the center of panel between beam supports would be the worst case.

Slab: All the floor slabs in this area are supported by steel beams and have similar panel arrangements, thickness, and reinforcement. A typical slab is 2 feet thick with #9 at 12" top and bottom steels in N-S direction and with #10 at 12" top steels and #9 at 12" bottom steels in E-W direction. For simplicity, it was idealized as an isotropic slab with #9 at 12" top and bottom steels. The insitu steel decking was ignored.

A.1.1.2 Case B: Drumming Station/Truck Bay

Target: Spent Fuel Cooling Pump XPP-32B at elevation 412' is the single safe-shutdown equipment in this area.

Load: The postulated dropping object is the radwaste cask with an empty weight of 25,250 lbs. and maximum filled weight of 40,000 lbs. The cask's overall dimensions are 5'-7-5/8" in height and 4'-9-5/8" in diameter. The maximum dropping height is 10 feet, measured from the bottom of the cask to the top of floor slabs. The most critical dropping orientation is when the long axis of cask makes an approximate 45 degree angle with the vertical and strikes at the center of the slab panel.

Slab: The slab over the target is 3 feet thick, supported and monolithic with concrete walls and with reinforcement: #10 at 6" of top and bottom steels in E-W direction and #10 at 12" top and bottom steels in N-S direction.

A.2 ASSUMPTIONS/IDEALIZATIONS

A.2.1 MATERIAL PROPERTIES

For Concrete:

f'_c = Compressive Strength = 3,000 psi

ε_c = Ultimate Compressive Strain = 0.003

For Reinforcing Steel:

F_y = Yield Stress = 60,000 psi

F_u = Ultimate Tensile Strength = 90,000 psi

E_s = Young's Modulus = 29×10^6 psi

ε_s = Ultimate Tensile Strain = 0.13

A.2.1.1 Loading Conditions

The impact load is distributed over a small area of the contact surface between the dropping object and target slab. For simplicity, it is conservatively assumed that the impact load acts as a concentrated impulsive force.

A.2.1.2 Local Effects

Local effects such as penetration and perforation are not considered to be of concern in view of the large slab thicknesses and low velocities at impact of dropped objects.

A.2.1.3 Energy Absorption Mechanism

The kinetic energy of a dropping object upon impact may be dissipated in several of the following ways:

a. Energy absorption by the target slabs resulting from the elastic response of the structure to the impact.

b. Energy absorption by the dropping object due to plastic deformation during collision.

c. Energy absorption by the target slabs due to plastic deformation and local crushing.

The manner of absorption of the total kinetic energy of the dropping object will depend on the sharpness, mass, and velocity of the dropping object, and also the material properties of both the dropping object and target slabs. It is conservative in the present analysis to assume that all of the energy absorption capacity will be due to the plastic deformation of the impacted floor slab.

A.3 BEHAVIOR OF REINFORCED CONCRETE SLABS UNDER IMPACT

References 1 and 2 describe the plastic collapse mechanisms of reinforced concrete slabs with different boundary conditions and subjected to different loading cases.

In the case of a concentrated impact force, a collapse mechanism corresponding to a cone, whose axis is normal to the slab and passes through the point of load application, may form. For isotropic slabs (same reinforcement in both directions), the collapse area will be limited by a circular yield line. For orthotropic slabs (different reinforcement in orthogonal directions), the collapse area will be limited by an elliptic yield line. The slabs in the Intermediate Building (Case A) are, therefore, likely to experience a circular failure mode while slabs in Drumming Station/Truck Bay (Case B) experience an elliptic failure mode.

For both Case A and Case B, it is found that the concrete will reach its ultimate compressive strain before the tensile steel breaks. When the concrete is completely crushed, the slab loses its moment resistance. However, it can sustain further impact through the membrane effect of reinforcing steel until the steel strain also reaches the ultimate limit. For Case A, the existing steel deck underneath the slabs will prevent the scabbing of concrete from underneath the slab; however, its resistance to impact has been neglected.

A.4 EVALUATION OF SLAB CAPACITY

To evaluate the total capacity of the target slab, two (2) contributions need to be evaluated: the capacity due to bending along yield lines U_b and the capacity due to membrane effect U_m. Results are summarized in Table A-1.

The kinetic energy of the dropping object and the external work done by the dead load and service load are given in Table A-2. Comparison of Table A-1 and Table A-2 shows that for both Case A and Case B, the energy capacity of the target slab is larger than the applied kinetic energy due to drop of corresponding loads.

A.5 SUMMARY/CONCLUSIONS

It is concluded that the 24 inch slabs in the Intermediate Building and the 36 inch slabs in Drumming Station/Truck Bay of the Auxiliary Building are capable of withstanding the impact from a dropped heavy-load. The factor of safety is 1.21 for Case A and 5.6 for Case B.

The results are considered to be conservative for the following reasons:

1. It is assumed that all of the kinetic energy will be converted into the plastic strain energy of the target slab.

2. Permissible increases of 25% for compressive strength of concrete and 10% for yield stress of reinforcing steel for dynamic loading are not utilized.

3. The energy absorption capacity of girder supports and insitu steel deck in Case A is neglected.

It should be noted that the foregoing investigation did not consider any effects that localized distortion at impact may have on the supports of services hung directly from the underside of the elevation 436' slab. For Case A, scabbing of the underside of the slab can be discounted because of the presence of insitu steel decking; however, for Case B some scabbing is a possibility that has not been evaluated in this study.

A.6 REFERENCES

1. Wood, R.H., "Plastic and Elastic Design of Slabs and Plates", The Ronald Press Company, New York, 1961.

2. Save, M.A. and Massonnet, C.E., "Plastic Analysis and Design of Plates, Shells and Disks", American Elsevier Publishing Company, Inc., New York, 1972.

TABLE A-1

THE ENERGY CAPACITY OF TARGET SLABS

Location	Case A Intermediate Building	Case B Drumming Station/ Truck Bay (Auxiliary Building)
Thickness	2'-0"	3'-0"
Reinforcement	Each Way, Each Face (#9 at 12")	(#10 at 6" E-W) (#10 at 12" N-S)
Insitu Steel Deck	Yes	No
Secondary Beam Support	Yes	No
Failure Mode	Circular	Elliptic
U_b	6675.18 k-in.	24197.02 k-in
U_m	1382.40 k-in.	5760.00 k-in.
$U_p = U_b + U_m$	8057.58 k-in.	29957.02 k-in.

Gilbert/Commonwealth

TABLE A-2

KINETIC ENERGY DUE TO DROPPED LOADS

Location	Case A Intermediate Building	Case B Drumming Station/ Truck Bay (Auxiliary Building)
Dropped Load	Main Steam Isolation Valve	Radwaste Cask
Weight	27,250 lbs.	40,000 lbs.
Dropping Height	20 ft.	10 ft.
Kinetic Energy V_k	6540 k-in.	4800 k-in.
Work Due to D.W. of Slab V_d	9.5 k-in.	49.1 k-in.
Estimated Work Due to Service Load and Live Load	95 k-in.	491 k-in.
$V_t = V_k + V_d + V_s$	6645 k-in.	5340 k-in.

APPENDIX B

WESTINGHOUSE ANALYSIS OF THE REACTOR BUILDING

APPENDIX B

WESTINGHOUSE ANALYSIS OF THE REACTOR BUILDING

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B.1 INTRODUCTION

The following sections are the procedures and results of Westinghouse's analysis of heavy load drops from the Reactor Building Polar Crane in the Reactor Building, as transmitted in Reference 6.

B.2 PROCEDURE

The heavy loads under consideration are those given in Table 1-1, handled by the Reactor Building Polar Crane. The loads will be compared, where applicable, to the loads given in the head drop analysis of Reference 4. In this analysis, a dropped integrated head package weighing 423,841 lbs. was shown to cause no consequential damage to the structural integrity of the vessel nozzles, core cooling capability, or integrity of the fuel cladding.

Each of the loads in Table 1-1 will be evaluated as a separate postulated drop accident against the total integrated head assembly drop accident postulated in Reference 4.

B.3 RESULTS

For each of the items handled by Reactor Building Polar Crane XCR-4, the following results were obtained:

1. CRDM Missle Shields (54,000 lbs.) - If dropped on a closed vessel, it would cause damage to CRDM's and reactor vessel head. However, loads on the reactor vessel, reactor vessel nozzles, and fuel assemblies would be less than those caused by the reactor head drop discussed in Reference 4.

2. Reactor Vessel Head Assembly (.68,000 lbs.) - Westinghouse has performed a dropped head analysis, provided in

Reference 4, that assures the consequences of dropping the reactor vessel head assembly at all critical points along its travel path to the vessel head storage stand. This analysis shows that the buckling load on affected fuel assemblies would not exceed design limits and that there would not be any damage to the structural integrity of the reactor vessel, reactor vessel nozzles, or reactor coolant loop piping.

Therefore, since the total head assembly weight for the Virgil C. Summer Nuclear Station is less than in Reference 4 and since the travel path to the storage stand is essentially the same, it can be concluded that the core cooling capability and fuel cladding integrity will be maintained.

3. Reactor Vessel Head Lifting Rig (21,000 lbs.) - This item would not cause unacceptable loads on the reactor vessel or nozzles. However, it should not be carried over the open vessel after the upper internals have been removed and prior to removal of the fuel assemblies.

4. Upper Internals and Internals Lifting Rig (92,000 lbs.) - The loads produced by dropping the upper internals are less than those discussed in Reference 4 because the weight is less.

5. Lower Internals and Internals Lifting Rig (268,000 lbs.) - The core must be completely removed prior to removal of lower internals, therefore fuel damage is not a problem. The loads on the reactor vessel nozzles would be smaller than those in Reference 4.

6. Internals Lifting Rig (19,000 lbs.) - This item would not cause unacceptable loads on the reactor vessel or nozzle. However, it should not be carried over the open vessel after the upper internals have been removed and prior to removal of the fuel assemblies.

7. ISI Tool and Westinghouse-Supplied Lifting Device (20,000 lbs.) - This item would not cause unacceptable loads on the reactor vessel or nozzle. However, it should not be carried over the open vessel after the upper internals have been removed and prior to removal of the fuel assemblies.

8. RCP Internals (48,000 lbs.), RCP Casing and Lifting Beam (52,000 lbs.) and RCP Motor (77,140 lbs.) - Loads on the reactor vessel nozzles and the reactor vessel would be less than those discussed in Reference 4. Damage to the upper head assembly would be significant and if the head assembly and the upper internals were not in place, possible fuel cladding failure and release of radioactive materials would take place. Therefore, the RCP assembly parts should not be carried over the reactor vessel cavity without the reactor vessel shield in place.

9. RV Studs, Nuts, and Washer Stand (8500 lbs.) - This item would not cause unacceptable loads on the reactor vessel or nozzles. However, it should not be carried over the open vessel after the upper internals have been removed and prior to removal of the fuel assemblies.

10. Equipment Bridge (4000 lbs.) - This item would not cause unacceptable loads on the reactor vessel or nozzles. However, it should not be carried over the open vessel after the upper internals have been removed and prior to removal of the fuel assemblies.

It can therefore be concluded that for the above postulated drop accidents there will be no consequential damage to the structural integrity of the vessel nozzles, no loss of core cooling capability, or loss of fuel cladding integrity.

B.4 REFERENCES

1. GAI Letter CGGW-1647, dated August 6, 1981.

2. NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants", July, 1980.

3. NRC Letter by D. G. Eisenhut of December 22, 1980 and attachments.

4. WCAP-9289, "Integrated Vessel Head Package for One-Lift Operation", March, 1978.

5. GAI Report No. 2289, "Control of Heavy Loads at Nuclear Power Plants - Virgil C. Summer Nuclear Station Unit 1", June 22, 1981.

6. Westinghouse Letter CGWG-2440 and attachment.

APPENDIX C

ANALYSIS OF IMPACT LOADS

APPENDIX C

ANALYSIS OF IMPACT LOADS

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C.1 INTRODUCTION

An evaluation was performed to determine the effects of a large steel beam impacting a section of service water piping. The service water line of interest is located at elevation 451'-6" in the Auxiliary Building near the equipment hatch for XCR-19. The line cannot be struck by a load drop; however, an inadvertent movement of the trolley could cause an odd size load, such as large steel beam, to strike the service water pipe.

C.2 BASIS FOR ANALYSIS

The following data were used as the input to the analysis:

I-Beam: Size: W 18 x 60
Length: 14 ft
Total Weight: 840 lbs

Pipe: Size: 16"
Wall Thickness: 0.375"
Material: SA 106 Gr B
Support: 11.27 ft span fixed at both ends

A W 18 x 60 I-beam was chosen for the study since this is the largest section that could be expected at the elevation of the pipe.

The evaluation investigated both pipe puncture and pipe collapse. The criteria used for pipe puncture was based on an equation developed by The Stanford Research Institute, as noted below:

$$\left(\frac{e}{d}\right)^2 + \frac{3F}{128}\left(\frac{e}{d}\right) = \frac{0.0452\ DV_o^2}{Su}$$

where,

- e = Penetration depth (in.)
- d = Effective projectile diameter (in.)
- F = B/d, except $F \leq 100$ (e/d) and $F \leq 8$, whichever is lower
- B = Width of plate between rigid supports (in.)
- D = W/d^3, caliber density (lb/in^3)
- W = Projectile weight (lb)
- V_o = Traveling speed of projectile (lb)
- Su = Ultimate strength (lb/in^2)

The criteria used for pipe collapse is based on a ductility analysis of the pipe. The equations and curves used for the analysis were taken from "Introduction to Structural Dynamics" by J. M. Briggs, McGraw Hill, 1960, page 72.

C.3 RESULTS

The evaluation indicates that the pipe is in no danger due to the impact of the beam. The puncture analysis showed that maximum indentation of the pipe to be 0.016 inches which is much less than the 0.375 inch wall thickness. The ductility analysis determined that the pipe stays well within its elastic limits after the impact; therefore, pipe collapse can be eliminated as a concern.

C.4 REFERENCES

1. GAI Drawing C-314-251, Rev. 5.

2. ASCE, "Structural Analysis and Design of Nuclear Plant Facilities", 1980, page 346.

3. ASME Boiler and Pressure Vessel Code Section III, Division 1, Appendices, Table I-1.1.

4. "Introduction to Structural Dynamics", J. M. Briggs, McGraw Hill, 1960, page 72.

5. "Formulas for Stress and Strain", R. J. Roark and W. C. Young, 5th Edition, McGraw Hill, 1975, page 576.