GPU Nuclear

GPU Nuclear Corporation
Post Office Box 388
Route 9 South
Forked River, New Jersey 08731-0388
609 971-4000
Writer's Direct Dial Number:

February 15, 1985

Mr. John A. Zwolinski, Chief
Operating Reactors Branch No. 5
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Zwolinski:

Subject: Oyster Creek Nuclear Generating Station
Docket No. 50-219
Generic Letter 81-07 (Heavy Loads)

Pursuant to the requirements of Generic Letter 81-07 dated December 22, 1980, enclosed please find our response to NUREG-0612, Phase II.

Should you have any questions, please contact me or Mr. Drew Holland of my staff at (609)971-4643.

Very truly yours,

Peter B. Fiedler
Vice President and Director
Oyster Creek

PBF/dam
Enclosure

cc: Dr. Thomas E. Murley, Administrator
Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

NRC Resident Inspector
Oyster Creek Nuclear Generating Station
Forked River, NJ 08731

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ENCLOSURE I
RESULTS AND STATUS OF NUREG-0612
HEAVY LOAD HANDLING EVALUATIONS FOR OYSTER CREEK NUCLEAR STATION

Overview of NUREG-0612 Evaluations

General Public Utilities' (GPU) initial submittals addressing NUREG-0612 included identification of the fixed handling systems to which NUREG-0612 is applicable. They are:

Recirculation Pump Monorail
Reactor Building Bridge Crane

GPU's submittals to date relative to these two handling systems have addressed all of the requests for information in Section 2.1 of Enclosure 3 to D. Eisenhut's generic letter of December 22, 1980 with the exception of providing a response to item 3.f. A response to this item relative to the Recirculation Pump Monorail has not been provided previously because of the lack of available design documentation. During the current outage, actual measurements have been taken and the design evaluation requested in NUREG-0612 and generic letter Item 3.f has been performed. The results of the design evaluation are provided in Appendix A and indicate that the intent of the criteria in NUREG-0612, Section 5.1.1 is satisfied.

With regard to the additional evaluations requested in NUREG-0612 and Section 2.2 and 2.3 of Enclosure 3 to the December 22, 1980 letter to address handling system reliability and/or load drop consequences, there are two basic approaches available to licensees. They are: (1) demonstrate adequate load handling reliability or (2) demonstrate that load drop consequences are within the limits of the four criteria delineated in NUREG-0612 Section 3.1. The objective of GPU's evaluations to date have been to attempt to demonstrate acceptable consequences (i.e., the second approach).

A combination of systems, structual, criticality and dose evaluations have been utilizied to address the NUREG-0612 guidelines for Oyster Creek. To assist in performing these evaluations the Reactor Building was subdivided into eight (8) load impact regions. The subdivisions were based, in part, on the configuration of the building and a knowledge of specific locations where heavy loads are typically handled. These regions are identified in Table 1. Note that Regions 1-7 apply to the Reactor Building Crane and Region 8 is applicable to the Recirculation Pump Monorail. Figures 1 and 2 illustrate the load handling paths for loads handled by the Reactor Building Crane. Figures 3 through 9 show how the refueling floor was subdivided into Load Impact Regions for evaluation purposes.

Table 2 relates the defined load impact regions with the four acceptance criteria listed in Section 5.1 of NUREG-0612. As indicated in the table, the majority of the regions were defined to assist with and focus safe shutdown evaluations to address NUREG-0612 Criterion IV.

Table 3 indicates the types and combinations of evaluations employed for each region.

Table 4 provides a listing of loads handled by the Reactor Building Crane that were considered in the evaluations. The Reactor Building Crane load block was not considered as a potential heavy load for the reasons described below.

NUREG-0612 requires that the load block and hook be considered as a heavy load. The load block is used for handling several loads. In moving these loads, the hook, load block, rope, drum, sheave assembly, motor shafts, gears and other load bearing members are subjected to significant stresses approaching the load rating of the crane. By comparison, these components are subjected to a considerably smaller load when only the hook and load block are being moved. Accordingly the likelihood of dropping the load block and hook without a load due to a structural failure is considered negligible.

The more likely cases for dropping of the load block and hook would be due to a "two-blocking" event or due to an uncontrolled lowering. The Oyster Creek Reactor Building crane main hoist and auxiliary hoist are provided with design features to minimize the potential for such events. The main hoist and auxiliary hoist are provided with dual and diverse upper limit switches such that when the hoist block reaches a pre-determined limit of travel, current to the hoist motor is interrupted. Each hoist is provided with a screw type limit switch as well as a load block position limit switch. Additionally, the main hoist and auxiliary hoist are equipped with redundant electric holding brakes. Each holding brake is solenoid released and spring applied on loss of power to the solenoid. Each solenoid brake for the main hoist has a torque rating of 140% of the full load torque of the motor, and the auxiliary hoist brakes each have a torque rating of 250% of the full load torque of the motor.

With the limit switch and braking features provided as noted above, and based on the relatively small load imparted by the main hook and load block, it is not considered reasonable to postulate dropping of the crane load block and hook when moving the main hoist load block or the auxiliary hoist hook without a load.

Systems Evaluation

As noted above, systems evaluations were utilized for many of the regions to evaluate potential load drop consequences. The objective of these systems evaluations was to determine whether defined safety functions could be accomplished assuming that certain equipment was made inoperable as a result of a postulated load drop.

The systems evaluations involved several basic steps; namely,

1) define the safety functions which must be accomplished;

2) identify the systems and support systems relied on to accomplish each safety function;

3) for each load impact region, identify the applicable safety functions and systems and determine which components of those systems could be affected by a heavy load drop within the region;

4) perform an analysis of the effects of failure of those components on the ability to accomplish the applicable safety functions.

Structural Analyses

As indicated in Table 3, a number of load impact regions were addressed utilizing structural analyses/evaluations. The load drop scenarios addressed or supported with structural analyses included:

1. drops onto and into the reactor vessel;

2. drops into the spent fuel pool;

3. drops onto concrete slabs potentially over safe shutdown equipment; and,

4. drop of a Recirc Pump Motor onto Recirc System Piping.

Fuel Integrity, Dose and Criticality Considerations

As indicated in Table 2, the integrity of spent fuel and the associated potential offsite dose/criticality consequences were considerations for Regions 1 (reactor vessel) and 3 (spent fuel pool area). For the reactor vessel, structural analyses of a vessel head drop onto the reactor pressure vessel and of a dryer or separator drop into the reactor were utilized to determine if fuel crushing leading to criticality or dose considerations could occur.

With regard to the spent fuel pool, the evaluations performed were based on the fuel storage conditions and fuel rack design that will exist after the currently planned fuel pool expansion is complete. A postulated drop of a fuel storage pool shield plug was judged to be the most limiting load drop scenario. Dose and criticality evaluations were performed for this drop.

RESULTS OF LOAD DROP CONSEQUENCE EVALUATIONS

An overview of the results of consequence evaluations performed to date by GPU is provided in Table 5. Note that the term "OK" used in the table means that the analyses/evaluations performed demonstrated compliance with the applicable NUREG-0612 acceptance criterion and the term "NO" means that it was not possible to demonstrate compliance with the applicabale NUREG-0612 acceptance criterion.

Recirculation Pump Monorail

As can be seen from the table, the potential load drop consequences associated with the Recirculation Pump Monorail were determined to be within the acceptable limits specified for the applicable NUREG-0612 criteria, Criteria III and IV. The Recirculation Pump Monorail is located in the drywell and would be used for removing and reinstalling recirculation pump motors. This would only be performed while the reactor is shutdown and in

long-term decay heat removal cooling. In this mode, the critical equipment to protect in the drywell would be piping associated with decay heat removal and instrumentation lines for vessel level monitoring. A review of piping isometrics and instrument routing shows that shutdown cooling system piping and vessel level instrument lines are routed at an elevation that is above this monorail. Accordingly, Criterion IV is met with respect to the Recirculation Pump Monorail.

With regard to Criterion III, vessel integrity, recirculation loop piping is located below this monorail and potentially could be impacted by a drop of the pump motor. Since a large break in this piping could lead to draining of the reactor vessel, structural analyses of a recirculation pump motor drop onto the recirculation loop piping were performed.

A Recirculation System piping loop consists of a suction and discharge line connected to the reactor vessel, a recirculation pump and suction and discharge valves. In addition to being connected to the reactor vessel, the loop is supported in the vertical direction by constant force hangers at (1) the midway of the vertical suction and discharge pipe sections and (2) the pump support frame.

The analysis performed was based on an energy balance method. The energy of the drop of the pump motor was equated to the energy absorbed in deforming the piping system and the work done to displace the constant force hangers. The energy potentially dissipated in connecting shock suppressors was conservatively neglected.

For determination of the flexibility of the system under the drop load, the following contributing factors were considered:

(1) flexibility of the elbows at the ends of the straight pipe sections; and,

(2) flexibility of the straight vertical pipe sections.

The results show that the discharge line is stiffer than the suction line and, therefore, carries most of the drop load. The pump support frame was calculated to displace vertically 10.8 inches due to the postulated drop and local yielding is predicted in the outer fibers of the elbow sections in the discharge line. The suction line remains elastic throughout the drop. Based on this analysis, it is concluded that the Recirulation System piping will sustain the postulated drop without loss of integrity, deformation being limited to local fiber yielding. Accordingly, NUREG-0612 Criterion III is met for the Recirculation Pump Monorail.

Reactor Building Crane

With regard to the Reactor Building Crane, problem areas were identified that involve numerous drop locations and scenarios. The number and complexity of the problem areas indicate that additional more sophisticated analyses, modifications to procedures and/or modifications to the physical plant itself to reduce the predicted consequences to acceptable levels may not be useful or feasible. Accordingly, GPU has decided to address the Reactor Building Crane on the basis of the alternative approach by the NUREG guidelines, i.e., successful demonstration of load handling reliability. At present, GPU is reviewing several alternatives for evaluating and, if necessary, improving the reliability of the Reactor Building Crane load handling system. GPU will report the results of this review and evaluation by June 15, 1985.

In the meantime, the Phase 1 actions of NUREG 0612, which Oyster Creek has implemented, afford reasonable assurance that a load drop will not occur.

TABLE I

LOAD IMPACT REGIONS

	Description
Region 1	Reactor Vessel
Region 2	Dryer/Separator Pool and 75'-3" el. immediately below the pool
Region 3	Spent fuel pool and 51'-3" el. immediately below the pool
Region 4	119' el. south of dryer/separator pool and 95'-3" el. area immediately below
Region 5	119' el. west of the dryer/separator pool, spent fuel pool and reactor cavity and north of spent fuel pool and 95'-3" el. area immediately below
Region 6	119' el. east of dryer/separator pool, spent fuel pool and reactor cavity and 95'-3" el. area immediately below
Region 7	Reactor Building Main equipment hatch
Region 8	Drywell compartment below the Recirculation Pump Monorail

TABLE 2

LOAD IMPACT REGIONS VS. NUREG CRITERIA

LOAD IMPACT REGIONS	REACTOR BUILDING CRANE							RECIRCULATION PUMP MONORAIL
NUREG-0612 CRITERIA (SECTION 5.1)	1	2	3	4	5	6	7	8
I (DOSE LIMITS)	X		X					
II (CRITICALITY)	X		X					
III (RV OR SFP INTEGRITY)	X		X					X
IV (SAFE SHUTDOWN AND DECAY HEAT REMOVAL)		X	X	X	X	X	X	X

TABLE 3

EVALUATION APPROACHES UTILIZIED
VS.
LOAD IMPACT REGIONS

LOAD IMPACT REGIONS	REACTOR BUILDING CRANE							RECIRCULATION PUMP MONORAIL
NUREG-0612 CRITERIA (SECTION 5.1)	1	2	3	4	5	6	7	8
DOSE			X					
CRITICALITY			X					
STRUCTURAL	X	X	X			X	X	X
SYSTEMS		X	X	X	X	X	X	X

TABLE 4

HEAVY LOADS CARRIED BY THE REACTOR BUILDING CRANE

LOAD	WEIGHT (TONS)
Drywell Head	62
Reactor Vessel Head	92
Cavity Shield Plugs (8)	85 ea.
Reactor Vessel Head Insulation	5
Steam Dryer	26
Steam Separator	44
Fuel Pool Gates (2)	Approx. 1 (ton each)
Spent Fuel Cask	Varies[1]
Fuel Transfer Shield ("Cattle Chute")	16.5
Equipment Storage Pool Shield Plugs (4)	37.5 to 39[2]
Dryer/Separator Sling Assembly	1.5
Fuel Storage Pool Shield Plugs (4)	4.5 ea.
New Fuel and Shipping Containers	1
Stud Tensioner Assembly	10
Plant Equipment	less than 20 tons
Head Strongback	3.7
Cavity Shield Plug Lifting Beam	4.9
Equipment Pool Plug Lifting Beam	1.9

1 Shipping casks can range from 5 tons to over 40 tons; analyses and evaluations were aimed at establishing acceptable methods of handling casks weighing up to 40 tons.

2 The top Equipment Storage Pool Shield Plug weighs 39 tons; the remaining three plugs weigh 37.5 tons each.

TABLE 5

EVALUATION RESULTS VS. LOAD IMPACT REGIONS

NUREG-0612 CRITERIA (SECTION 5.1) \ LOAD IMPACT REGIONS	REACTOR BUILDING CRANE							RECIRCULATION PUMP MONORAIL
	1	2	3	4	5	6	7	8
I (DOSE LIMITS)	NO		OK					
II (CRITICALITY)	OK		OK					
III (RV OR SFP INTEGRITY)	NO		NO					OK
IV (SAFE SHUTDOWN AND DECAY HEAT REMOVAL)		NO	NO	NO	NO	NO	NO	OK

OK - Analyses/Evaluations successfully demonstrated compliance with NUREG criterion.

NO - Analyses/Evaluations performed to date were not successful in demonstrating compliance with NUREG-0612 criterion

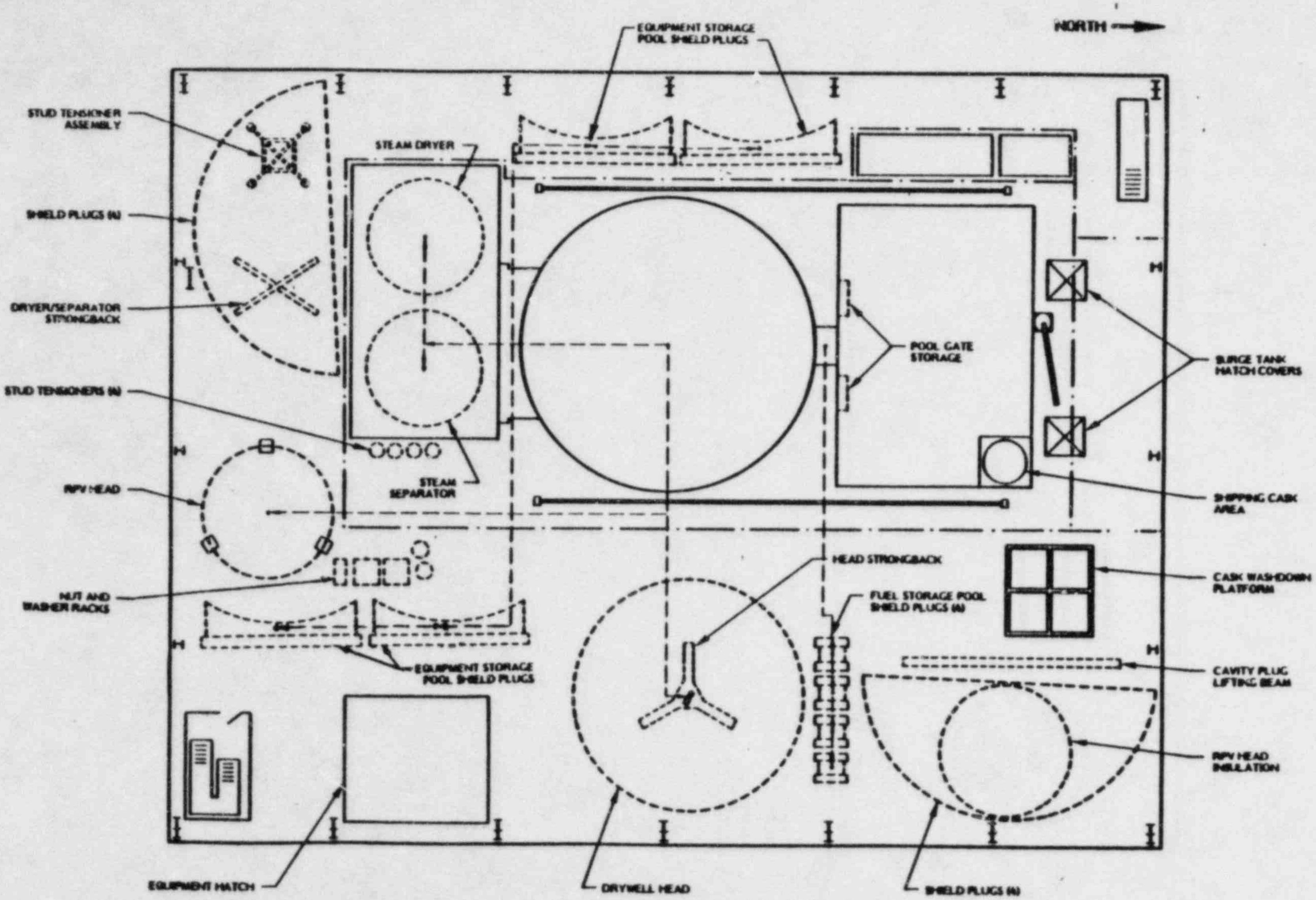

FIGURE I

LAYDOWN AREAS AND SAFE LOAD PATHS FOR MAJOR EQUIPMENT

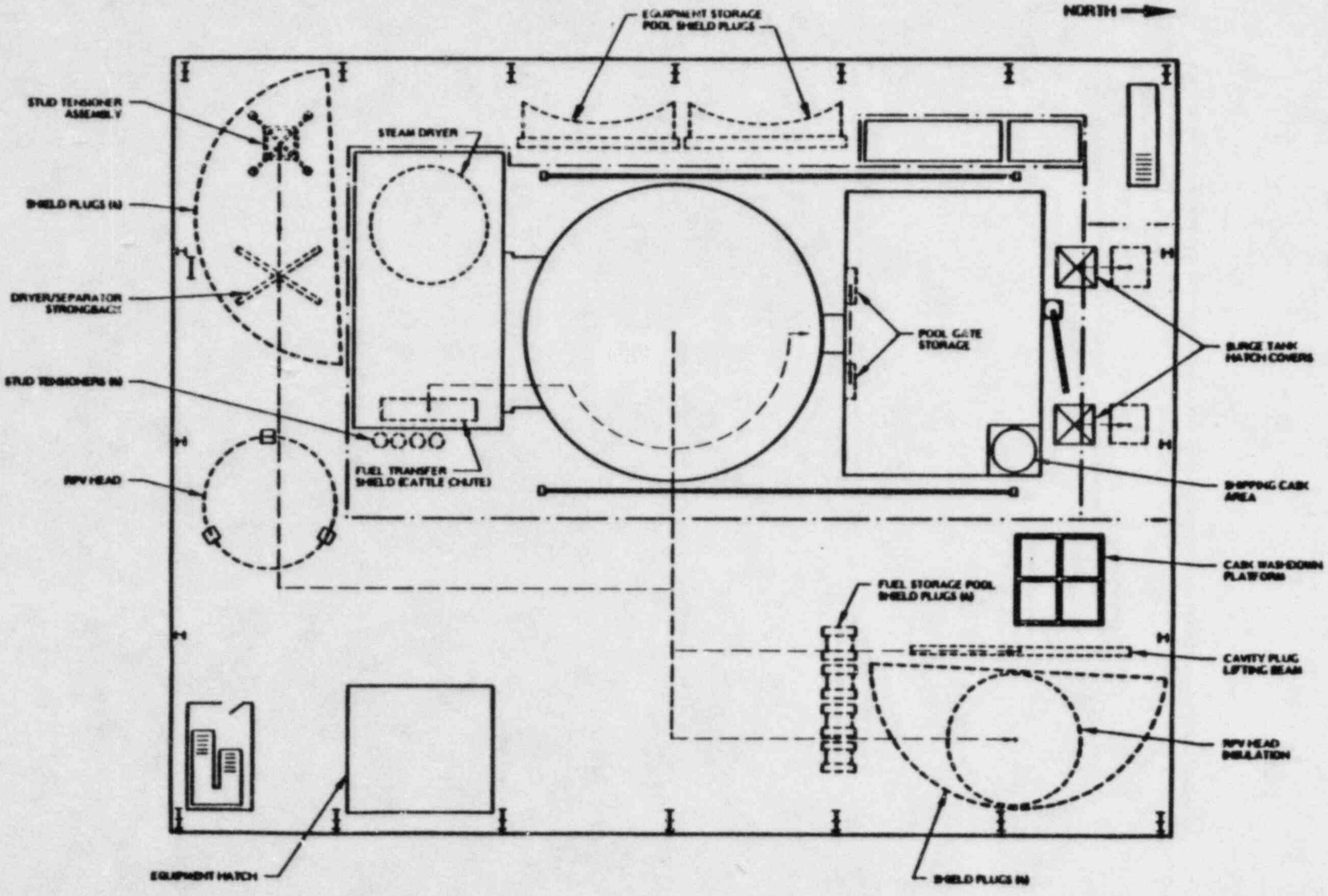

FIGURE 2

LAYDOWN AREAS AND SAFE LOAD
PATHS FOR MISCELLANEOUS EQUIPMENT

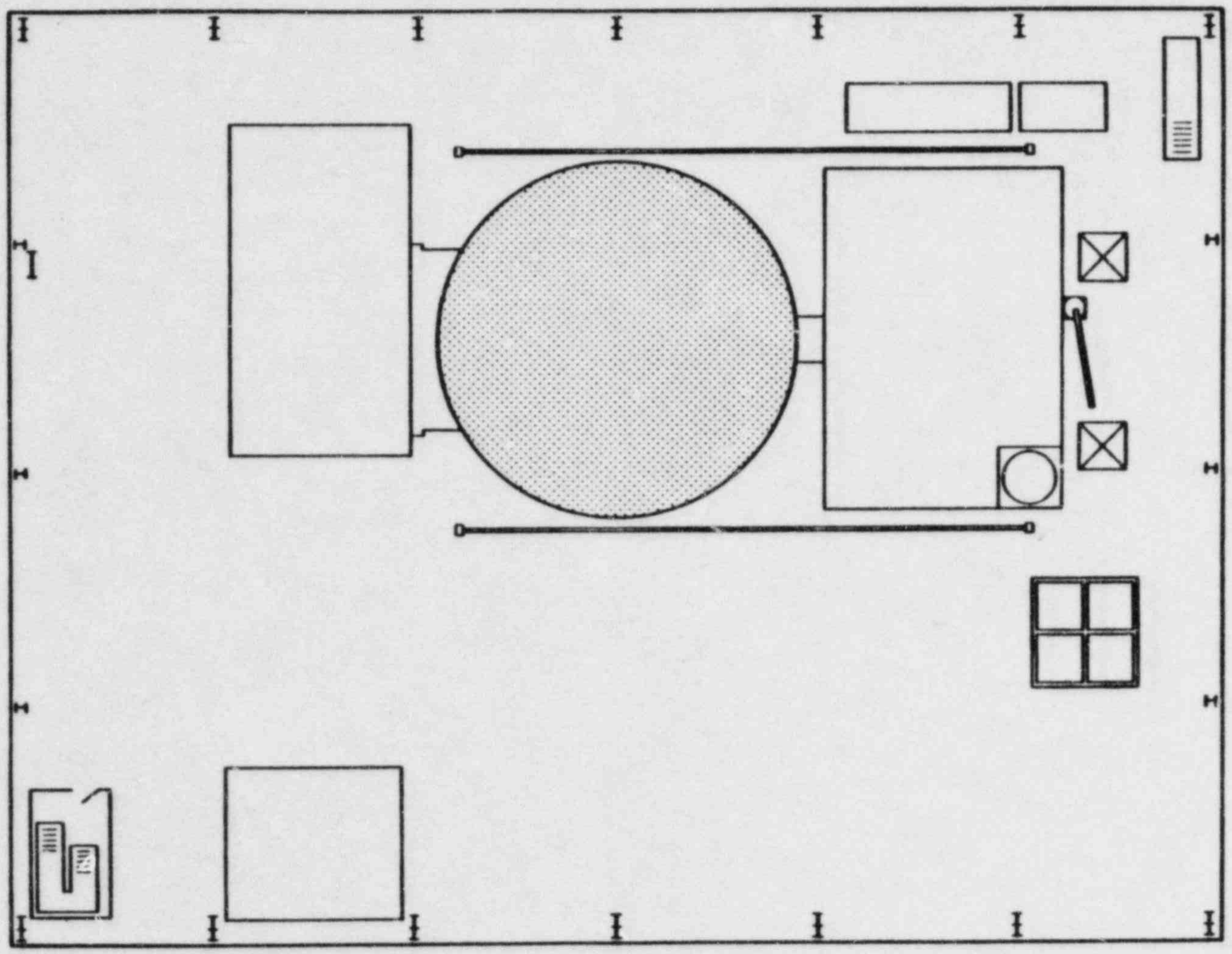

FIGURE 3

REACTOR BUILDING
LOAD IMPACT REGION I

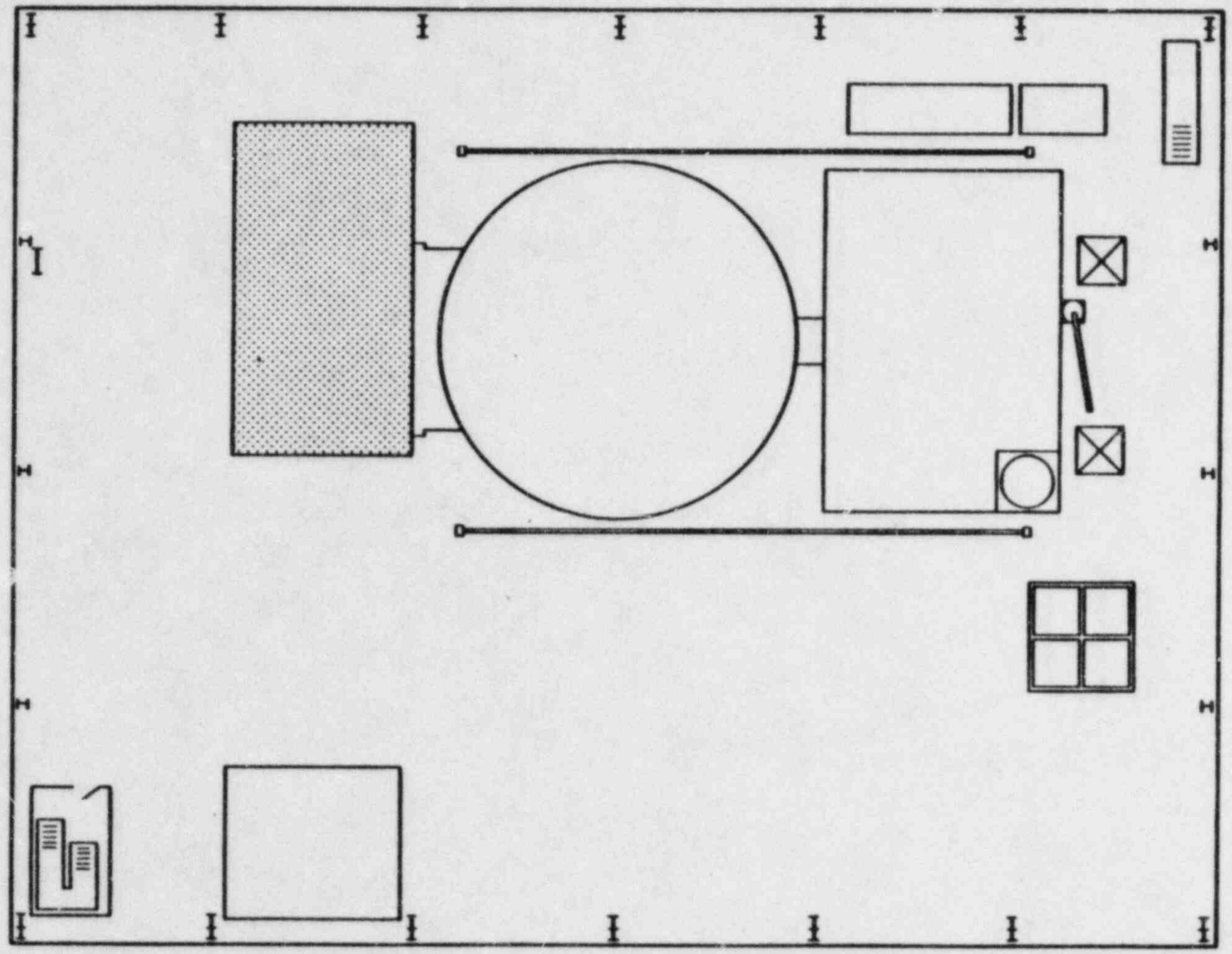

FIGURE 4

REACTOR BUILDING
LOAD IMPACT REGION 2

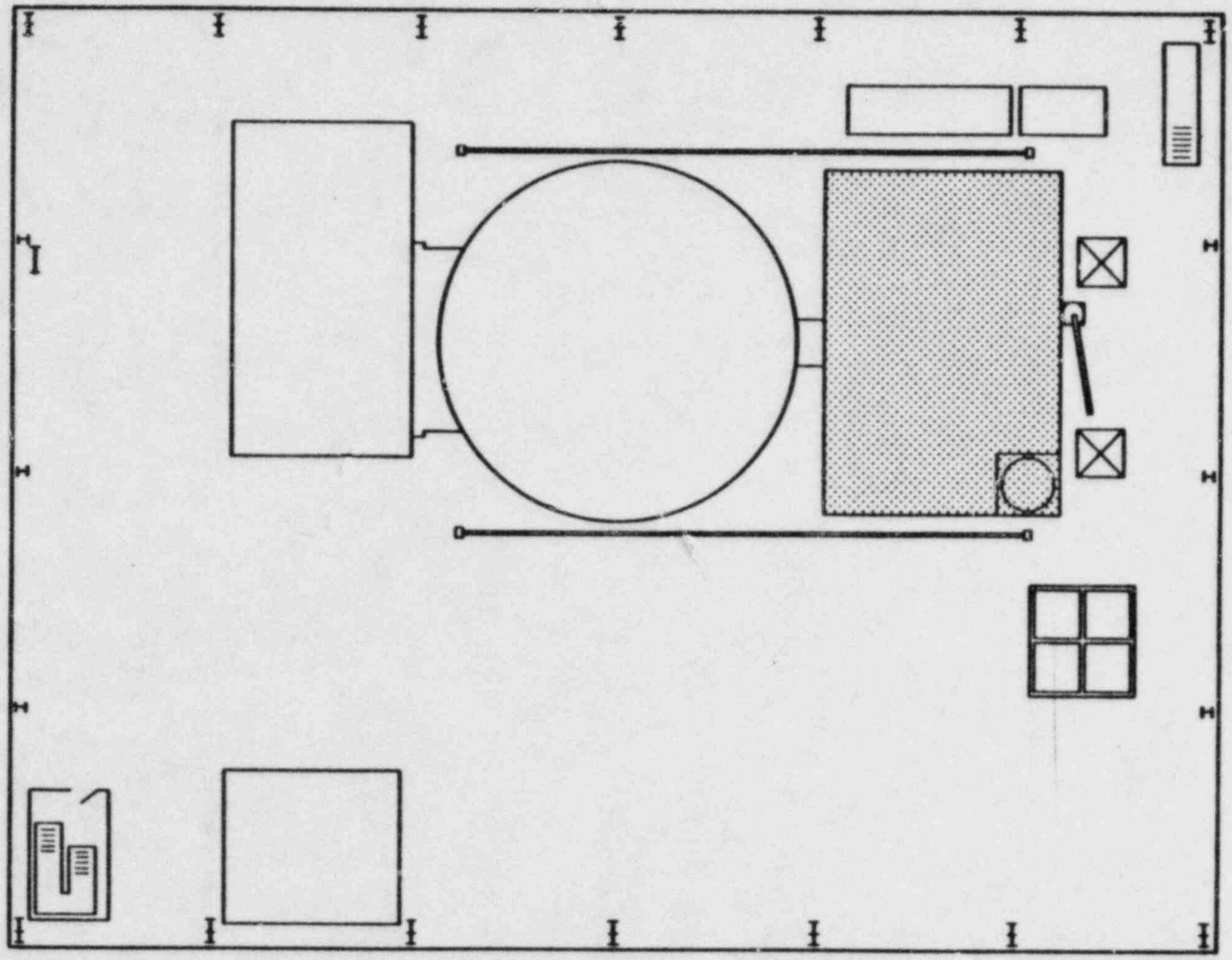

FIGURE 5

REACTOR BUILDING
LOAD IMPACT REGION 3

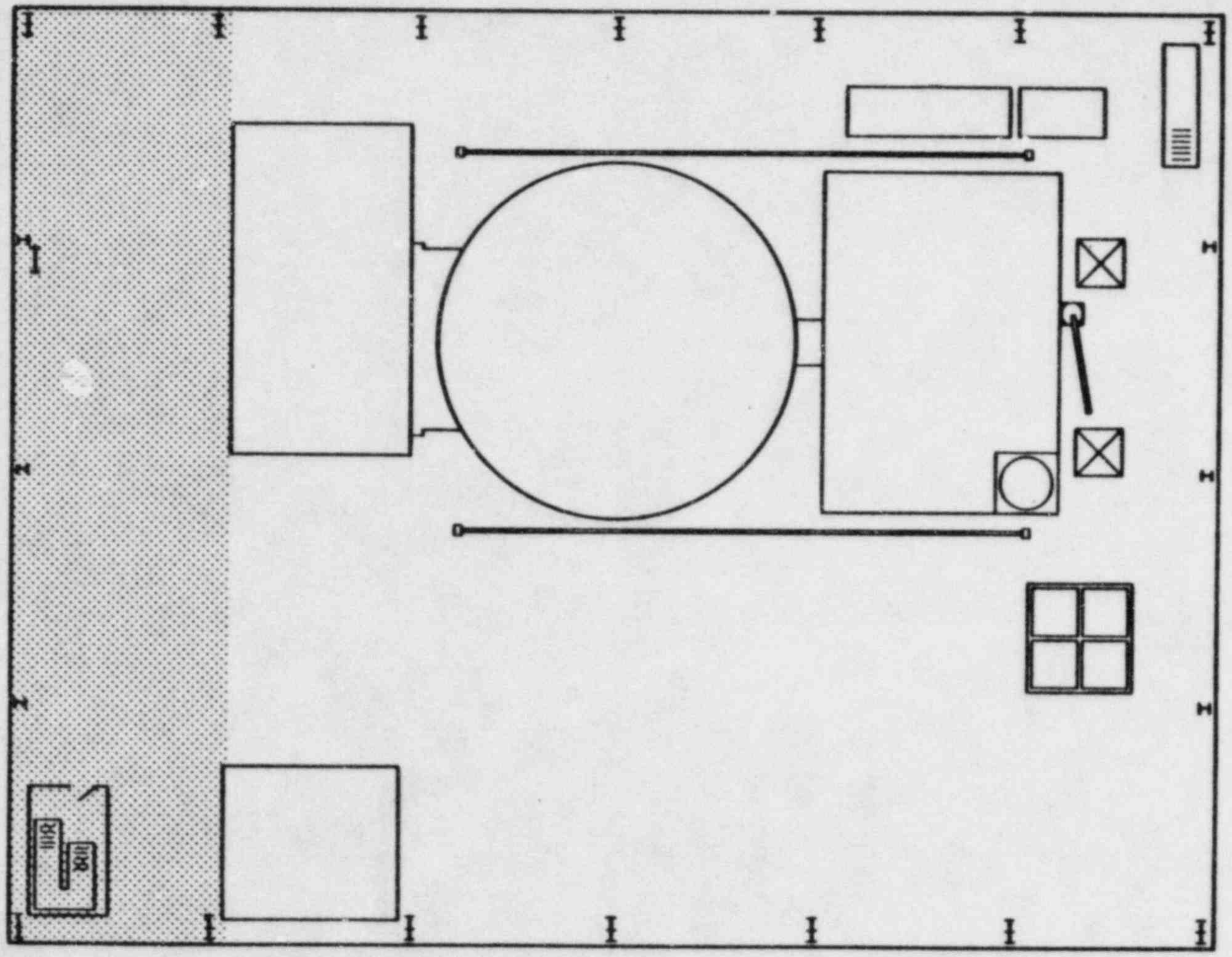

FIGURE 6

REACTOR BUILDING
LOAD IMPACT REGION 4

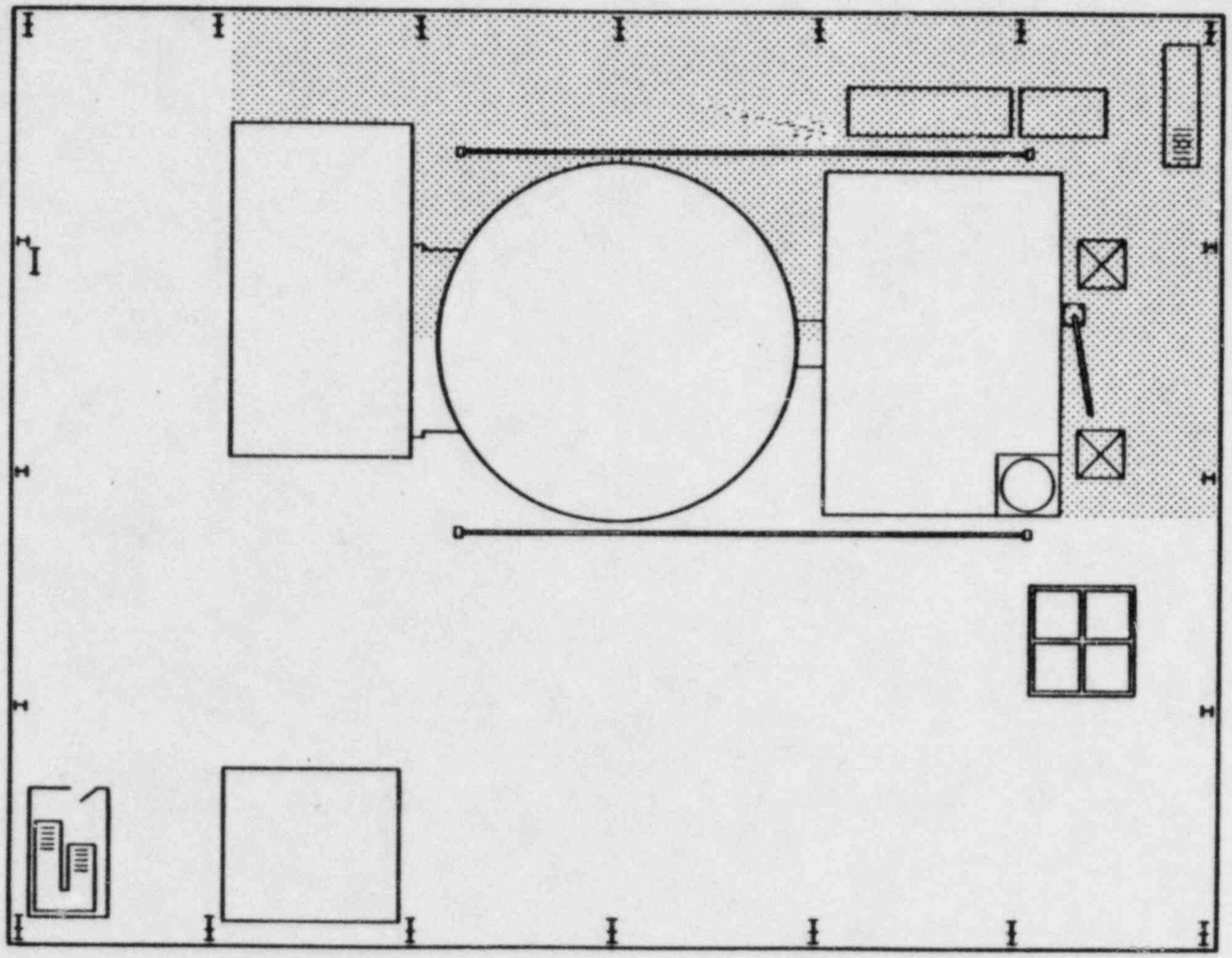

FIGURE 7

REACTOR BUILDING
LOAD IMPACT REGION 5

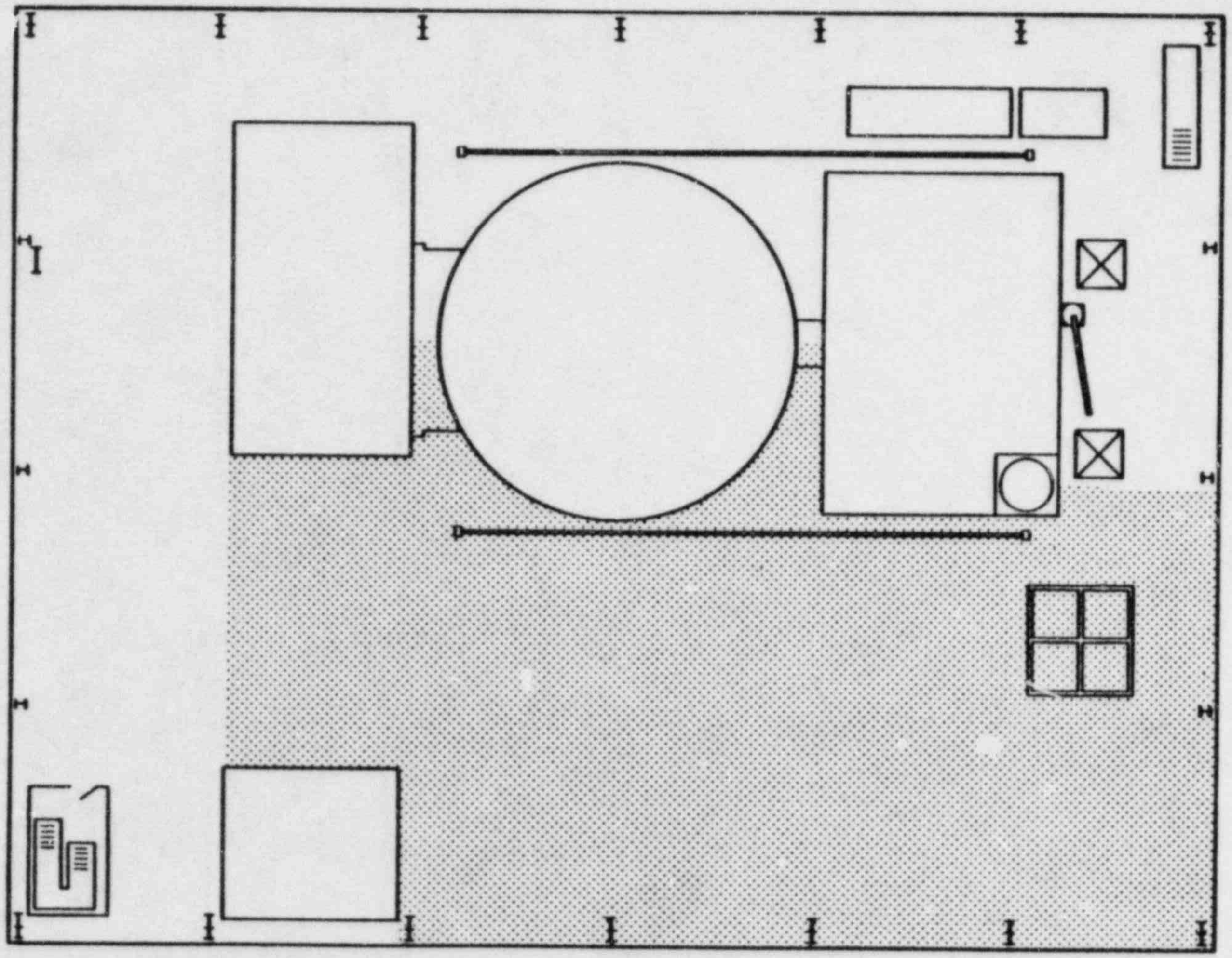

FIGURE 8

REACTOR BUILDING
LOAD IMPACT REGION 6

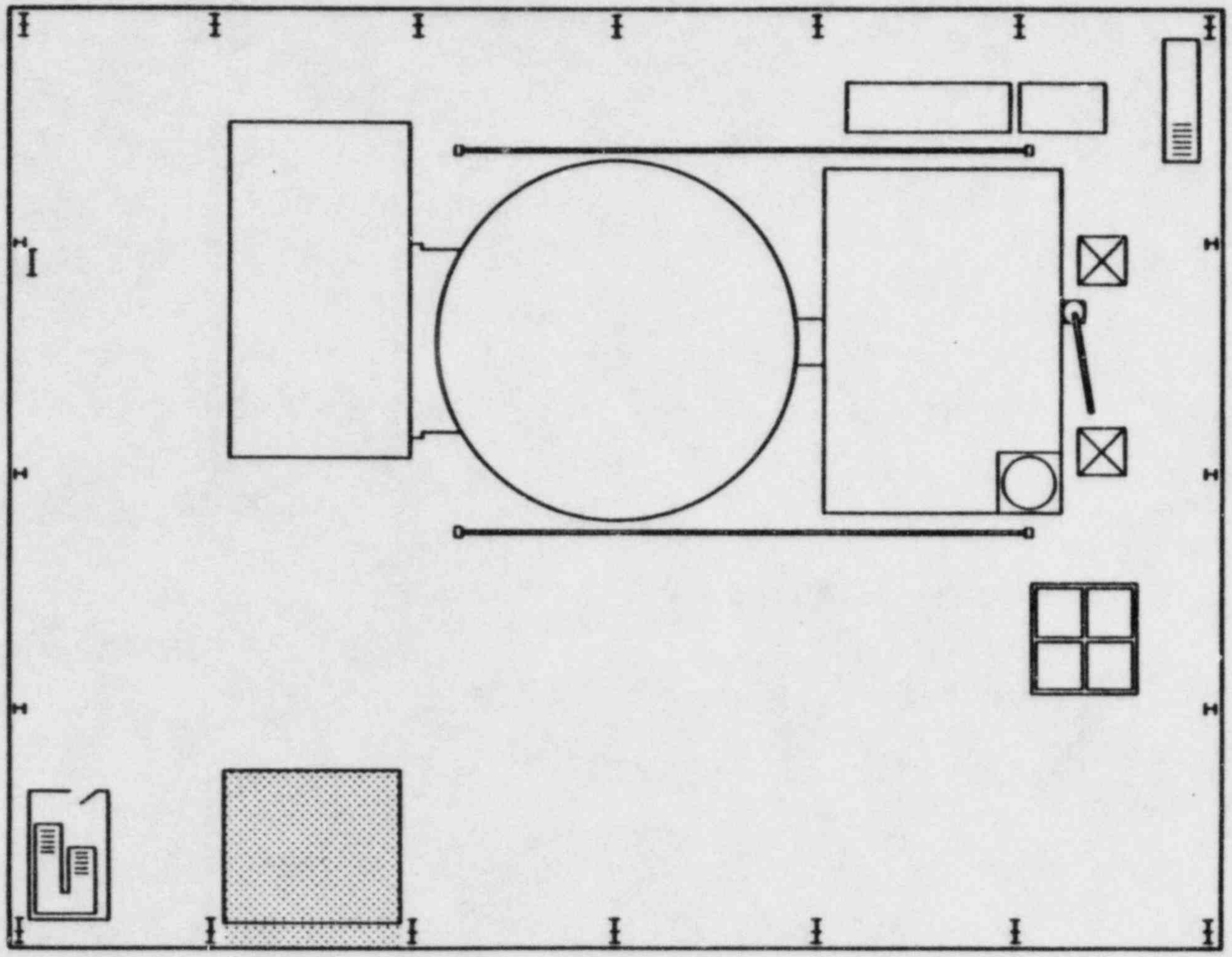

FIGURE 9

REACTOR BUILDING
LOAD IMPACT REGION 7

APPENDIX A

RECIRCULATION PUMP MONORAIL DESIGN REVIEW

GPU's previous submittal to NRC dated January, 1983 noted that design evaluations for the Recirculation Pump Monorail would be deferred until a later date pending the acquisition of sufficient details to perform stress evaluations. Sufficient drawings or specifications were not initially available to perform the stress analyses. For this reason, GPU personnel obtained necessary dimensional and configuration information through direct measurement and photographs at the first convenient opportunity. Based on this information, stress evaluations of critical sections and components of this system were performed to demonstrate compliance with the applicable design safety factor criteria.

The design criteria contained in ANSI B30.2 and CMAA-70-1975, although referenced by NUREG-0612, are not applicable to the design of monorail type handling systems such as the Oyster Creek recirculation pump monorail. Similar standards are, however, available for monorail type systems. The most appropriate standard is ANSI B30.11, "Monorails and Underhung Cranes."

ANSI B30.11, Section 11-1.3.1 requires stress in the monorail tracks due to the rated load to be within AISC specifications and for maximum delfection of the monorail to be less than 1/450 of this span. To assure that stress design safety factors are also consistent with criteria contained in ANSI B30.2, the criterion of 5:1 design safety factor against ultimate strength was used. The stress evaluations performed confirmed that calculated stresses and deflections in the recirculation pump monorail due to the rated load do not exceed the above criteria. Based on this evaluation, it is judged that the monorail design satisfies the intent of the NRC criteria contained in NUREG-0612, Section 5.1.1.