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License DPR-35
Docket 50-293

Boston Edison Company Response to
NRC Request for Additional Information
on Increasing Allowed Fuel Assembly Storage
(TAC No. M85898)

Reference: "Proposed Technical Specification Change, Pilgrim Nuclear Power Station Spent Fuel Storage Capacity Expansion", BECo Letter 93-016, dated February 11, 1993.

This letter responds to the November 15, 1993, NRC Request for Additional Information and a December 9, 1993 telephone question on the referenced proposed Technical Specification change.

Should you desire further information on these responses, please contact our Licensing staff through Mr. Paul Hamilton at (508) 830-7948.

Sincerely,

E T Boulette

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ETB/WGL/increase/nas

cc: See next page

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RESPONSES TO 11/15/93 NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) AND 12/9/93 TELEPHONE QUESTION FROM NRC PROJECT MANAGER

Reference: Pilgrim Station (Docket 50-293), License Amendment Application, BECo Letter No. 93-016, dated February 11, 1993.

A. Heavy Loads Handling Concerns

Question 1

Provide a figure showing the proposed rack iift rig.

Answer 1

Figures 1 and 2 (attached) illustrate the Holtec lift rig design.

Question 2

What is the maximum load the lift rig is able to lift before reaching the yield stress on any component?

Question 3

What is the maximum load the rig is able to lift before reaching the ultimate stress on any component?

Answers to Questions 2 and 3

The lift rig is designed to satisfy the following limits on primary bending stresses:

(i) At six times the maximum load to be lifted (29,400 lbs), the stress field across one or more sections of a primary member may become fully plastic (reach the minimum yield strength).

(ii) At ten times the maximum load to be lifted (29,400 lbs) the stress field across one (or more sections) of a primary member may form a plastic hinge at the ultimate stress value.

The above stress requirements are for non-single failure proof rigs, but we have applied them to our single failure proof lift rig for added conservatism.

Question 4

Explain how the 150% test load you intend to employ for the lift rig (as noted on page 2-2 of the Holtec Report) complies with the test specified in Section 6.3 of ANSI N14.6-1978.

Answer 4

As explained in Section 2 of the licensing report, the Holtec lift rig is in full compliance with the single failure criteria of NUREG-0612. Accordingly, the rig will be tested at 150% of the maximum rack weight, by the manufacturer, prior to use for rack installation. The testing is done in accordance with Section 5.1.1(4) of NUREG-0612 which refers to ANSI N14-6. For testing the rig, the ANSI Standard Section 6.3.1(2) is followed which allows for testing of each load path to 150% of lifted weight. Alternatively, by 6.3.1(1) of the ANSI Standard, testing the entire assembly with all load paths active, to 300% of lifted load, would ensure bounding of the requirement of 6.3.1(2) since our design analyses methodology uses increased load factors for extra conservatism.

Question 5

Show how you intend to test the lift rig to verify continuing compliance for use in installing racks after the initial reracked configuration.

Answer 5

The lifting rig will initially be load tested by the manufacturer, in accordance with the requirements of NUREG 0612, prior to use. The rig will not be load tested after the initial manufacturer's test.

Since a fuel rack is a "heavy load" as defined in NUREG-0612, the lifting rig will be stored and maintained in compliance with our heavy load procedure, until it is needed for future racking operations. Our procedure requires non-destructive examination of lifting gear prior to use. As such, the lifting rig will receive non-destructive examination prior to future rack installation campaigns. This approach is consistent with the requirements of NUREG-0612.

Question 6

The reactor building bridge crane (RBBC) is being specified for use in the reracking process. What is the ultimate load this crane can lift before any crane component fails?

Answer 6

The ultimate load at which any crane component will fail has not been determined. The crane is rated for 100 tons. The heaviest rack which will be lifted weights less than 15 tons, which is only 15% of the rated capacity of the crane. There is a substantial margin (the margin of safety exceeds a factor of 6), when comparing the cranes rated capacity to the actual lifted load. In addition, the heaviest load routinely lifted by the crane is the 81 ton vessel head, which is 81% of the rated capacity and substantially more than the weight of a rack. In recognition of these parameters, a numerical margins analysis, against the ultimate crane failure load, is not warranted for rack installation.

Question 7

Section (i) and (ii) on page 2-3 of the Holtec International Report (HI-92925) mention that "cranes" will be used in the reracking process. For those cranes other than the RBBC, provide the following information:

a. What will each crane be used for?
b. What specification has each crane been designed to, e.g. EOCI-51, CMAA-70?
c. What ultimate load can each crane lift before failing?
d. What is the maximum load each crane is expected to lift?

Answer 7

The only crane we plan to use in the racking process is the RBBC. We expect to use both the main hoist and the auxiliary hoist. Only the RBBC main hoist will be used to lift a fuel rack, since it is the only hoist which has the capacity to lift a fuel rack. The auxiliary hoist will be used for handling miscellaneous tools that are relatively light in weight and which are not defined as a heavy load, as defined in the Pilgrim Station heavy load handling procedures.

The refuel bridge auxiliary hoists and the fuel pool jib cranes are other cranes, which are available for in-pool service. The physical configuration of these cranes and the low capacities of their hoists preclude their use in handling a fuel rack.

The refuel bridge will be used for personnel access over the pool during rack installation, and to move fuel into the new racks.

Question 8

In section (i) on page 2-3 of the Holtec Report you state that cranes used in the project will receive a preventative maintenance checkup and inspection for the reracking operation. Will this be done for both the initial and other reracking configurations? How soon will this be accomplished before each reracking phase?

Answer 8

A Pilgrim Station procedure currently mandates a preventive maintenance and inspection every 12 months, or prior to being placed in service if the device has not been in service for a period exceeding 12 months. The heavy loads procedure mandates a verification and sign-off that the TEST DUE DATE on the TEST/INSPECTION TAG has not been reached for the equipment being utilized. The procedural controls ensures the crane has received preventive maintenance and inspection either immediately prior to the rack installation or within the 12 month period preceding rack installation. These procedures will be followed through this and future rack installations.

Question 9

You state the following on page 2-3 of the Holtec Report:

(1) No heavy load (rack or rig) with a potential to drop on a rack has less than 3 feet lateral free zone clearance from actual fuel.

This assures the reader that there is at least 3 feet of separation between a rack fully loaded with spent fuel and an empty rack or rig before being moved.

It is not clear that a similar clearance will be maintained between a partially filled rack and a rack or rig being moved. Explain and justify any deviation for maintaining any lesser separation (less than 3 feet).

Answer 9

A lateral separation of 3 feet will be maintained between any heavy load (as defined per NUREG -0612) with a potential for drop and a rack fully loaded with spent fuel. In the case of a partially loaded rack, a lateral separation of 3 feet must be maintained from the cells containing fuel and any heavy load. In addition, the center of gravity of the heavy load will be kept outside the periphery of the entire rack. The latter requirement ensures the heavy load will, if dropped, tip away from the cells containing fuel. Any local deformation and/or vibration at the point of impact will not lead to damage to the cells containing fuel because of the honeycomb construction of the modules (the impact load on a honeycomb structure attenuates rapidly away from the location of loading in the manner of an elastic half-space).

Question 10

Show at what loads the rigging for the overhead platforms (discussed on page 2-5 of the Holtec Report) will fail. You intend to prevent damage to racks and spent fuel by carrying platforms over racks at a height of 36 inches or less. Discuss how you intend to monitor the 36 inch height.

Answer 10

The rigging for the overhead platform consists of four turnbuckles each rated for 10 tons. This means that each turnbuckle will fail at a proof load of 50 tons. To provide maximum redundancy, four turnbuckles will be used. In contrast, the platform weighs only 1850 lbs.

The 36" maximum height will be administratively controlled. BECo will specify installation instructions, in the Plant Design Change package, to administratively control the maximum height.

Question 11

What is the purpose of the rack overhead platforms? Will all the racks have platforms or only the new racks? How will you monitor placement of material on the platforms so as to prevent damage to spent fuel?

Answer 11

The overhead platforms will be used for the purposes of storing irradiated material in the fuel pool, but not for storing fissionable material. The future needs for in-pool storage of this type of irradiated material is not defined at this time, since it is not possible to project how much irradiated material will be generated and require storage. It is anticipated that only the new fuel racks N1 through N5, manufactured by Holtec, will be used for overhead platform storage.

The maximum load to be placed on each rack is 10,000 pounds, including the platform weight. This load is consistent with the seismic and structural analyses supporting the licensing submittal. A calibrated load cell will be used to weigh the emplaced material to ensure that the loading will not exceed the 10,000 pound limit. After the 10,000 pound loading is reached, the platforms will be covered and labelled to prevent future placement of material on top of them.

The overhead platform will serve to store miscellaneous radioactive materials in suitably designed containers. The platform serves as a structural shield for the fuel stored below. The placement of containers on the platform will be carried out under strict administrative controls. The containers would be designed, fabricated and tested to achieve compliance with NUREG 0612 and the Pilgrim Station heavy loads procedure.

B. Thermal/Hydraulic Concerns

Question 1

Show that the spent fuel pool cooling and cleaning system (FPCC) components are protected in the event of a spent fuel (SFP) cooling pump failure during a normal refueling. Provide the maximum temperature expected for the SFP bulk coolant, in that case.

Answer 1

During refueling, the spent fuel pool is not solely dependent on the normal spent fuel pool cooling system (SFPCS) for decay heat removal. The Residual Heat Removal (RHR) system may be used either in addition to, or instead of, the SFPCS. The station sometimes uses the RHR system in one of the modes of Augmented Fuel Pool Cooling (AFPC) during normal refuelings to minimize pool and reactor basin temperatures, or for water cleanup in lieu of the Reactor Water Cleanup System.

The RHR system would be employed in an AFPC mode if one of the SFP cooling pumps failed at a time when two SFP cooling pumps are required to maintain acceptable temperatures. The spent fuel pool temperature would rise if cooling was provided by only one SFPCS pump/heat exchanger train during refueling. This situation can be avoided by the use of AFPC. The capability to initiate one of the AFPC modes is maintained throughout the duration of all refuelings. If the refueling includes either a full core off-load or any discharge greater than 28% of the core, the AFPC would already be in use.

The two refueling scenarios in the Holtec Report represent the bounding cases for fuel pool temperature. The Case 1 normal refueling was based on only the normal SFPCS operating with two pump/heat exchanger trains during a 28% core discharge commencing 120 hours after reactor shutdown. The maximum temperature of 142°F in that scenario is greater than the maximum temperature produced with either RHR AFPC Modes 1 or 2 since these provide significantly greater cooling capacity.

There are several options for spent fuel pool cooling during refueling as follows:

1. Utilize the normal spent fuel pool cooling system with both pump/heat exchanger trains operating during the entire refueling. This will provide adequate cooling for normal spent fuel discharges of approximately 28% of the core.

2. Operate RHR Augmented Fuel Pool Cooling Mode 1 in conjunction with the normal SFPCS during part or all of the time that the reactor basin is flooded with the fuel pool gate open. This mode discharges up to 1800 GPM of cooled RHR return water to the fuel pool. The normal SFPCS continues to provide cooling and filtration-demineralization and surface skimming for the fuel pool water.

3. Operate RHR Augmented Fuel Pool Cooling Mode 1 during all or part of the time that the basin is flooded with the fuel pool gate open without the normal SFPCS operating. In this case, the RHR/SFPCS intertie may be configured to pass a portion of the RHR return water through the filter-demineralizer of the SFPCS to provide cleanup of the reactor water.

4. Operate RHR AFPC Mode 2 if the normal RHR Shutdown Cooling flowpath is not available. This is the configuration analyzed as Case 2 in the Holtec Report. In AFPC Mode 2 the normal SFPCS pump/heat exchangers are not used. The RHR/SFPCS intertie may be configured to pass a portion of the return water through the filter-demineralizer of the SFPCS.

In summary, if a normal SFP cooling pump fails during refueling, the maximum fuel pool temperature would be maintained below the bounding Case 1 temperature of 142°F described in the Holtec Report. Under normal circumstances, the temperature of 142°F is considered undesirably high for personnel working on the refuel floor. One of the RHR AFPC modes would already have been placed in use if the fuel pool had approached this temperature during a normal refueling.

Question 2

What systems are available to provide coolant for the SFP in the event of complete failure of the FPCC system? What coolant flow rate can be provided as makeup from each system in the event of such failure? Which, if any, is designed to function after a seismic event? Which systems can operate without offsite power?

Answer 2

A complete failure of the normal SFPCS that occurs during refueling is addressed in the answer to B.1 above in which RHR AFPC is described.

A loss of Spent Fuel Pool Cooling scenario may be considered that includes a seismic event during plant operation immediately after refueling with the following assumptions:

1. The reactor is at 100% power immediately following a 36-day refueling outage.
2. A seismic event has taken place.
3. The Spent Fuel Pool Cooling System becomes inoperable.

During reactor operation, the RHR System is dedicated to service as part of the emergency core cooling and containment cooling systems and is not used for decay heat removal from the Spent Fuel Pool. Following a refueling outage, the SFPCS is capable of maintaining the fuel pool below 125°F without assistance from the RHR system. The greatest heat load in the Spent Fuel Pool during reactor operation is immediately following a refueling outage when the latest batch of spent fuel contributes the greatest heat load.

The design of the SFPCS is based on the need for a reliable cooling system, but this system performs no function that is directly related to the safe shutdown of the reactor. Following a seismic event there is a possibility that the SFPCS and the normal supply of make-up water, the Condensate Transfer System, will be inoperable. The available sources of makeup water include the following:

1. Condensate Transfer System 3" piping to the Fuel Pool Skimmer Surge Tanks with a maximum flow rate of 200 GPM with either of the two Condensate Transfer Pumps operating. The 3" line also has a 2" branch that connects directly to the SFPCS return lines to the fuel pool.

2. Condensate Transfer System 10" piping to the SFPCS that discharges directly to the fuel pool or to the filter demineralizer train. Either of the two Condensate Transfer Pumps can provide approximately 2000 GPM flow through this interconnection.

3. Demineralized Water Transfer System 4" piping to the Reactor Well and Dryer Separator Pool service boxes. Either of the two Demineralized Water Transfer Pumps can provide 110 GPM to the service boxes which may be connected to discharge to the fuel pool.

4. The Fire Protection System (FPS) has two hose stations on the Refuel Floor (Elev. 117'). The FPS can be fed from the Motor Driven Fire Pump or the Diesel Fire Pump, each rated at 2000 GPM. Each hose station is rated to discharge 150 GPM. The FPS can also be fed from a mobile fire engine drawing water from either of the two Fire Water Storage Tanks, the two Condensate Storage Tanks, the Demineralized Water Storage Tank, or pumped directly from the city water supply main to the FPS.

5. After the reactor has been brought to the Cold Shutdown condition, the RHR/SFPCS intertie may be used to add makeup water to the fuel pool if the other methods described above are not available. The Fire Protection System is connected to the RHR loop cross-tie to which the RHR/SFPCS intertie is also connected. This flowpath may be used to deliver water from the FPS directly to the SFPCS return lines to the fuel pool. This makeup water flowpath may be used while still maintaining normal RHR Shutdown Cooling of the reactor. One loop of RHR, using one pump, may also be used to deliver water from the torus to the SFPCS while the other RHR loop maintains Shutdown Cooling of the reactor.

The Condensate Transfer, FPS, and SFPCS are not qualified as seismic Category I. Following a seismic event the available systems would be assessed to determine which are operable. There are three alternate storage tanks, four pumps, and three separate flow paths from the Condensate and Demineralized Water Transfer Systems to the SFPCS.

The Fire Protection System, although not seismic Category I, is configured with a ring header arrangement that provides two independent flow paths to each hose station. Mobile pumping trucks (fire engines) can provide backup capability to pressurize the FPS from the two storage tanks or from several city water hydrant locations. The fire protection piping system is designed to allow isolation of failed piping with many alternate locations (seven yard hydrants) to pump water into any functional part of the ring header. There are two independent and isolatable piping paths from the ring header to the refuel floor and all lower elevations of the reactor building.

Following a loss of off-site power, the FPS Diesel Fire Pump and mobile fire engines, if needed, would be operable. The normal SFPCS pumps will stop with a loss of off-site power. The pumps can be restored by a temporary interconnection of AC power available from a safety-related AC power bus energized by the Emergency Diesel Generators. During refueling, the RHR system can provide Augmented Fuel Pool Cooling following a loss of off-site power.

If the SFPCS becomes inoperable, there will be a time period when the pool will heat up. Such a situation requires restoring the cooling system and providing makeup water to the pool. The makeup water source would be used to maintain pool water level and/or to subcool the water to delay the onset of boiling.

The heat load for the SFP for the condition immediately following the 36-day long Refueling Outage RFO 18 (year 2011) is projected to be 5.63 MBtu/Hr (BECo Calc. M-588). Using this heat load, the time-to-boiling following a complete loss of SFP cooling with a starting temperature of 125°F is over 30 hours. The makeup water rate for the boiling condition is under 12 GPM. The pool boil-down time from the onset of boiling in the absence of makeup water will be 2.5 days before reaching the 33 ft water depth limit in Technical Specification Section 3.10.C and 12 days before reaching the level of the top of the spent fuel racks. These results for the RFO 18 case are conservative for any earlier RFO case because the background heat load becomes incrementally higher after each consecutive refueling outage.

Question 3

The Holtec Report, on page 5-13, shows the capability of residual heat removal (RHR) cooling Mode 2 (maximum bulk pool temperature 129°F) for a "normal" offload. What would be the SFP bulk coolant temperature in the event RHR cooling Mode 1 was utilized? Are the decay heat loads in both cases 8.69 MBTU/hr? Are there any refueling scenarios wherein an RHR pump would not be available in the event of a single failure?

Answer 3

The full core off-load Case 2 scenario in the Holtec Report is the bounding case for determining spent fuel pool temperatures when the RHR AFPC modes are to be used. The decay heat load is the same for AFPC Mode 1 and 2. It should be noted that for all refueling scenarios, the cooling of the full reactor core and the spent fuel pool is accomplished by some combination of the RHR and SFPC systems. When the RHR system is intertied with the SFPCS, the total heat load on the combined systems is the sum of the decay heat from the reactor core and the spent fuel in the fuel pool. If the systems are intertied at the postulated 120 hours after reactor shutdown, the total heat load would be 27.0 MBTU/Hr per Holtec Figure 5.9.4.

At the time at which AFPC Mode 1 or 2 is initiated, the reactor basin is flooded, the fuel pool gate is open, and the RHR system is in the normal Shutdown Cooling mode. At this point the reactor and the spent fuel pool are a common reservoir and the two heat sources both contribute to this single volume of water. In AFPC Mode 1, the RHR heat exchanger may be utilized at its rated flow condition (5000 GPM) to maximize the heat transfer to the cooling water system. Up to 1800 GPM of the return flow may be discharged into the fuel pool while the remainder returns directly to the reactor vessel. The normal SFPCS may also be operated with both pump/heat exchangers providing additional cooling to the fuel pool.

In AFPC Mode 2, the RHR heat exchanger must be utilized at the reduced flow rate of 1800 GPM with all the flow passing through the RHR/SFPCS intertie discharging to either the fuel pool, reactor basin, or both.. The normal SFPCS pumps/heat exchangers are isolated and not used. The cooling capacity for AFPC Mode 2 is less than Mode 1 due to the reduced RHR heat exchanger flow rate and the isolation of the normal SFPCS. The analysis of this configuration in the Holtec Report is therefore the bounding case for the use of AFPC and yields the highest pool temperature. If AFPC Mode 1 is used, the maximum pool temperature will be less than 129°F.

The RHR system can provide cooling of the reactor basin via the normal Shutdown Cooling flowpath and/or through the intertie with the SFPCS. In AFPC Mode 1, the RHR pump suction is from the normal Shutdown Cooling suction flowpath. The return flow of cooled water is to the reactor vessel, the fuel pool, and the reactor basin, if needed. Since the reactor vessel, basin and fuel pool are a common reservoir in this mode, the entire volume of water can be cooled by the RHR system with several different combinations of flowrates through the return paths.

In AFPC Mode 2, the RHR pump suction is from the fuel pool skimmer surge tanks. The return flow has the same options as for Mode 1 if the reactor basin is flooded and the fuel pool gate open. If the full core has been transferred to the fuel pool and the gate closed, then the return flow must all discharge to the fuel pool at the 1800 GPM flow rate. This configuration would only be necessary if the reactor basin were to be drained. There are considerations in this configuration that are different from other refueling scenarios. The total volume of water is considerably less than when the reactor basin and vessel are included. The analysis in the Holtec Report for time-to-boil during the full core offload (Case 2) is based on only the volume of water in the fuel pool since this is the worst case condition. Pilgrim Station has not de-fueled the reactor and drained the basin since RFO 4 in 1980.

It is typical during refueling that one loop of the RHR system is in-service while the other loop is undergoing outage maintenance. Each RHR loop has two pumps and one heat exchanger. Both pumps will normally be operable and available for the in-service loop. The heat exchanger rated cooling capacity is achieved with one RHR pump. In RHR Shutdown Cooling, only one pump is typically operated. In the event one RHR pump fails, the second pump is available.

The RHR heat exchanger is a passive component that is not subject to an active component failure. The valves required to line-up the cooling flowpath are all operated initially to establish Shutdown Cooling and AFPC Mode 1 or 2. Once this flowpath is established, the valves are not required to cycle until the end of the refueling or at the time of swapping RHR loops, at which time the other loop is operable.

When the reactor is operating, both loops of RHR are required to ensure the system can perform its Core Standby Cooling System (CSCS) and Containment Cooling functions since many active components must operate to initiate the system. However, the Shutdown Cooling and AFPC functions are all initiated under stable shutdown conditions and operation with only one loop occurs only after the system has already been successfully placed into operation. Therefore, the single failure criteria that apply to the Containment Cooling functions requiring two operable RHR loops during reactor operation do not apply to the refueling modes of decay heat removal.

The outage procedures used at Pilgrim provide maximum assurance that a single failure including loss of off-site power will not disable the removal of decay heat from the reactor or spent fuel pool. Operation of the station electrical power and distribution system during refueling outages is carefully controlled so as to maintain at least two backup power sources to the normal off-site power sources. The normal sources are from either the 345kV Station Startup Transformer or the 345kV Unit Auxiliary Transformer in the backscuttle mode. The station has a 345kV ring bus that is connected by two separate

345kV transmission lines to sources of off-site power on the 345kV power grid. As a backup to the normal off-site sources, at least one station emergency bus must be operable with at least two alternate power sources. These alternate sources include the Emergency Diesel Generator for the active loop, the Station Blackout Diesel Generator, and/or the 23kV Shutdown Transformer. The 23kV Shutdown Transformer is fed from offsite sources by a separate 23kV line.

During an outage when one of the two emergency buses is out-of-service for maintenance, there are potential single failures in the station's electrical distribution system that would result in loss of AC power to the decay heat removal systems. As stated earlier, operation of the active loop of decay heat removal is established before the other loop is deactivated. The active loop is normally maintained in a steady-state operating mode with few manipulations required until such time as the other loop is operable again. During equipment steady-state operation, electrical bus, transformer, or breaker failures are least likely to occur. Should a distribution system electrical component failure occur, the necessary temporary or permanent repairs can be made to restore operation within the fuel pool/reactor basin heat-up time. Makeup water supplied via the Fire Protection System's Diesel Fire Pump would not be affected by any failure in the electrical distribution system.

Question 4

Explain your use of collocation in determining the velocity fields in the lower plenum and in-cell as noted in Section 5.7.2, "Model Description" of the Holtec Report.

Answer 4

The solution of the integral equation containing the vertical distribution function as the unknown is effected by assuming a polynomial function in the radius coordinate with undetermined coefficients. Substituting this polynomial function in the integral equation leads to algebraic equation forms. Requiring that this equation be rigorously satisfied at discrete radial coordinates is the method of collocation. This method results in reduction of the mathematical problem to the solution of a set of simultaneous linear algebraic equations that are readily solved during a standard Gaussian algorithm based subroutine. This procedure is implemented in the computer code THERPOC'., used in over 20 rerack applications.

C. Telephone Question from NRC Project Manager, dated December 9, 1993.

Question:

Does BECo intend to comply with the R.G. 8.38, Appendix A guidance for divers during pool diving operations?

Answer:

BECo intends to utilize divers for rack installation and intends to comply with the R.G. 8.38, Appendix A guidance for divers during spent fuel pool diving operations.

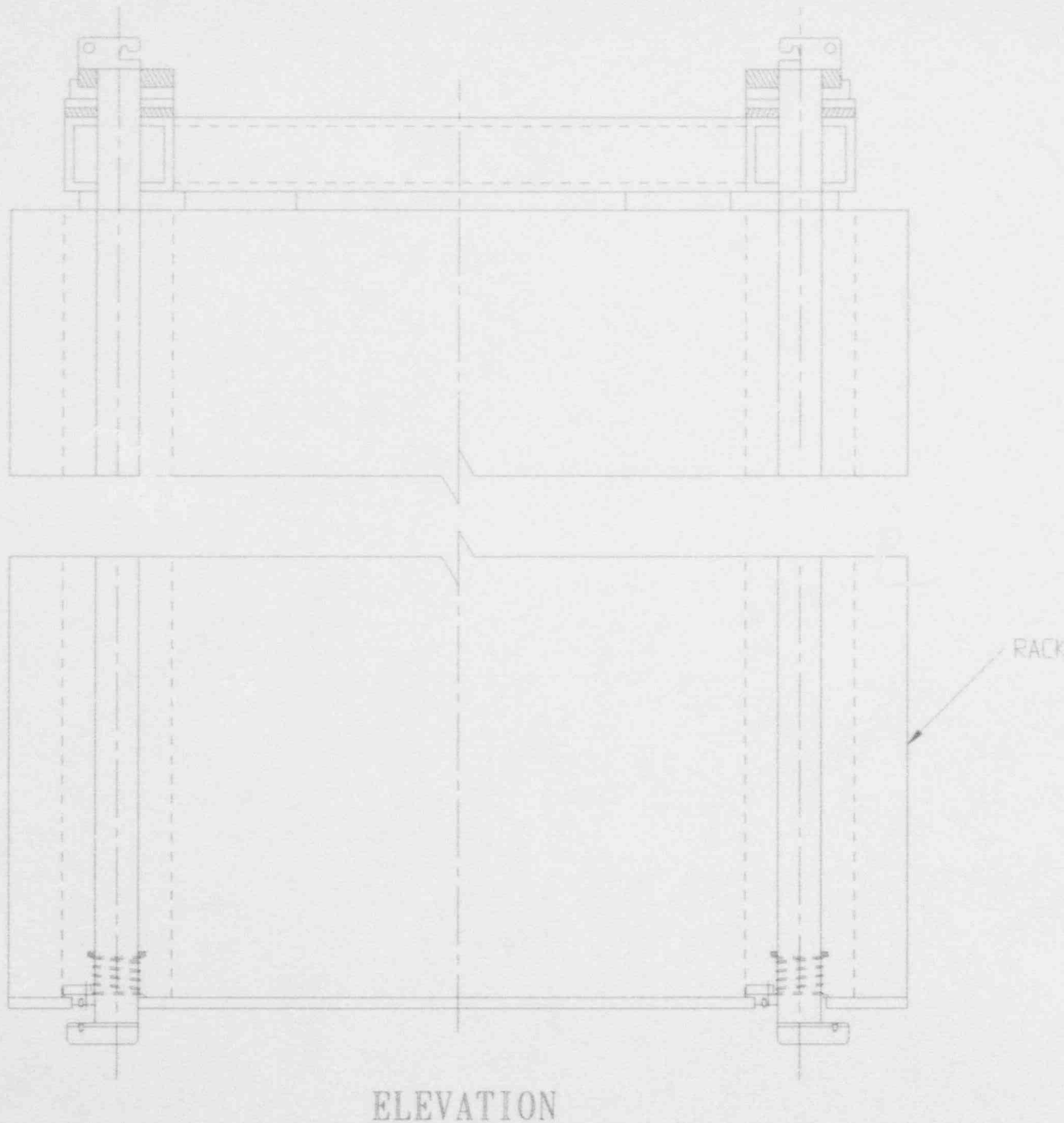
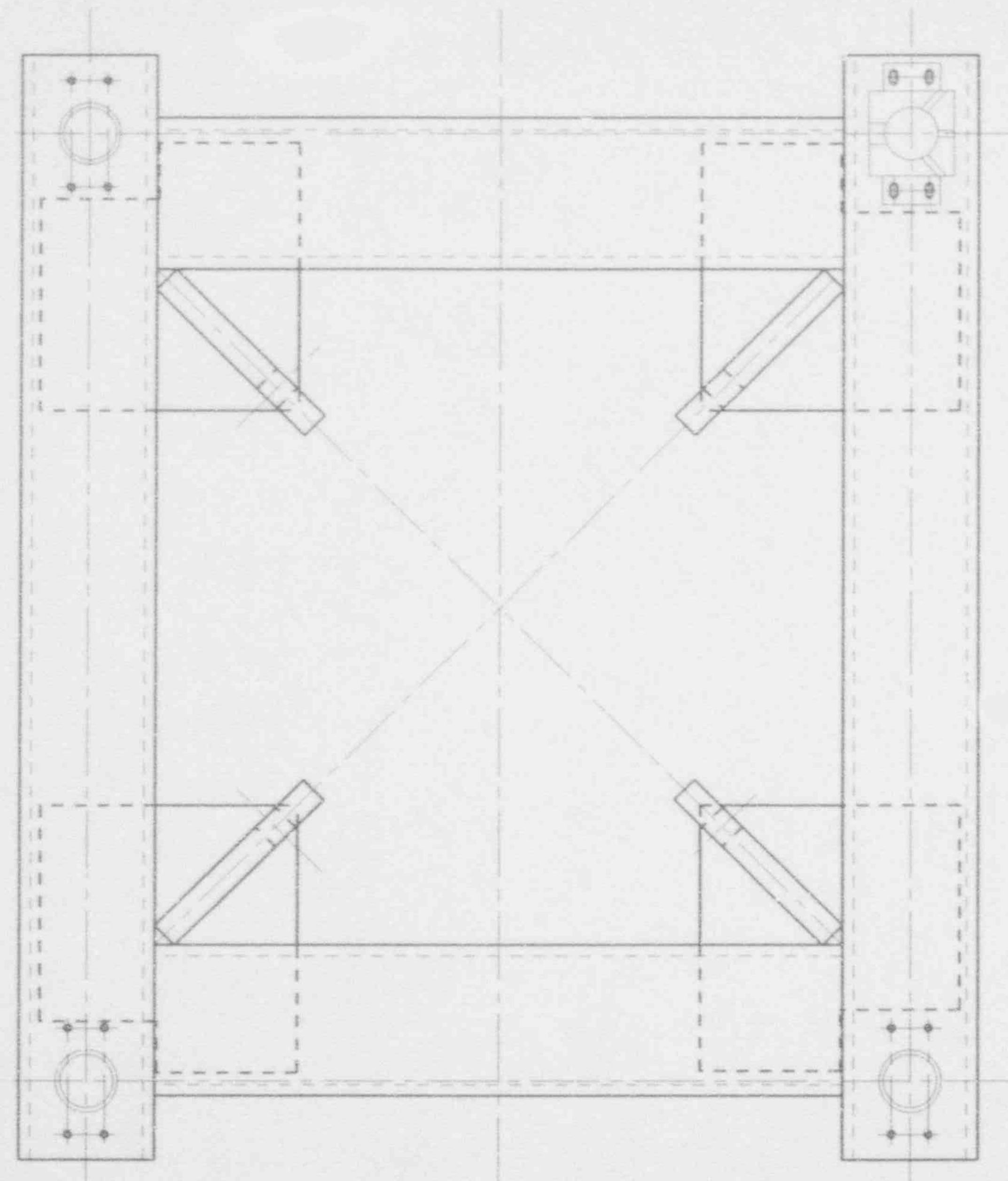


FIGURE 1: ELEVATION VIEW OF HOLTEC LIFT RIG



PLAN VIEW (FRAME)

FIGURE 2: PLAN VIEW OF HOLTEC LIFT RIG