Wisconsin Electric POWER COMPANY
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October 2, 1984

Mr. J. G. Keppler, Regional Administrator
Office of Inspection and Enforcement,
Region III
U. S. NUCLEAR REGULATORY COMMISSION
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Dear Mr. Keppler:

DOCKET NOS. 50-266 AND 50-301
RESPONSE TO IE BULLETIN 84-03
REFUELING CAVITY WATER SEAL
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

IE Bulletin 84-03 dated August 24, 1984, requested that we provide a summary report of the potential for and consequences of a refueling cavity water seal failure prior to beginning our next refueling. This safety hazard evaluation has been accomplished, and the results are summarized in the attachment to this letter. Reactor cavity filling in anticipation of Unit 2 refueling operations is not scheduled to take place until about October 15, 1984.

The original design of the Point Beach spent fuel pools, refueling cavity, and fuel transfer system addresses many of the concerns raised by the event at Haddam Neck. First, the reactor cavity seal system is designed without an active failure mechanism. Therefore, gross seal failure and leakage like that experienced at Haddam Neck is unlikely at Point Beach. Second, the elevation relationship between the spent fuel pool and the fuel transfer system at Point Beach precludes the possibility of uncovering spent fuel in the spent fuel racks by a failure of the reactor cavity seal. Similarly, the top of the active fuel for a fuel assembly in the rod cluster control change baskets, upenders, or fuel transfer tube will not be uncovered by a reactor seal failure, even assuming no operator action. Of course, those assemblies suspended in the manipulator crane or spent fuel pool bridge hoist would have to be lowered into the reactor or a spent fuel rack to prevent their uncovery. The attachment provides additional details that support these conclusions.

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Recovery actions for a reactor cavity seal failure are considered in the discussion section of the attachment. Although not proceduralized, the discussion section does indicate that there are multiple recovery actions available to deal with a reactor cavity water seal failure.

In summary, we have concluded that the Point Beach refueling system design and method of operations are sufficient to safely and effectively respond to an occurrence similar to that experienced at Haddam Neck. Development of a new procedure or revision of present refueling procedures to include mitigative measures developed in the evaluation of IEB 84-03 will be considered and implemented as appropriate. With the transmittal of the attachment, we have completed our demonstration that potential for cavity seal failure at Point Beach is minimal and that the consequences of a cavity seal failure would not constitute a significant impact on the public health and safety.

If you have any questions concerning this submittal, please contact us.

Very truly yours,

Vice President-Nuclear Power

C. W. Fay

Attachment

Copies to NRC Resident Inspector
✓NRC Document Control Desk, Washington
(with original)

Subscribed and sworn to before me
this 3rd day of October 1984.

Gloria J. Monsoor
Notary Public, State of Wisconsin

My Commission expires June 12, 1988.

RESPONSE TO IE BULLETIN NO. 84-03
EVALUATION OF REFUELING CAVITY WATER SEAL FAILURE
POINT BEACH NUCLEAR PLANT

In response to IE Bulletin No. 84-03, "Refueling Cavity Water Seal", Wisconsin Electric has evaluated the potential for and consequences of a reactor cavity water seal failure. This attachment describes the seal system at PBNP, the potential for failure of the system and the associated leakrate as well as makeup capabilities, and the effects on stored fuel and fuel in transfer.

PBNP Reactor Cavity Seal System

The reactor cavity seal system at PBNP consists of the reactor vessel refueling seal ledge, the reactor cavity seal support ring, the reactor vessel seal ring, four (4) silicone rubber pentagonal seal rings, and twenty-four (24) seal ring clamps i.e., brackets with a holddown rod and leveling pad. As can be seen in Figure 1, these components form a passive reactor cavity seal system.

When the reactor cavity seal is initially established, the reactor vessel seal ring is held in place by twenty-four clamps spaced every 15° around the circumference of the seal ring. This assures that the base of the reactor vessel seal ring is flat and in firm contact with the silicone rubber pentagonal rings and that these rings are in flat contact with the reactor vessel sealing ledge and reactor cavity support ring. Redundancy is provided in the present seal system by the two silicone rubber pentagonal seal rings on each side of the reactor vessel seal ring. This essentially forms a double barrier against refueling water leakage. New silicone rubber seal rings are used every time the reactor cavity water seal is installed to provide additional assurance that the seal will be leaktight. Pneumatic seals are not used.

The reactor vessel seal ring, itself, is formed from three 120° segments of carbon steel that are either mechanically joined by splice plates for Unit 1 or welded together for Unit 2. Figure 2 further describes the reactor vessel seal ring details.

Experience With Reactor Cavity Seal At PBNP

The reactor vessel and reactor cavity are prepared for refueling operations in a controlled manner using PBNP refueling procedure, RP-1A, "Preparation For Refueling". The reactor cavity seal ring, which is installed in one step of this procedure, is monitored for leakage periodically during cavity filling and during the entire flooded condition. After the reactor cavity water seal is first installed, the cavity water level is raised to a level that just covers the refueling cavity floor seals. Then the cavity water seal and the keyway are physically inspected for signs of leakage. Following this inspection, the sump in the keyway is continuously monitored with a remote alarm in the control room.

PBNP has not experienced any sizable leaks with its reactor cavity water seal system. On occasion, after the seal ring is first installed and the cavity is flooded to just above the seal ring, there have been some small leaks, some of which were attributable to the removable vessel nozzle shielding covers. In a few cases the water has had to be drained down and the seal ring tightened or adjusted. Most often these leaks have been evaluated as not significant and cavity filling has continued. As would be expected when the water level is increased, the weight of the water over the reactor cavity seal ring tends to seat the seal.

As mentioned previously, the PBNP reactor cavity water seal is a passive system. The holddown clamps serve only to retain the seal ring prior to flood-up. With the reactor cavity flooded, the weight of the water negates any further need to have the holddown clamps installed. Thus, there can be no active component failure with the PBNP reactor cavity seal. Gross seal failure is virtually impossible. Therefore, it is improbable that PBNP could have leakage from the cavity seal ring of similar magnitude as that described in IE Bulletin 84-03.

Calculated Leakrate and Makeup Capabilities

Notwithstanding the above conclusion, a postulated failure of the PBNP reactor cavity seal ring was evaluated. No mechanism for this failure was identified. Gross seal ring failure, such as by brittle fracture, is assumed not likely. It is also considered unlikely that one, or more of the four pentagonal seal rings could be breeched to any large extent, since they are not exposed. Even in this latter case, the reactor cavity seal ring would still be compressed by the weight of the water onto the reactor vessel refueling seal ledge and the reactor cavity seal support ring and thus would permit only orifice-type flow into the annulus around the reactor vessel.

For the leak evaluation, a ¼" crack was postulated to occur at the mechanical or welded joint where two 120° segments of the cavity seal ring are joined. This yields a slot in the cavity seal of ¼" x 2" or an effective area of break equal to ½ in^2. Assuming the reactor cavity water to be an ideal fluid and the water level in the reactor cavity to be at the highest design level, the maximum volumetric leakrate was calculated to be 61.9 gpm. Conservatively assuming this leakrate to be constant as water is emptied into the annulus around the reactor vessel yields the following:

Conditions	Rate of Water Level Decrease
1. Spent fuel pool and transfer canal water communicates fully with reactor cavity water (i.e., transfer tube is open).	
a. EL 64' 8" down to EL 40' 8"[1]	~0.04 inch/minute
b. EL 40' 8" down to EL 40' 2 1/8"[2,3]	~0.07 inch/minute
2. Reactor cavity alone (i.e., transfer tube is isolated).	
a. EL 64' 8" down to EL 40' 2 1/8"	~0.1 inch/minute

Notes

1. The spent fuel pool will only empty to a level of 40' 8", the height of the bottom of the spent fuel gate.
2. From EL 40' 8" to 40' 2 1/8", only the transfer canal and reactor cavity continue to drain.
3. All draining of the reactor cavity stops at EL 40' 2 1/8", the height of the cavity water seal ledge.
4. The nominal elevations of the spent fuel pool, the reactor cavity and associated refueling equipment are given in Table 1. Figure 3 also shows these relative elevations as well as a plan view of the spent fuel pool, transfer canal, and refueling cavity.

As can be seen, it would take in excess of 98 hours to drain the reactor cavity, transfer canal, and spent fuel pool from the height of the low level alarm as sensed in the spent fuel pool, EL 60', down to EL 40' 8" and then continue to drain the transfer canal and refueling cavity to EL 40' 2 1/8". If it is assumed that just the refueling cavity is drained, it would take in excess of 39 hours to drain from a level of 60' to the level of the reactor cavity seal, 40' 2 1/8". Both of these cases assume no operator action.

In the event water level was decreasing in the refueling cavity, two charging pumps would be available to add borated makeup water at a rate of 60 gpm per pump. This is more than adequate to keep up with the postulated leakrate.

The RHR pumps, although available, could not add much water at this point because the refueling water storage tank is essentially empty from the initial filling of the refueling cavity. If the leakage were to occur for a sufficient period of time, however, containment Sump A, the reactor cavity keyway, and Sump B (floor of containment) would become filled with water. When the floor of containment becomes covered with water, the RHR pumps could be lined up to take suction on Sump B to add makeup water directly to the reactor vessel and hence to the refueling cavity through the core deluge lines. The design flow is 3,120 gpm for two RHR pumps operating. Recirculation of water in this manner could continue indefinitely and is more than adequate to handle the postulated leakrate.

It should also be noted that the makeup capacity of an RHR pump is not limited to 1,560 gpm. During normal RHR operation, the RHR heat exchanger discharge and heat exchanger bypass valves are throttled to maintain this design flow. During the refueling cavity filling, full flow tests are done on the RHR pumps to compute the pump performance curve. RHR pump discharge capacities typically run as high as 2000 gpm during these tests. Thus, additional makeup capability is possible.

Potential Effect on Stored Fuel and Fuel in Transfer

At any given time during refueling at PBNP there is the possibility of having five assemblies in positions other than in the core or spent fuel pool. These positions are:

1 fuel assembly in the manipulator,
2 fuel assemblies in the RCC change fixtures,
1 fuel assembly in the upender or transfer system, and
1 fuel assembly on the spent fuel pool bridge hoist.

Table 1 gives the maximum elevations of spent fuel in these positions. Both Table 1 and Figure 3 show that the active fuel in any fuel assemblies in either the RCC change fixtures or the upender will not become uncovered in any reactor cavity leak scenario. Similarily, three feet of water will remain above the top of the active fuel in the racks, assuming total drawdown of the reactor cavity water to the seal level. Fuel assemblies in either the manipulator tube or on the spent fuel pool bridge hoist could possibly become uncovered. However, this is unlikely since it would take only moments for the operator to lower the fuel assemblies into either the reactor or the spent fuel racks. Hence, the probability of damage to cladding is minimal.

Discussion

No emergency procedure currently exists to deal specifically with a reactor cavity water seal failure, since the seal design at PBNP is not subject to gross failure. Notwithstanding that conclusion, the actual time that the reactor cavity seal is depended on at PBNP is minimized. Fuel movement is planned in detail and typically lasts five to six days.

Assuming that a leak would develop on the PBNP reactor cavity seal during refueling yields the scenario below. Though the discussed actions are not proceduralized, they would be undertaken because they accomplish the following objectives:

1) Place fuel in a safe position where fuel damage cannot occur,
2) Minimize the radiation problems that could occur as water level is lowered, and

3) Minimize the amount of refueling water leaked into containment, thus shortening the cleanup time and time till the seal could be repaired.

During the refueling cavity flood-up and during refueling, itself, the PBNP operators would be alerted soon after seal leakage started. Should leakage occur, it would drain to containment sump A. The level in sump A is monitored in the Control Room, and the high level alarm sounds when the sump contains only 23 gallons of water for Unit 1 and 46 gallons for Unit 2. Thus, any seal leakage is subject to early detection.

After seal leakage is detected, the resulting leakrate would be evaluated. Depending on the leakrate, the refueling would either be continued normally or the refueling would be halted and preparations made to drain the refueling cavity to repair the seal ring.

For the leakrates calculated earlier in this Attachment, even without adding borated makeup water, there is adequate time for the operators to complete required fuel movement to place the fuel assemblies in transit in either the reactor or the spent fuel pool. In the event the leakrate is much larger, the operator would still have time to lower any fuel on the manipulator crane or the spent fuel pool bridge hoist into the reactor or spent fuel racks.

While fuel is being placed in positions to ensure it remains covered, makeup water would be added to the refueling cavity. However, after all fuel is in a safe position, the amount of makeup water added would be minimized, because at this point it just becomes more water that can drain to the bottom of containment or water that will have to be pumped out of the cavity. Also, only after all fuel has been placed in a safe position would the fuel transfer tube isolation valve be closed. Prior to this time the additional water in the spent fuel pool provides a source of borated makeup water through the fuel transfer tube to slow the rate of water level drop in the refueling cavity.

The spent fuel in the spent fuel pool (SFP) cannot be physically uncovered by a failure of the reactor cavity water seal. However, the SFP cooling suction line is relatively high up on the SFP wall to prevent siphoning problems. If this piping became uncovered prior to any operator action, which is unlikely, makeup water could be added from various sources. This could be continued indefinitely.

After the transfer tube isolation valve is closed, the remaining water in the refueling cavity above the vessel flange would likely be pumped back to the refueling water storage tanks. This would minimize the amount of water leaked into the reactor keyway and then to the floor of containment. After the cavity has been dewatered, the normal RHR cooling lineup would be reestablished for cooling of fuel in the reactor.

Hence, there is sufficient capability at PBNP to deal with a reactor cavity water seal failure.

TABLE 1
ELEVATIONS OF THE SPENT FUEL POOL AND REACTOR CAVITY AND THE ASSOCIATED EQUIPMENT

ITEM	ELEVATION
*Spent Fuel Pool Floor	24' 8"
*Refueling Canal Floor	24' 8"
*Refueling Cavity Floor at Transfer Tube	24' 8"
Inside Bottom of Spent Fuel Racks	25' 5" Δ
*Centerline Transfer Tube	26' 8"
*Lower Cavity Floor	29' 11"
Top of Core Elevation	30' 6.475"
*Top of Active Fuel in the Spent Fuel Racks	37' 9"
*Top of Spent Fuel Racks	39' 0"
Top of Fuel Assembly in Spent Fuel Racks	38' 9" (4)Δ; 39' 3" (5)Δ
Top of Active Fuel in RCC Carriage Assembly (approx.)	39' 7"
*Top of Active Fuel in Upender (approx.)	39' 8"
*Reactor Vessel Refueling Seal Ledge	40' 2.125"
*Reactor Vessel Cavity Seal Support Ring	40' 2.125"
Top of RCC Carriage Assembly	40' 6"
*Top of Upenders	40' 6.5"
Top of Fuel Assembly in RCC Carriage Basket (approx.)	40' 7" (4)
Top of Fuel Assembly in Upender	40' 7.5" (4)
*Lowest Edge of North and South Spent Fuel Pool Gates	40' 8"
*Top of Notch between Spent Fuel Pools	40' 8"
Bottom of Manipulator Crane Tube	41' 9"
Bottom of Spent Fuel Pool Cooling Return Line	52' 8"
Maximum Fuel Assembly Elevation (manipulator)	55' 2"
Bottom of Spent Fuel Pool Cooling Suction Line	59' 8"
Spent Fuel Pool Low Water Level Alarm	60' 0"
Spent Fuel Pool High Water Level Alarm	64' 0"
*Maximum Water Level Height (design)	64' 8"

Δ - as installed dimension

Notes:
1. Floor elevations are given to the top of the liner plate.
2. Dimensions involving fuel are prior to irradiation; maximum irradiated difference is 0.3".
3. Asterisks (*) identify components shown in Figure 3.
4. Without inserts (i.e., thimble plug devices, source assemblies, or burnable poison rodlet assemblies).
5. With part length control rod fully inserted.

CAVITY SEAL ASSEMBLY

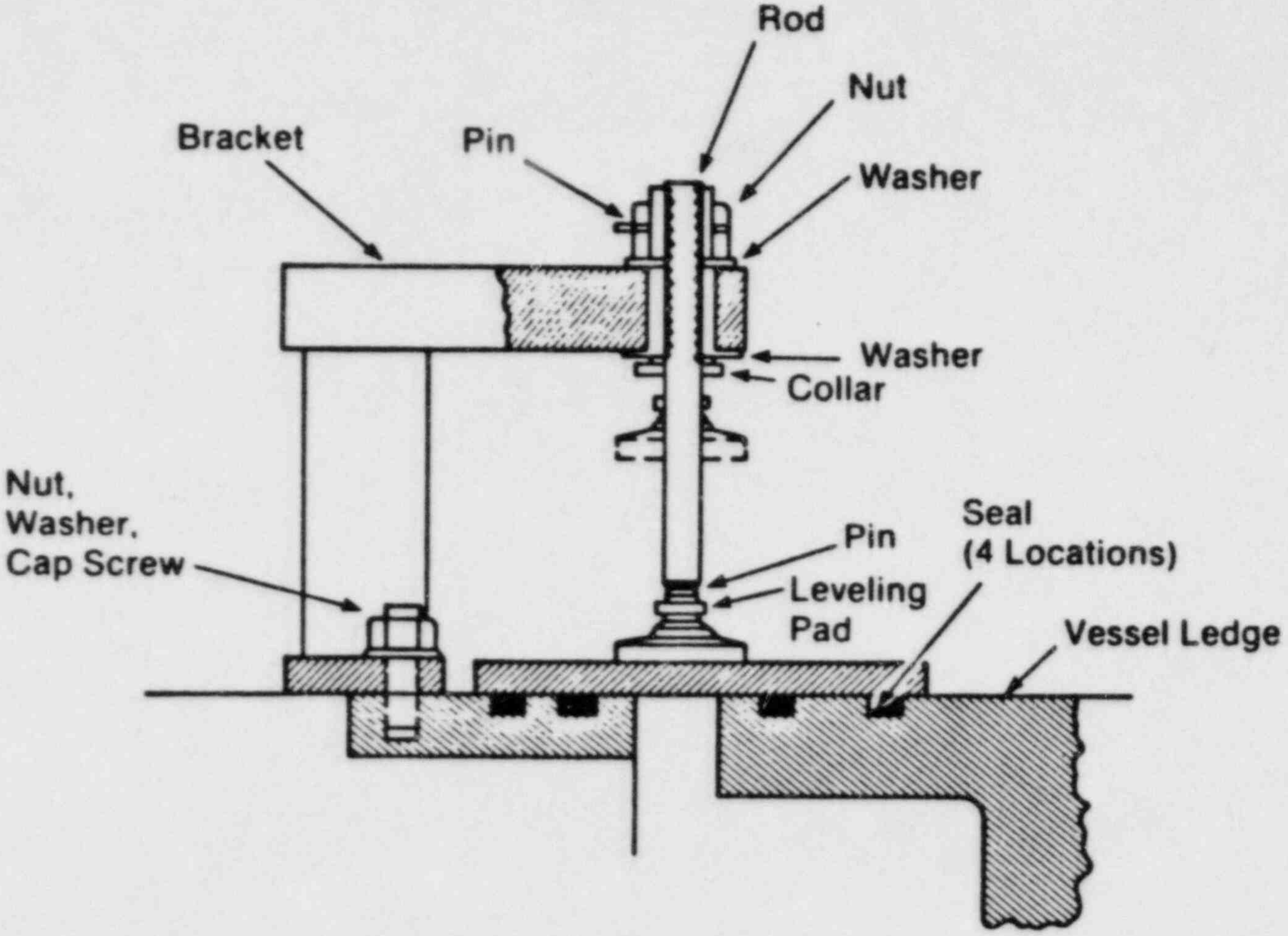
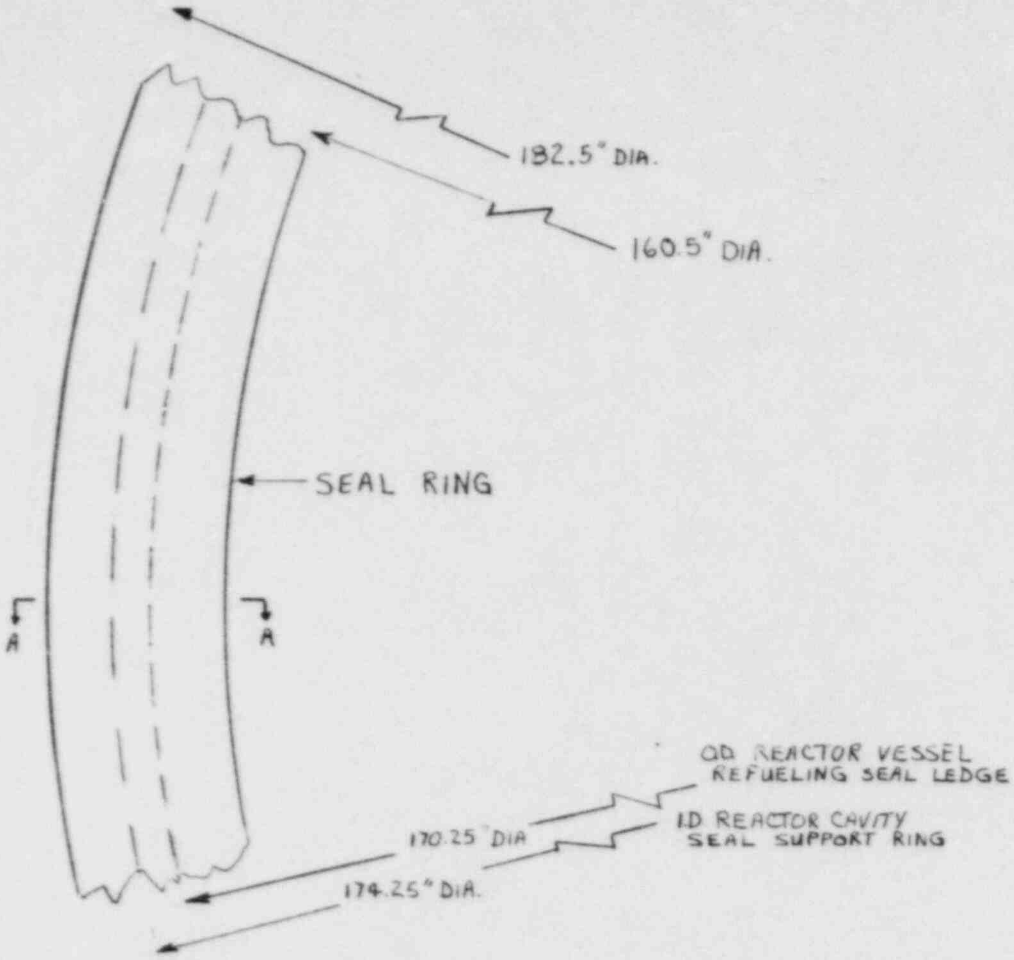
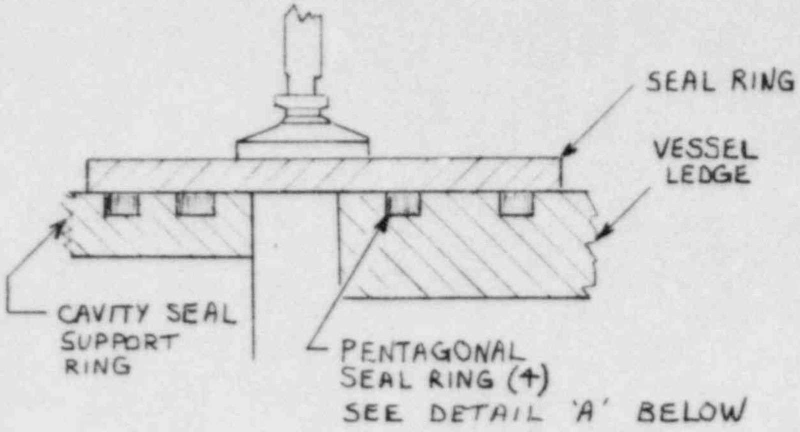
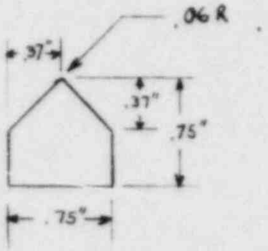


FIGURE 1

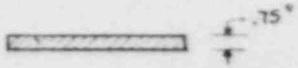
MISCELLANEOUS DETAILS
CAVITY SEAL RING







DETAIL A



SECTION A-A

NOTES

1. SEAL RING MATERIAL: CARBON STEEL
2. PENTAGONAL SEAL RING MATERIAL: SILICONE RUBBER

FIGURE 2

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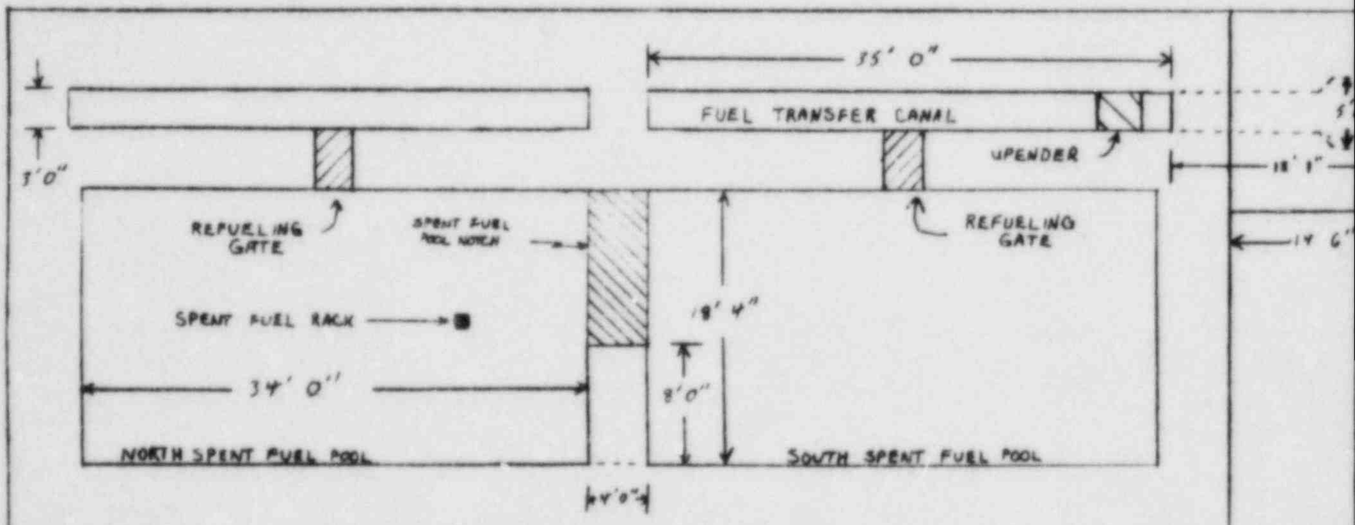
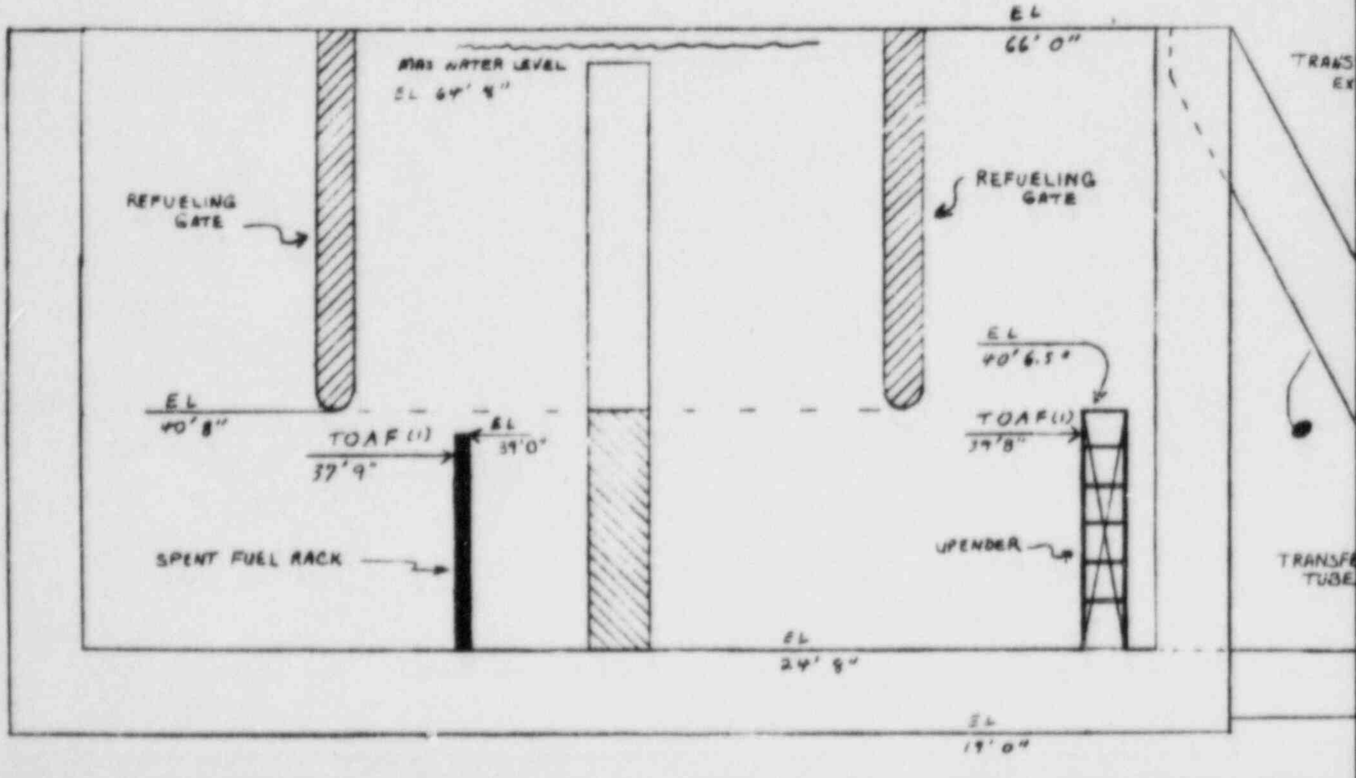
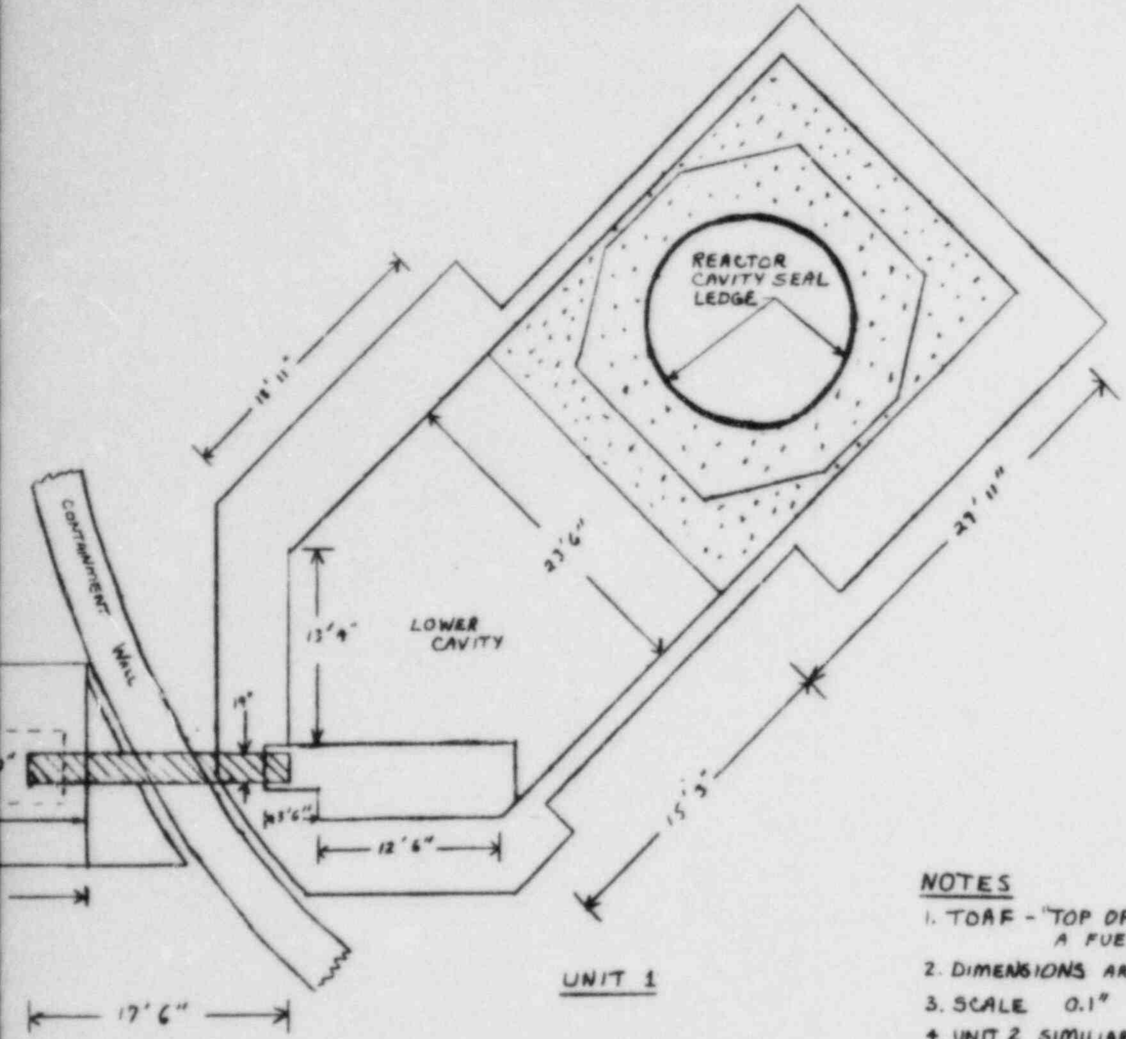
SPENT FUEL POOL AND REFUELING CAVITY PLAN AND ELEVATION SKETCH







UNIT 1

NOTES

1. TOAF - "TOP OF ACTIVE FUEL" IN A FUEL ASSEMBLY.
2. DIMENSIONS ARE APPROXIMATE.
3. SCALE 0.1" = 1.0'
4. UNIT 2 SIMILIAR TO UNIT 1.

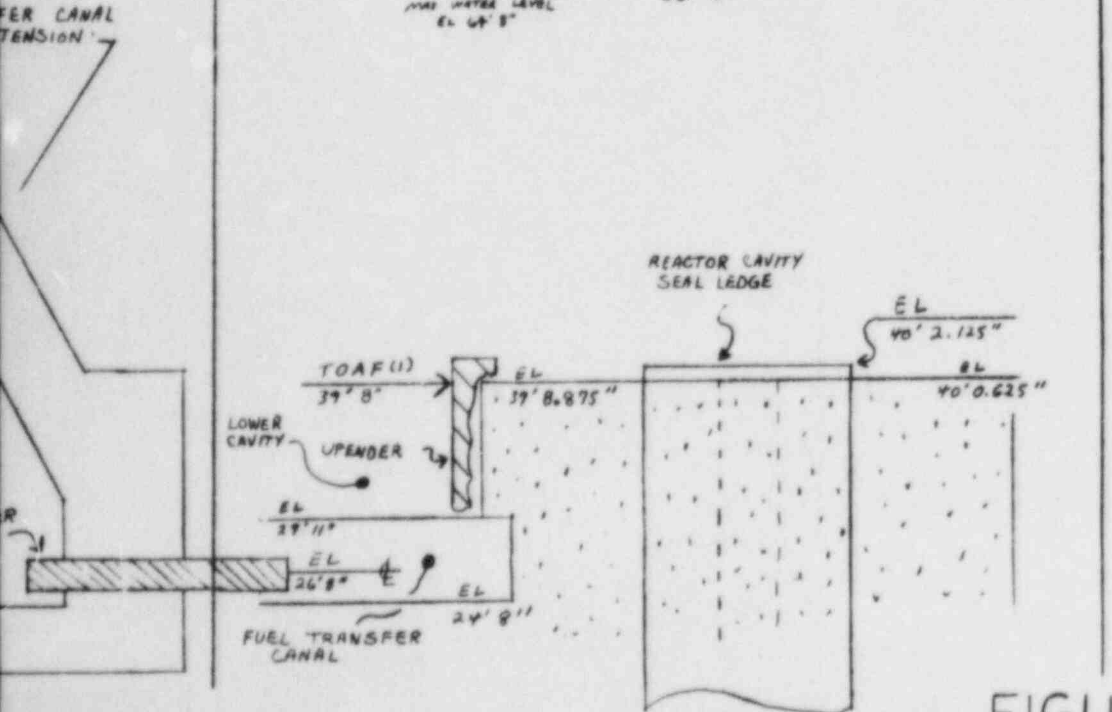


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FIGURE 3