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Docket Nos. 50-348
50-364

Regional Administrator
U. S. Nuclear Regulatory Commission
Region II, Suite 2900
Atlanta, Georgia

Attention: Mr. J. P. O'Reilly

Joseph M. Farley Nuclear Plant - Units 1 and 2
IE Bulletin No. 84-03, Refueling Cavity Water Seal

Gentlemen:

IE Bulletin No. 84-03, Refueling Cavity Water Seal, requests that an evaluation be performed and a summary report be provided to the NRC on the potential for and consequences of a refueling cavity water seal failure. The evaluation was requested to include consideration of gross seal failure; maximum leak rate due to failure of active components such as inflated seals; makeup capacity; time to cladding damage without operator action; potential effect on stored fuel and fuel in transfer; and emergency operating procedures. The results of the evaluation performed on the refueling cavity water seals are provided below and show that the failure of these seals is not a credible event at Farley Nuclear Plant.

A comparison of the refueling cavity water seal in use at Farley Nuclear Plant (Figure 1) and the seal that failed at Haddam Neck Nuclear Plant reveals that the two seals have no design similarities. The Farley seal consists of a 3/4 inch stainless steel ring, 11 inches wide and approximately 17 feet in diameter, spanning a two inch gap between the vessel flange and the seal support ring. This steel ring rests on four elastomer O-Ring seals (double gaskets): two on the vessel flange and two on the seal support ring. The seals are in grooves to prevent their moving out of place and are compressed by 18 holddown clamps acting on the seal ring, only nine of which are required by design. Each clamp is made of a 3 inch by 2 inch steel bar which is anchored to the seal support ring by two 7/8 inch set screws. There are no active

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components and the weight of water above the 11 inch ring is approximately 37 tons which acts to make the seal tighter (not to displace the seal as in the Haddam Neck design). In addition, the double gaskets on both the reactor flange and the cavity floor provide a means of leak testing the seal configuration prior to the flooding of the refueling cavity. The leak testing procedure provides for pressurizing the area between the seals to detect leakage. Observation of the ability of the seal to maintain air pressure provides the required assurance that no leakage will be experienced after flooding.

An analysis was also performed to evaluate the effects of an impact of a fuel assembly on the holddown cavity seal clamp. Of particular interest were the loads and deformations of the clamp holddown bolts with subsequent potential deformation of the seal ring resulting in seal cavity leakage. The two cases of fuel assembly transfer incidents considered were: 1) a horizontal impact of a fuel assembly on the clamp at the maximum translational speed of the fuel assembly (40 ft/min.), and 2) a drop of the fuel assembly onto the clamp from a height of 8 inches, which is the approximate maximum vertical distance between the fuel assembly and the top of the clamp during refueling. It is noted that such incidents could only impact one holddown clamp. For a horizontal impact at 40 ft/min., an elastic analysis was performed which indicated that the bolt would stretch but not fracture. The vertical drop from 8 inches was then analyzed and found to be the more severe case because the impact velocity is approximately 10 times as high. A refined elastic-plastic analysis was performed which yielded strains well below the fracture point. In summary, the analysis indicates that the bolts will yield but will not fracture under the loads produced by either horizontal or vertical impact.

For the case of the vertical drop, the force which could produce yielding in the holddown clamp could not produce seal deformation since all of the forces exerted would be unidirectional thus precluding loss of sealing capabilities. The only postulated means of causing deformation to the seal would be a horizontal impact lifting the seal ring at the clamp location due to the seal ring/holddown assembly arrangement which is secured by set screws as shown in Figure 1. In such an event, the resulting gap would be minimized due to the weight of water above the seal ring, the thickness of the ring, and the locations of other clamps approximately two feet on either side of the impacted clamp.

For such a hypothetical event where seal deformation could be experienced, a sixty (60) mil gap has been postulated between the seal ring and the reactor vessel flange/refueling cavity floor assuming that the double gaskets were not in place. In addition, the gap was conservatively assumed to be on both the inside (reactor vessel flange side) and the outside (refueling cavity side) of the seal ring. Figure

2 shows the reduction in water level with respect to time, with and without communication between the spent fuel pit and the refueling cavity. Even though this postulated sixty (60) mil leak is extremely unlikely, Figure 2 indicates that eighty-six (86) minutes is required to drain the refueling cavity to the level of the seal ring with the spent fuel pit isolated and one hundred sixty-four (164) minutes to drain to the same level with the transfer canal open. Figure 3 illustrates the leakage rate over time with and without communication between the spent fuel pit and the refueling cavity. Figure 3 also shows that the maximum leak rate is 5500 gpm when the refueling cavity is filled. As the level decreases, the leak rate will also decrease because of a decrease in hydrostatic pressure exerted by the water column above the seal ring.

As discussed previously, testing of the seals provides a means of verifying the leak tightness of the seals prior to flooding the reactor cavity. However, should the postulated gap of sixty (60) mils appear during flooding, the leakage would be identified by personnel in containment responsible for the flooding activities. In addition, the leakage would be collected in the reactor sump which alarms in the control room.

In such an event an existing Farley Nuclear Plant procedure requires that a fuel assembly in transit be relocated to the reactor vessel or upender. In such positions the fuel assembly would not be uncovered since all fuel would be below the level of the reactor vessel flange. The only condition where potential fuel assembly damage would result is if the manipulator crane fails while transferring a fuel assembly concurrent with a condition precipitating seal leakage, thereby precluding relocation of the fuel assembly below the vessel flange. Under this condition, from Figures 2 and 3, it is shown that a makeup capability of low head and high head safety injection pumps (i.e., 4560 gpm) will be capable of maintaining the water level above the highest possible elevation of a fuel assembly (i.e., 15 feet above cavity seal elevation). The Farley Nuclear Plant Refueling Accident Procedures will be revised to include guidance for the operator during a refueling cavity water seal failure.

In conclusion, the difference in design of the Farley Nuclear Plant refueling cavity water seal to the Haddam Neck Nuclear Plant seal provides the assurance that the gross seal failure experienced at Haddam Neck would not occur at Farley Nuclear Plant. The Haddam Neck seal is an active design, whereas the Farley seal is a passive design. The only postulated events which could damage the Farley seals are either a dropped or a dragged fuel assembly. Both of these events have been shown to be not capable of causing a gross seal failure. Based on the above considerations, the consequences noted in IE Bulletin 84-03 need not be evaluated since a gross failure of the water seal is not a credible event for the Farley Nuclear Plant.

If you have any questions, please advise.

Yours truly,

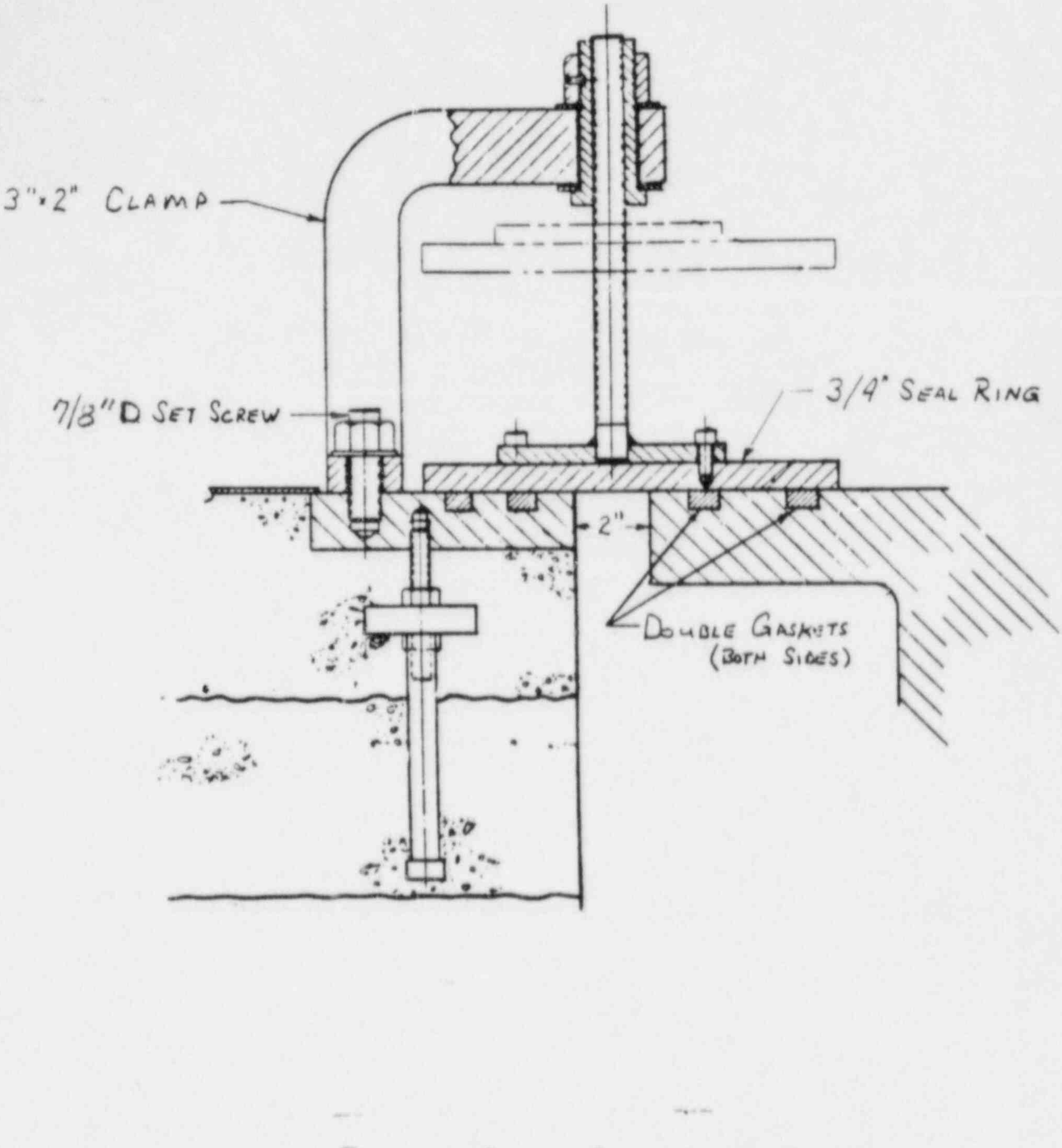
R. P. McDonald

RPM/JAR:bdh-D1
Attachments
cc: Mr. L. B. Long
Mr. E. A. Reeves
Mr. W. H. Bradford
Mr. G. F. Trowbridge

SWORN TO AND SUBSCRIBED BEFORE ME
THIS 26th DAY OF November 1984

Robert W. Stewart
Notary Public

My Commission Expires: 10/27/85



REACTOR CAVITY SEAL CROSS SECTION
(TYPICAL 18 LOCATIONS EQUALLY SPACED)

FIGURE 1

FIGURE 2

ALA REFUELING CAVITY WATER HEIGHT AFTER SEAL FAILURE WITH NO MAKEUP WATER

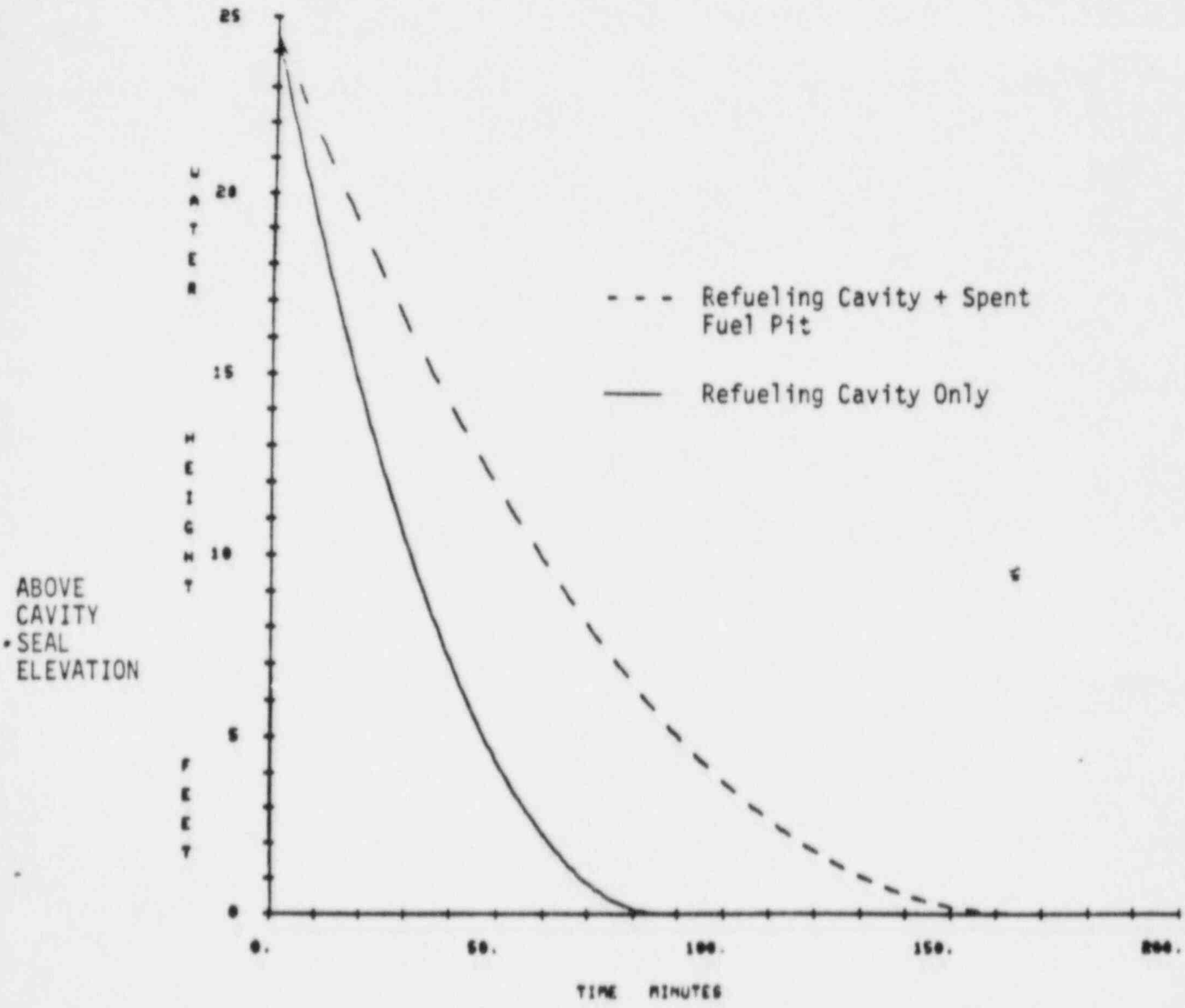


FIGURE 3

ALA REFUELING CAVITY SEAL LEAKAGE RATE AFTER SEAL FAILURE