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JPN-87-014

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
IE Bulletin 84-03 "Refueling Cavity Water Seal".

Reference: 1. NYPA letter C. A. McNeill to T. E. Murley (NRC) dated December 20, 1984 (JPN-84-85) on the same subject.

Dear Sir:

In August 1984, NRC issued IE Bulletin 84-03 which required that the Authority evaluate the potential for, and consequences of a refueling cavity water seal failure at the FitzPatrick plant. The Authority responded to the Bulletin in December 1984 (Reference 1). This response was based on information contained in the updated and original FSARs, design drawings and associated documents. No plant walkdown was conducted at that time. The information regarding leak detection systems for bellows rupture, in the FSARs, has subsequently been found to be in error. This resulted in incorrect statements in Reference 1.

A recent plant walkdown has identified the discrepancies between the 'as built' configuration of the plant and Reference 1. Contrary to Reference 1, the inner bellows seal is not equipped with a leak detection system. The walkdown also identified that the guard ring plates for both inner and outer bellows can only be removed with considerable difficulty. Even though no leak detection system presently exists for the inner bellows seal, any leakage from the inner bellows will be contained by a backing plate and a self-energizing spring seal that surrounds the outer circumference of the bellows to prevent gross water leakage. Any leakage past the self-energizing spring seal would spill over the backing plate and down into the drywell area. Therefore, the conclusions reached in Reference 1 do not change in any way.

The Authority will install a leak detection system for the inner bellows, and a flow switch in the outer bellows rupture drain line, by the end of the next refueling outage to bring the plant into conformance with the FSAR. The Authority will update the FSAR, drawings and design documents to reflect the 'as built' configuration of the plant in conjunction with the modifications.

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A revised copy of Attachment 1 of Reference 1 showing the changes is enclosed. Description of modifications will be provided in the annual FSAR update.

Should you or your staff have any questions on this subject, please contact J. A. Gray, Jr. of my staff.

Very truly yours,

John C Brons

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Enclosure

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ATTACHMENT I

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
RESPONSE TO IE BULLETIN NO. 84-03:
REFUELING CAVITY WATER SEAL
SUMMARY REPORT

This summary report is in response to the NRC request to evaluate the potential for and consequences of a refueling cavity water seal failure. Consideration has been given to: gross seal failure; inflated seals; makeup capacity; time to cladding damage without operator action; potential effect on stored fuel and fuel in transfer; and emergency operating procedures.

1. Gross Seal Failure

The refueling cavity water seal system of the James A. FitzPatrick Nuclear Power Plant (JAFNPP) is composed of two (2) refueling bellows, an inner and outer, of type 304 stainless steel, and a refueling bulkhead. The refueling bulkhead and bellows provide a water tight barrier to permit flooding above the reactor and to prevent water from entering the drywell. Following is a description and purpose of each of the components that are a part of the leak tight drywell system.

1.1 Inner Refueling Bellows:

The inner refueling bellows forms a seal between the reactor vessel and the surrounding drywell to permit flooding of the reactor head cavity during refueling operations. The inner bellows are designed to accommodate for differential expansion or contraction that occurs between the reactor vessel and the drywell mainly during reactor heatup and cooldown.

The inner bellows assembly consists of the following equipment:

(a) A cylindrical fully corrugated one piece type 304 stainless steel bellows seal. The bellows do not contain circumferential welds. As per the referenced drawing no. 11825-510-3B (Attachment I), all welds in the convoluted section were required, at the time of fabrication, to be inspected by dye penetrant testing and proved leak tight by helium leak detector test or hydrostatic test. Welder performance qualification had to be in accordance with ASME Boiler and Pressure Vessel Code Section IX. The bellows support skirt plates are seal welded to the reactor vessel shell flange, and to the refueling bulkhead.

(b) A cylindrical guard ring plate that protects the inner circumference of the bellows.

(c) A seal barrier that surrounds the outer circumference of the bellows to prevent gross water leakage in the event of bellows failure. This seal will be equipped with a leak detection system. This secondary seal includes circumferential stainless steel plates and a sealing system to prevent water loss by yielding to make a tight fit to the backing plate when subjected to full hydrostatic pressure. The leak detection system will consist of a drain line connected to the equipment drain sump with a flow switch to monitor leakages. The leak detection system of the inner bellows will be equipped with a valve that can be shut manually as leakage is detected in the system.

1.2 Outer Refueling Bellows:

The outer refueling bellows forms a seal between the drywell shell and the concrete containment wall to permit flooding of the reactor head cavity during refueling operations. The outer bellows are designed to accommodate for differential expansion or contraction that occurs between the drywell shell and the primary containment wall during plant heatup and cooldown.

The outer bellows assembly consists of the following equipment:

(a) A cylindrical fully corrugated one piece type 304 stainless steel bellows seal. The bellows do not contain circumferential welds. As per the referenced drawing no. 11825-510-3B (Attachment I), all welds in the convoluted section were required, at the time of fabrication, to be inspected by dye penetrant testing and provide leak tight by helium leak detector test or hydrostatic test. Welder performance qualification had to be in accordance with ASME Boiler and Pressure Vessel Code Section IX. The bellows support plates are seal welded to a drywell shell structure and to the primary containment circumferential embedded plate.

(b) A cylindrical guard ring plate that protects the inner circumference of the bellows.

(c) A flow switch will be installed in the rupture drain line.

1.3 Refueling Bulkhead:

In conjunction with the inner and outer assembly of bellows seals, the refueling bulkhead provides a watertight barrier to permit flooding of the space (reactor head cavity) above the vessel during refueling operations. Basically it is a flat circumferential plate seal welded to bulkhead support brackets encompassing an integral part of the drywell shell structure. There are a total of six (6) vent and drain openings in the bulkhead plate all equipped with watertight hinged covers bolted in place during the extent of normal refueling operations. In case of a gasket failure for the water tight hinged covers, the amount of leakage would be insignificant compared to the leakage due to a gross seal failure of the refueling bellows. During plant normal operation, these covers are opened to permit circulation of ventilation air in the region above the reactor well seal.

The following summary provides a listing of material requirements associated with the construction of the drywell leakage barrier and its safeguards to prevent a gross seal failure:

A. Leakage barrier sealing system built in conformance with Quality Assurance Class II requirements; level switches to Class I requirements.

B. Mill test reports or certificates of compliance for all materials.

C. Materials in conformance with applicable ASTM requirements.

D. Seal welds, welder qualifications and non destructive examination performed in accordance with applicable ASME requirements.

E. Both inner and outer bellows are protected by a cylindrical guard ring.

F. The leakage barrier does not contain pneumatic seals. The entire system relies on mechanical welded bellows which requires no outside source of power to maintain seal integrity. Failure of the seal would require structural failure of welded components and hence, this event is considered to be highly unlikely.

G. A dual leakage barrier at the inner bellows. The secondary seal will be equipped with a leak detection system.

H. A sump collector system outside the outer bellow that drains water to the condensate storage tank.

I. Inner bellows leak detection system will be equipped with a flow switch to monitor leakage.

J. Common annunciator in the Control Room aided by back up computer capability to help detect source of leakage augmented by a local panel alarm in the Reactor Building.

K. During movement of fuel bundles, water levels are monitored by available personnel on the refueling floor. These personnel are in constant radio communication with the Control Room Operator. Level switches are provided on the skimmer surge tanks to indicate high, low and low - low tank levels. Alarms are provided in the Control Room and locally at the spent fuel pool panel in the Reactor Building, to indicate abnormally high or low water level.

L. A make-up system that maintains normal water level in the refueling pools.

Because of the nature of the leakage barrier design, its construction requirements and safeguards, we preclude the possibility of a gross failure in the refueling cavity water seal system of the JAFNPP.

2. <u>Maximum Leak Rate Due To Failure Of Active Components Such As Inflated Seals And Make-Up Capacity</u>

There are no inflated seals in the refueling cavity sealing system of the JAFNPP. The sealing boundary, is a water retaining permanent structure with normal leakage of zero (0) GPM.

In the unlikely event however, of a total gross seal failure of the refueling bellows, the maximum leak rate is as follows:

Inner Refueling Bellows:	(1)370 GPM
Outer Refueling Bellows:	(2)7,100 GPM
Total (max.) Potential Water Loss: (without operator assistance)	(3)533,000 GAL
Minimum Time for Total Water Loss: (without operator assistance)	(3)75 MIN

Notes:

(1) Maximum calculated leak rate through the secondary seal drain line.

(2) Maximum calculated leak rate through all openings and gaps in the guard plate segments. Approximately 5,300 GPM will transfer to the condensate storage tanks and 1,800 GPM will overflow into a 2 inch gap between the drywell shell and containment wall and, to the suppression pool enclosure area (torus room).

(3) Maximum potential water loss during refueling includes: water from spent fuel pool and dryer - separator pool up to the bottom of the refueling canals and total water from the reactor well pool cavity.

For make-up water systems and capacity rates refer to Table I (Sheet No. 7).

3. <u>Time To Cladding Damage Without Operator Action, Potential Effect on Stored Fuel And Fuel Transfer And Emergency Procedures</u>:

During refueling operations there is continuous communication between operators of the Control Room and on the refueling floor. There are two (2) operators in the Control Room and a minimum of two (2) operators on the refueling floor. Abnormal high or low water level is immediately detected by the Control Room or the refueling floor operators for their assessment and action as required. In the event of a rapid pool inventory loss, the refueling operations would be immediately suspended and fuel in transfer would be immediately placed either in the reactor vessel below the flange elevation or in the fuel pool, depending on proximity. Placing the fuel assembly in either of these locations would protect it from uncovering as a result of a gross seal failure, because the top of the fuel bundles are approximately 2 feet lower than the bottom of the refueling canal.

With constant operator surveillance from the refueling floor and Control Room, and a make-up system that is capable of maintaining normal water level, the possibility of fuel damage is therefore eliminated, even in the highly unlikely event of a bundle being transferred simultaneously with gross failure of the cavity seal. During this highly unlikely event, and assuming a potential water loss at a rate of 7,100 GPM, the calculated refueling floor operator response time exceeds 20 minutes before the top of the assembly is uncovered. This time is based on seven (7) feet water cover. We consider this response time to be sufficient enough to allow manual activation of the fuel pool make up water system, and/or for fuel in transfer to be placed in the reactor vessel below the flange or in the fuel pool, depending on proximity.

TABLE I

MAKE-UP WATER CAPACITY RATES

Gross Seal Failure/Location	Maximum Calculated Leak Rate	Drain Lines	Drain Lines Connections	Storage capacity	Pumps Operation Mode	Make-up Water System
Inner Bellows	(1) 370 GPM	2-1 1/2" dia connecting to a 1 1/2" dia Line.	Equipment drain sump	500 Gal.	Auto/Manual	(3)Condensate Storage System -2- 200,000 Gal Storage Tanks and 2 pumps each at rate of 525 GPM
Outer Bellows	(2) 7,100 GPM	4-4" dia connecting to a 6" dia Line	Condensate Storage tanks	2 - 200,000 Gal each	Manual	For additional make-up water systems refer to note (3)

Notes (1) Maximum calculated leak rate through the secondary seal drain line.

(2) Maximum calculated leak rate through the outer seal rupture drain line.

(3) Make-up water for the spent fuel pool is transferred from the condensate storage tanks to the skimmer surge tanks to make-up any pool losses by manual operation of the condensate transfer system.

The condensate storage tanks are designed to seismic class I requirements.

Provisions exist to add lake water to the Reactor cavity through the RHR System in the extremely unlikely event of loss of normal makeup system and when pool water level is threatened due to heavy pool water inventory loss. There are four (4) RHR service water pumps each having a design flow of 4,000 GPM at 267 feet TDH per pump. The RHR service water system is designed to seismic class I requirements.

Additional make-up water systems also exist, i.e.: RHR pumps (LPCI mode) takes suction from the supression pool (min. capacity = 790,000 Gal) and discharges into the reactor vessel core region through the recirculating loops; and core spray system using the condensate storage tanks.

REFERENCE DRAWINGS

DRAWING NO.	TITLE
729E729	Arrangement Reactor Well Seal (by General Electric)
97-6707-D	22 ft. Diameter Refueling Bellows (Inner) By Solar Industrial Products)
11825-FV-2A (Rev 5)	Drywell Outer Refueling Seal (By Stone & Webster Eng. Corp.)
11825-FV-3A (Rev 4)	Drywell Inner Refueling Seal Support Ring. (By Stone & Webster Eng. Corp.)
11825-510-3B	Refueling Bellows
11825-FM-19A-14	Flow Diagram - Fuel Pool Cooling & Clean-up System No. 19.

FINAL SAFETY ANALYSIS REPORT (FSAR) REFERENCES

Section	Title
4.1.5.5	Inner Refueling Bellows
4.8	Residual Heat Removal System
9.3	Spent Fuel Storage
9.4	Fuel Pool Cooling and Clean Up System
9.7.3	Residual Heat Removal Service Water System
12.3.1	Reactor Building