NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Turkey Point Unit 3	0 5 0 0 0 2 5 0	1 OF 0 4

TITLE (4)
Technical Specification - Reactor Vessel O-Ring Leakage

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 6	2 6	8 5	8 5	— 0 1 5	— 0 0	0 7	2 6	8 5	N/A	0 5 0 0 0
									N/A	0 5 0 0 0

OPERATING MODE (9)	3	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.406(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.406(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	[X] OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.406(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	Voluntary Report
		20.406(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.406(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
	AREA CODE
R. L. Teuteberg, Regulation and Compliance Engineer	3 0 5 — 2 4 5 - 2 9 1 0

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
X	A B	S E A L	U 0 7 0	Y							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[X] NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

Event: On June 26, 1985, while Unit 3 was in a hot standby condition, a voluntary unit cooldown was initiated using the guidance of Technical Specification 3.0.1 due to the detection of a reactor coolant system (RCS) leak. On June 25, 1985, indications of outer O-ring leakage were discovered and subsequent direct visual observations were made of steam escaping from at least three areas between the reactor vessel and head flanges. The leakage at this time was estimated to amount to 2-3 gallons per minute. Although not specifically required by Technical Specifications, a voluntary cooldown using the guidelines of Technical Specification 3.0.1 was initiated to allow a full investigation into the cause of the leakage. The RCS reached cold shutdown conditions at approximately 3:18 a.m., on June 28, 1985. Upon reaching refueling shutdown conditions, the O-rings were replaced, and subsequent RCS leak testing demonstrated the complete leak-tightness of these new O-rings.

Cause of Event: The cause of the unit cooldown was the result of RCS leakage past two reactor vessel and closure head flange O-rings.

Corrective Actions: The following long term precautionary and corrective measures will be pursued to prevent a recurrence of this type of leakage:

1) Plant personnel are investigating the use of Inconel 600 O-rings in order to obtain a greater springback to better accommodate the closure head flange design.
2) The same dimensional measurements and examinations performed on the Unit 3 reactor vessel and head flange sealing grooves will be made on Unit 4 during the next refueling outage.
3) The plant procedures for the new flange leakoff system will be enhanced to more clearly define the actions which should be initiated when vessel and head flange leakage is detected.
4) Improvements will be made in the equipment used for the head and flange inspections.
5) An evaluation will be performed to identify whether improvements in the cleaning procedure for the reactor vessel and head flange seal grooves should be made.
6) Changes in practices will be made to enhance the control over the vessel water level and water usage in the refueling cavity. These added precautionary measures will ensure that exterior debris or internal crud is not swept in the flange seal grooves to inhibit a proper sealing of the O-rings.

The health and safety of the public were not affected. Similar Occurrences: None

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FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Turkey Point Unit 3	0 5 0 0 0 2 5 0	8 5	— 0 1 5	— 0 0	0 2 OF 0 4

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Event:

On June 26, 1985, while Unit 3 was in a hot standby condition, a voluntary unit cooldown was initiated using the guidance of Technical Specification 3.0.1 due to the detection of a reactor coolant system (RCS) leak. Earlier, during the heatup and pressurization of Unit 3 on June 23, 1985, following a refueling outage, a leakoff alarm for the inner reactor vessel O-ring seal annunciated as the RCS temperature reached 350°F. The inner seal leakoff path was isolated, and the plant heatup continued. After reaching the full pressure and temperature of hot standby conditions on June 24, 1985, a visual inspection of the outer reactor vessel O-ring was performed. No outer O-ring leakage was detected during this inspection.

On June 25, 1985, indications of outer O-ring leakage were discovered, and a containment entry was made on June 26, 1985, to verify this RCS leakage and determine its location and size. Reactor vessel head insulation was removed and direct visual observations were made of steam escaping from at least three areas between the reactor vessel and head flanges. The leakage at this time was estimated to amount to 2-3 gallons per minute. Although not specifically required by Technical Specifications, a voluntary cooldown using the guidelines of Technical Specification 3.0.1 was initiated to allow a full investigation into the cause of the leakage. The RCS reached cold shutdown conditions at approximately 3:18 a.m., on June 28, 1985. Upon reaching refueling shutdown conditions, the O-rings were replaced, and subsequent RCS leak testing demonstrated the complete leak-tightness of these new O-rings.

Preliminary Investigation:

An interdepartmental task team was formed to determine the cause and identify corrective actions for the event. The reactor head was removed on Monday, July 1, 1985. The O-rings were removed, tagged, and visually examined on July 2 and 3, 1985. To date, it has been found that at least three leak paths existed over the top of the inner O-ring and about twenty-two leakage paths existed underneath the inner O-ring. Over forty leakage paths underneath the outer O-ring were found. Examination of the O-rings revealed some wire cutting where leakage occurred, some embedding of magnetite (crud) in the silver, and marginal dimensional behavior of the O-rings. In parallel activities, the reactor head and vessel sealing surfaces were cleaned and were subjected to extensive dimensional measurements and examinations.

Although no dimensional irregularities in the reactor head and vessel flange seal surface grooves were found during these examinations, honing and polishing of suspect areas in the head surfaces were performed to provide the best possible chance of avoiding a recurrence of a leak. The new replacement O-rings also received an extensive inspection prior to their placement on the head.

The leakage at Turkey Point occurred within the first few days after reaching full pressure, which led investigators to initially consider the possibility of a gross O-ring failure mechanism. The initial findings of the investigation did not, however, conclusively identify this mechanism. The leaking O-rings were found seated correctly in the grooves and clipped in place correctly. No foreign materials, such as debris, were found between the surfaces. A further detailed investigation is continuing to focus on areas which have been identified as having the most plausible contribution to the event.

Cause of Event:

Although the cause of the reactor vessel O-ring leakage is still under investigation and no final conclusions have been reached, the investigation has focused on the possibility of several contributing causes.

1) The reactor vessel head O-rings are made of silver clad stainless steel with a specified yield stress of 30,000 to 70,000 psi. The O-rings used are typically at the low end of this range and may have had a resultant springback that was insufficient to naintain a tight seal, considering the closure head movement relative to the seating surfaces. The inner O-ring may have been unseated during the plant heatup, and the outer O-ring unseated when the closure head had reached its equilibrium temperature distribution.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Turkey Point Unit 3	0 5 0 0 0 2 5 0	8 5	— 0 1 5	— 0 0	0 3 OF 0 4

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Cause of Event: (continued)

2) The reactor vessel and closure head were designed and manufactured by Babcock and Wilcox under contract to Westinghouse. The seating surface of the closure head was designed with a .010" per inch taper beginning at the flange "pivot" point between the O-ring grooves. When the reactor studs are tensioned, the closure head flange rotates so that the outer O-ring is compressed and the inner O-ring is unloaded. This rotation behavior increases during the heatup of the closure head and vessel. When the closure head and vessel reach their steady state temperatures, this rotation decreases slightly reducing the compression on the outer O-ring.

   The amount of closure head flange rotation may have been larger than expected due to the rounding of the pivot point. This rounding may have resulted from progressive deformations during the repeated tensioning-detensioning cycles of the closure head during past refueling outages.

3) When the closure head was removed, the O-rings were found properly positioned in their grooves with all of the retainer clips in place. The grooves, however, were smeared with a black residue, and there were 10-20 mill scattered particles embedded in the contact surfaces of the O-rings. This material had not been present before replacement of the closure head. Three locations on the top of the inner O-ring had flow cuts. There were 21 locations on the underside of the inner O-ring and 55 locations on the underside of the outer O-ring where contact had been lost but no flow cutting occurred. These locations may have acted like a particle filter for the leakage flow thus collecting the particles and residue. The continuing investigation will try to determine the cause of this phenomenon and what contribution this may have had to the O-ring failure.

Analysis of Event:

Up to the time of the event, the reactor had remained subcritical after the refueling outage, so that decay heat from the irradiated fuel remaining in the core after refueling was at very low levels. The O-ring leakage which developed also remained at very low leakage levels below Technical Specification threshold values. These leakage levels were easily replaced by makeup. Therefore, there was no risk of damage to the core. For these reasons, the health and safety of the public were not affected.

Corrective Actions:

The following long term precautionary and corrective measures will be pursued to prevent a recurrence of this type of leakage:

1) Plant personnel with the assistance of Babcock and Wilcox are investigating the use of the Inconel 600 O-rings with a higher yield stress in order to obtain a greater springback to better accommodate the closure head flange design. Many other licensees with Babcock and Wilcox vessels are already using Inconel O-rings.

2) The same dimensional measurements and examinations performed on the Unit 3 reactor vessel and head flange sealing grooves will be made on Unit 4 during the next refueling outage. The other corrective actions identified for Unit 3 will also be implemented on Unit 4.

3) The plant procedures for the new flange leakoff system will be enhanced to more clearly define the actions which should be initiated when vessel and head flange leakage is detected.

4) Improvements, such as higher intensity inspection lamps, will be made in the equipment used for the head and flange inspections.

5) An evaluation will be performed to identify whether improvements in the cleaning procedure for the reactor vessel flange seal grooves are necessary.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Turkey Point Unit 3	0 5 0 0 0 2 5 0	8 5	— 0 1 5	— 0 0	0 4 OF 0 4

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Corrective Actions: (continued)

6) Changes in practices will be made to enhance the control over decontamination activities and reactor vessel water levels during the critical period when the reactor hea[illegible] is set in place, prior to closure stud placement and tensioning. These added precautionary measures will provide added assurance that exterior debris or internal crud is not swept in the flange seal grooves to inhibit a proper sealing of the O-rings.

Should the final conclusions reached by the FPL investigating team be substantially different regarding the causes of the leakage or the long term corrective actions, a supplemental LER will be submitted with this new information.

P.O. BOX 029100 MIAMI, FL 33102

FLORIDA POWER & LIGHT COMPANY

JUL 26 1985
L-85-290

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

Re: Reportable Event 85-15
Turkey Point Unit 3
Date of Event: June 26, 1985
Technical Specification - Reactor Vessel O-Ring Leakage

The attached Licensee Event Report is being submitted as a voluntary report pursuant to 10 CFR to provide notification of the subject event.

Very truly yours,

for J. W. Williams, Jr.
Group Vice President
Nuclear Energy

JWW/PLP/ta
cc: Dr. J. Nelson Grace, Region II, USNRC
Harold Reis, esq.
PNS-LI-85-278

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