

# LICENSEE EVENT REPORT

CONTROL BLOCK: \_\_\_\_\_ (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

01	N	Y	I	P	S	2	0	0	-	0	0	0	0	0	-	0	0	3	4	1	1	1	1	4	5	
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	58
LICENSEE CODE						LICENSE NUMBER						LICENSE TYPE						CAT								

01	L	0	5	0	0	0	2	4	7	0	3	0	2	8	1	0	3	1	6	8	1				
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
CON'T		REPORT SOURCE		DOCKET NUMBER						EVENT DATE						REPORT DATE									

### EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

02 Investigation of loose objects retrieved from the reactor during re-

03 fueling has determined the source to be the RCP-24 labyrinth seal ring

04 and mounting bolts. Analysis to date indicates that the missing ring

05 did not affect performance of RCP 24 nor did the loose objects ad-

06 versely affect components of the primary system. Future operation with

07 unrecovered loose objects has been preliminary evaluated and safe plant

08 operation will not be affected.

09	Q	B	E	B	P	U	M	P	X	X	B	Z					
7	8	9	10	11	12	13	14	15	16	17	18	19	20				
SYSTEM CODE		CAUSE CODE		CAUSE SUBCODE		COMPONENT CODE				COMP. SUBCODE		VALVE SUBCODE					
17	8	1	0	9	6	0	1	0	1	T	0						
LÉR/RO REPORT NUMBER		EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE		REPORT TYPE		REVISION NO.							
18	Z	Z	Z	0	0	0	0	Y	N	N	W	1	2	0			
ACTION TAKEN		FUTURE ACTION		EFFECT ON PLANT		SHUTDOWN METHOD		HOURS		ATTACHMENT SUBMITTED		NPRD-4 FORM SUB.		PRIME COMP. SUPPLIER		COMPONENT MANUFACTURER	

### CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

10 The most likely cause appears to be a cyclic stress failure of the RCP

11 labyrinth ring/mounting bolts following entry of foreign material into

12 the small gap between the ring and the RCP impeller. Westinghouse

13 long-term investigations are continuing. Failure appears to be unique

14 to RCP-24 and this pump has been replaced with an operational spare.

15	H	0	0	0	N/A	C	Special Internals Inspection
7	8	9	10	11	12	13	14
FACILITY STATUS		% POWER		OTHER STATUS		METHOD OF DISCOVERY	
16	Z	Z	N/A	N/A	N/A		
7	8	9	10	11	12		
ACTIVITY RELEASED		CONTENT OF RELEASE		AMOUNT OF ACTIVITY		LOCATION OF RELEASE	
17	0	0	0	Z	N/A		
7	8	9	10	11	12		
PERSONNEL EXPOSURES		NUMBER		TYPE		DESCRIPTION	
18	0	0	0	0	N/A		
7	8	9	10	11	12		
PERSONNEL INJURIES		NUMBER		DESCRIPTION			
19	Z	N/A					
7	8	9					
LOSS OF OR DAMAGE TO FACILITY		TYPE		DESCRIPTION			
20	N	N/A					
7	8	9					
PUBLICITY ISSUED		DESCRIPTION					
20	N	N/A					
7	8	9					

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NAME OF PREPARER \_\_\_\_\_

PHONE: \_\_\_\_\_

NRC USE ONLY

ATTACHMENT

Docket No. 50-247

Consolidated Edison Co. of N. Y., Inc.

LER-81-006/01T-0

Indian Point Unit No. 2

During the Cycle 4/5 refueling outage, a number of loose objects were retrieved from the lower portion of the reactor vessel. An evaluation of the possible sources of these objects indicated the most likely source to be a reactor coolant pump (RCP) labyrinth seal ring and mounting bolts. The labyrinth ring is attached to the bottom of the RCP thermal barrier by sixteen mounting bolts.

In order to confirm that a RCP was the source of the loose objects, a review of past pump performance including pump vibration data for RCP's 21, 22 and 24 was undertaken. (RCP 23 was not suspect since its seal ring was found intact when the pump was placed in service in 1977, while the other three were original pumps). Subsequently, a decision was made to disassemble the pumps to permit identification of the affected labyrinth ring. RCP No. 21 was first selected for disassembly. The labyrinth ring on this pump was found to be intact. The second pump disassembled was RCP No. 24. An inspection of its internals revealed the labyrinth ring to be missing.

Several of the loose objects retrieved from the reactor vessel were delivered to Southwest Research Institute (SWRI) for chemical, metallographic and radiochemical analysis to establish the source of the objects. The SWRI results indicate that the objects are 304 stainless steel. Furthermore, on the basis of chemistry, hardness and grain structure, all the flat objects analyzed appear to have come from the same original part. Since 304 stainless steel is the specified material for RCP labyrinth seal rings and mounting bolts, the SWRI results reconfirmed the RCP No. 24 labyrinth ring as the source of the loose objects.

Westinghouse has initiated a detailed evaluation of the possible failure mechanisms for a RCP labyrinth ring. Two possible failure mechanisms have been postulated and preliminarily evaluated as follows:

- o Postulated failure of the labyrinth ring mounting bolts due to thermal fatigue-Such as a failure mechanism is considered highly unlikely based upon the low number of thermal cycles accumulated (est. 15 to 20) at Indian Point Unit No. 2 and comparison with other tests performed by Westinghouse which indicate many thousands of cycles lateral displacement without failure.

- o Postulated failure mechanism which could result in cyclic stress displacements-This mechanism suggests that a piece of foreign material was transported by flow into the small annulus between the labyrinth ring and the RCP impeller. This piece is then jammed so that rotation of the impeller causes eccentric rotational forces upon the ID of the labyrinth ring, until cyclic fatigue failure of the bolts occurs. The ring then falls on to the impeller and rotates at some intermediate velocity inducing frictional wear upon the ring ID and the upper impeller OD. Wear continues until the bolts are freed and cause further jamming and eventual disintegration of the labyrinth ring. It is also possible that a foreign piece could jam in such a way that transferred rotational forces from the impeller cause a shear type failure of the bolts. Once the ring has disintegrated, pieces are introduced into the primary system during pump seal maintenance when the impeller is dropped approximately one inch.

Westinghouse and Con Edison both agree that the second failure mechanism described above appears to be the cause of the RCP No. 24 labyrinth ring failure. Westinghouse is continuing more detailed investigations which will include a concentrated evaluation of bolt material retrieved from the pump volute and also performance of fatigue failure studies utilizing new bolts under varying pre-load tension and displacement amplitude conditions. The intent of this latter study is to determine boundary conditions for cyclic loading stresses.

Since neither the full linear length of the labyrinth ring nor all the ring mounting bolts have been recovered from the primary system, Westinghouse is performing an analysis of the effects of multiple loose objects in the reactor vessel. This analysis consists of:

- o Evaluation of the effects of unrecovered bolts becoming wedged between the energy absorbing device and the reactor vessel bottom during heatup.
- o Impact of the largest anticipated loose part on the core barrel, thermal shield flexures and bottom mounted vessel instrumentation penetrations.

Successful completion of the above analysis will provide assurance that plant heatup will not over stress the reactor vessel. As has been done in the past, neutron noise monitoring will be performed periodically to provide assurance that a loose object is not wedged between the energy absorbing device and the reactor vessel bottom. An evaluation of the thermal/hydraulic effects of local flow blockage due to loose objects will also be conducted and completed prior to reactor heatup.

Based on the visual, metallurgical and analytical evidence to date as described in this report, Con Edison and Westinghouse have concluded the following:

- o The source of the loose objects is the labyrinth seal ring and mounting bolts of reactor coolant pump no. 24.

- o The failure mechanism appears to be unique to RCP No. 24 based on analysis of pump operating data.
- o The presence of the loose objects has not had an adverse effect on the primary system.

As stated earlier, additional evaluations are continuing and the final results of these evaluations will be provided in a future update LER report.