NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
CONSUMERS ENERGY COMPANY - PALISADES NUCLEAR PLANT	05000255	1 OF 6

TITLE (4)

CONTROL ROD DRIVE SEAL HOUSING LEAK

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 NAME	DOCKET NUMBER
										05000
12	27	1998	98	-- 014 --	00	01	26	1999	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	N
POWER LEVEL (10)	000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)	X	50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Philip D. Flenner, Sr. Licensing Engineer	(616) 764-2544

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
B	AA	DRIV	C490	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 15 single-spaced typewritten lines) (16)

On December 26, 1998, inspection revealed an active leak (slow accumulation of water) in the autoclave area of control rod drive (CRD) number 2 seal housing. The leakage was thought to be at a mechanical joint in the area where the tool access tube and drive shaft tube penetrate the autoclave flange. However, increasing the torque on accessible autoclave flange bolts did not appear to affect the leak rate. This led to the determination at 1730 hours on December 27, 1998, that the leak may not be at the mechanical joint, and a four hour non-emergency report under 10 CFR 50.72 was made. Following removal, the seal housing was confirmed to contain a crack. The apparent cause of this condition was transgranular stress corrosion cracking in a region of extensive cold work introduced during manufacturing. The CRD-2 seal housing degradation was concluded to be unique to CRD-2 and not indicative of an immediate generic concern with the other seal housings. The faulted CRD-2 seal housing was replaced. Additional nondestructive examination and destructive metallurgical testing of the faulted seal housing will be completed to verify the root cause of the failure and to determine whether any additional actions are required.

EVENT DESCRIPTION

On December 26, 1998, during the performance of a primary coolant system (PCS) walkdown at hot shutdown conditions (normal operating pressure and temperature), an Auxiliary Operator identified an apparent active leak (slow accumulation of water) in the autoclave area of control rod drive (CRD) number 2 seal housing. The leakage was initially thought to be at a mechanical joint near the location where the tool access tube and drive shaft tube penetrate the autoclave flange. Increasing the torque on accessible autoclave flange gasket hold down bolts did not appear to affect the leak rate. This led to the determination at 1730 hours on December 27, 1998, that the leak may not be at the mechanical joint. The condition was reported at 1901 hours as a four hour non-emergency report in accordance with 10 CFR 50.72(b)(2)(i).

The plant was cooled down to a cold shutdown condition. A complete external visual inspection of all CRD housings was conducted during the cooldown with no additional active leaks being identified. Following removal of the CRD-2 seal housing, initial inspection on December 30, 1998, revealed a circumferential crack in the seal housing drive shaft tube approximately ¼ inch from the lower flange face. The crack extended for approximately 180 degrees around the circumference of the seal housing.

ANALYSIS OF EVENT

Each control rod at Palisades is driven by an electric motor through a drive shaft and bevel gears which engage a rack assembly coupled to the control rod. The primary coolant pressure boundary is provided by a rotating mechanical seal located at the top of the seal housing drive shaft tube (see sketch). The lower flange of the seal housing (autoclave flange) is fastened to the support tube with the autoclave nut. The lower region of the seal housing below the mechanical seal provides the primary coolant pressure boundary. The drive motor and clutch assembly mount on the atmospheric side of the mechanical seal at the top of the seal housing.

The CRD-2 seal housing was removed and inspected by plant and nondestructive examination (NDE) personnel on December 30, 1998, using visual and dye penetrant (PT) examination techniques. Visual inspection of the seal housing ID revealed a circumferential crack in the seal housing drive shaft tube approximately ¼ inch from the lower flange face. The crack extended for approximately 180 degrees around the circumference of the seal housing with the center of the crack opposite the tool access tube penetration (See Sketch). The length of

the crack was determined visually; the PT indication was intermittent due to the tightness of the crack and/or water within the crack. The housing was also placed on a test stand and pressurized with water to 2100 psi for 30 minutes, but no leakage was observed. A preliminary metallurgical evaluation (including acid etching and replication) indicated transgranular stress corrosion cracking as the most likely cause of the crack. The single flaw extended for approximately 3 inches directly through areas that had been reworked using weld repairs during original manufacturing. This was the only crack observed in the housing. An ABB review of the eddy current base line shop inspection of this housing revealed extensive cold working in the area that cracked. This finding is consistent with the preliminary conclusion that the cracking was due to transgranular stress corrosion.

To assess the potential for other CRD seal housings to have similar flaws, two additional seal housings (CRD-10 and CRD-23) were removed and PT examined. These housings were selected as being representative of the material, age, and service conditions of the faulted housing. These additional housings also provided one sample from each of the two shipment lots of the installed housings. No indications were found on either housing. In addition, the external surfaces of all other CRD seal housings were visually examined during this outage and no similar problems were noted.

The faulted CRD-2 seal housing was one of 45 redesigned type 347 stainless steel housings installed between 1990 and 1995 in place of original type 304 stainless steel housings. The type 304 housings had previously been proven to be susceptible to transgranular stress corrosion cracking. PT examinations of the ID of each seal housing are performed every time a mechanical seal is reworked. Since the original seal housings were replaced (1990-1995) and prior to the leak on CRD-2, examinations had been performed on 14 of the 45 total redesigned seal housings with no indications of cracking.

The faulted CRD-2 seal housing was replaced on January 2, 1999. Plant heatup was performed on January 4, 1999, and the plant was returned to service.

SAFETY SIGNIFICANCE

The crack in CRD-2 had minimal safety significance. Transgranular stress corrosion cracking would take years to propagate to failure at the temperature existing in the seal housing autoclave area (approximately 200 degrees). The extent of any cracking that might occur would be controlled by the self-limiting nature of the stresses (residual, not pressure stress).

Through wall cracks are able to be identified through inspections and leak monitoring prior to major degradation.

Manufacturing records indicate that the seal housing which was installed at CRD-2 had a unique history of problems throughout its manufacturing process. These problems include several failed non-destructive examinations, weld repairs in the bore of the housing tube, and three separate heat treatments. There are no other seal housings with such extensive manufacturing problems and rework/repair. The manufacturer (ABB) concurs with this finding.

Total failure of a seal housing (i.e., 360 degree through wall crack) due to this phenomenon without prior detection is not considered credible. The worst potential significance of even total failure, however, would be a small break loss of coolant accident (LOCA), an analyzed event that has been demonstrated to result in acceptable consequences. Failure could not result in a rod ejection.

CAUSE OF EVENT

The apparent cause of this condition is transgranular stress corrosion cracking in a region of extensive cold work introduced during manufacturing. Additional nondestructive examination and destructive metallurgical testing of the failed seal housing will be completed to verify the root cause of the failure.

CORRECTIVE ACTIONS

Corrective Actions Taken

1. The faulted CRD-2 seal housing was examined using visual and PT methods to assess the failure mechanism.

2. Two additional seal housings with comparable materials and service were removed and examined internally for similar indications. None were found.

3. The exterior surfaces of all other CRD seal housings were visually examined during this outage with no evidence of similar leakage noted.

4. The faulted CRD-2 seal housing was replaced with a spare housing.

Corrective Actions Remaining

1. Nondestructive examination and destructive metallurgical testing of the failed seal housing will be completed to verify the root cause of the failure and to determine whether any additional actions are required.

SKETCH SHOWING CRACK INDICATION LOCATION