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

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LICENSEE EVENT REPORT (LER)

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

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TITLE (4)

Containment Recirculation Fan Moisture Separator Vanes Incorrectly Installed Results in Plant Being Outside Its Design Basis

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
04	12	1999	1999	-- 004 --	01	08	24	1999	FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	5
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)(B)		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)
Carmen Vitali - Senior Engineer	(716) 771-3606

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

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 April 12, 1999, at approximately 1600 EDST, the plant was shutdown in Mode 5. It was discovered that the containment recirculation fan chevron moisture separator vanes were installed backwards, so that the path for air flow was less tortuous, decreasing moisture separation effectiveness.

Corrective action was to remove the vanes and install them in the proper orientation.

The incorrect installation was a result of improper assembly by the manufacturer in the 1960's. The original moisture removal equipment consisted of an assembly made up of the chevron type vanes and fiberglass moisture removal pads. This equipment was shop-assembled and shipped to Ginna Station. Vendor photographs taken during original shop assembly show the vanes installed in a manner now known to be incorrect.

Corrective action to prevent recurrence is outlined in Section V.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

I. PRE-EVENT PLANT CONDITIONS:

On April 12, 1999, the plant was shutdown in Mode 5 for the 1999 refueling outage. Among the many activities in progress during the 1999 refueling outage, maintenance was being performed on the Containment Recirculation Fan Coolers (CRFC). At approximately 1600 EDST, an engineer from Nuclear Engineering Services (NES) discovered that the chevron moisture separator vanes for the CRFCs were installed contrary to that shown in a vendor manual diagram, but correctly as shown on a vendor outline drawing.

II. DESCRIPTION OF EVENT:

A. DATES AND APPROXIMATE TIMES OF MAJOR OCCURRENCES:

- Original construction circa 1969: Event date and time.
- April 12, 1999, 1600 EDST: Discovery date and time.
- April 17, 1999, 1000 EDST: Chevron moisture separator vanes are correctly installed.

B. EVENT:

On April 12, 1999, the plant was shutdown in Mode 5 for the 1999 refueling outage. Among the many activities in progress during the 1999 refueling outage, maintenance was being performed on the Containment Recirculation Fan Coolers (CRFC). At approximately 1600 EDST, an engineer from Nuclear Engineering Services (NES) discovered that the chevron moisture separator vanes for the CRFCs were installed contrary to that shown on a vendor manual diagram, but correctly as shown on a vendor outline drawing. After further evaluation and discussions with the vendor, it was concluded that the vanes were installed backwards, so that the path for air flow is less tortuous than if the vanes were correctly installed. These vanes are Type T Mist Extractors, manufactured by American Air Filter Co., Inc.

The CRFC System consists of four fan units (A, B, C, and D), of which the A and C units supply charcoal filters. Each cooling unit consists of a motor, fan, cooling coils, dampers, moisture separators (vanes and pads), high efficiency particulate air (HEPA) filters, duct distributors and necessary instrumentation and controls. Air is drawn into the coolers through the fan and discharged into the containment atmosphere. The moisture separators function to reduce the moisture content of the airstream to support the effectiveness of the HEPA and post-accident charcoal filters.

Following the cooling coils is the moisture separator section, designed to remove entrained moisture exiting the cooling coils. Two separate moisture removal processes are employed; the first by direct impingement on vertical hooked vanes, and the second by trapping on separator pads. Runoff from both stages flows into collection pans from which it is piped to the containment sump. The moisture separator casings, hooked vanes, and collection pans are fabricated of galvanized steel. With the vanes installed backwards, the moisture separation capability is decreased. CRFC performance was not completely analyzed for this condition.

The supplier of the moisture removal equipment (American Air Filter) was contacted. It was concluded that this condition was a result of improper assembly by the manufacturer in the 1960's. The original moisture removal equipment consisted of an assembly made up of the chevron type vanes and fiberglass moisture removal pads. This equipment was shop-assembled and shipped to Ginna Station. Vendor photographs taken during original shop assembly show the vanes installed in a manner now known to be incorrect. As directed by the supplier, the vanes had to be dismantled and then correctly installed.

C. INOPERABLE STRUCTURES, COMPONENTS, OR SYSTEMS THAT CONTRIBUTED TO THE EVENT:

None

D. OTHER SYSTEMS OR SECONDARY FUNCTIONS AFFECTED:

None

E. METHOD OF DISCOVERY:

This event was discovered by an engineer from NES, who was supporting CRFC maintenance.

F. OPERATOR ACTION:

The plant was in Mode 5 at the time of discovery, and the CRFCs are not required to be operable in this mode. After the NES engineer notified the Shift Supervisor of this condition, no immediate actions were needed by the Control Room operators.

Subsequently, the Shift Supervisor notified higher supervision and the NRC Ginna Senior Resident Inspector. The Shift Supervisor notified the NRC per 10 CFR 50.72 (b) (2) (i), non-emergency four hour notification, at approximately 1948 EDST on April 12, 1999.

G. SAFETY SYSTEM RESPONSES:

None

III. CAUSE OF EVENT:

A. IMMEDIATE CAUSE:

The immediate cause of the plant possibly operating outside its design basis was that the installed configuration resulted in decreased moisture separation capability after a design basis accident, resulting in less cooling capability.

B. INTERMEDIATE CAUSE:

The intermediate cause was installation of improperly assembled moisture separator units. The original moisture removal units consisted of assemblies made up of the chevron type vanes and fiberglass moisture removal pads. This equipment was shop-assembled and shipped to Ginna Station. Vendor photographs taken during original shop assembly show the vanes installed in a manner now known to be incorrect.

C. ROOT CAUSE:

The underlying cause of the vanes being installed backwards was a manufacturing error.

IV. ANALYSIS OF EVENT:

This event is reportable in accordance with 10 CFR 50.73, Licensee Event Report System, item (a) (2) (ii) (B), which requires a report of, "Any event or condition that resulted in the condition of the nuclear power plant, including its principal safety barriers, being seriously degraded; or that resulted in the nuclear power plant being: (B) In a condition that is outside the design basis of the plant.

An assessment was performed considering both the safety consequences and implications of this event with the following results and conclusions:

There were no operational or safety consequences or implications attributed to the moisture separator vanes installed backwards because:

- The maximum air velocity through the containment recirculation fan cooling coils after a loss-of-coolant accident (LOCA) air velocity through the coil is below the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) threshold of 600 feet per minute (FPM) for moisture entrainment both for the new and old configuration.

- The coils will act as moisture separators due to the depth of the coil and spacing between fins, even if they are not operating . A heating coil similar to the cooling coils installed at Ginna, was tested with a spray stream equivalent to the Ginna Station LOCA environment directed at the coil entrance, but with a slightly lower air stream velocity (400 FPM) than Ginna. No moisture carry-over was observed on the outlet of the coil or on the moisture separator downstream of the coil. Approximately 5% of the spray was evaporated by the coil heating.

- Additional louvers are located on the inlet to the coils which will remove some entrained moisture prior to entering the cooling coils, which are not taken credit for in the CRFC unit operation.

- The air velocity significantly reduces after exit from the cooling coils, and would allow entrained droplets to fall to the fan unit floor prior to reaching the HEPA filters which are located approximately 6 feet from the cooling coils.

- The moisture separator media pads located upstream of the HEPA filters have been tested and found to remove moisture up to 1.5 lbs/100 cu.ft. The maximum expected entrained moisture content in the containment environment due to containment spray and condensation is only 0.4 lbs/1000 cu.ft. The original media pads installed at Ginna (American Air Filter Model M-105) were replaced with new model M-81 pads that have not been tested to Ginna LOCA conditions. However, due to similarities in design, they are expected to remain functional even though they have not been credited to function due to lack of qualification.

- The moisture separator vanes on the outlet of the coil would still remove entrained water even though they are installed backwards, due to their tortuous path. The number of hooks which protrude into the flow stream is reduced from 3 to 1. However, the moisture removal is dominated by the spacing between adjacent vanes, length of each vane and number of vane turns in path, all of which are unaffected with the vanes installed backwards. The water drops follow a sine-wave path through the vanes. The overall efficiency for the backwards installation is estimated to be 25%. The moisture removal capacity requirement as specified in the original Bill of Materials for the moisture removal section of the CRFC unit is 0.4 lbs/1000 cu.ft. This 25% reduction in the vane efficiency can be easily compensated for by the moisture removal pads since they were tested at moisture levels of greater than 1.0 lbs/1000 cu.ft. In addition, the HEPA filters were also tested and their pressure drop increased by 0.5 inches with an equivalent moisture loading of 0.4 lbs/1000 cu.ft. It is believed that the additional 0.5 inches of pressure loss is within the existing margin of the as-installed equipment and would result in reduction in total system CRFC flow of less than 10%.

- The main impact of a slightly reduced CRFC cooling capability on the design basis accidents (DBAs) such as LOCAs and Main Steam Line Breaks (MSLBs) would be a reduction in the long term cooling and depressurization capability of containment. Impact on peak containment pressures for DBAs is expected to be negligible. Since peak containment pressures typically occur within the first couple of minutes following DBAs, the increase in HEPA filter hydraulic resistance would not be fully developed over this time due to the limited water loading on the HEPA filters immediately following a DBA. Additionally, the early occurrence of containment peak pressures limits the integrated amount of energy that is removed by the CRFCs up to the time of peak containment pressure. Therefore, any degradation in CRFC heat removal capability due to reduced air side flow immediately following a DBA would have a negligible impact on the overall containment energy balance at the time of peak containment pressure. Based upon these factors, any increase in peak containment pressure that could have occurred as a result of the improperly installed louvers is judged to be within the overall structural capability of the containment following a DBA, although containment design pressure may have been slightly exceeded.

- As previously stated, the major impact of reduced heat removal capability due to water loading of the HEPA filters would be on long term containment cooling, since Containment Spray flow is terminated after the plant has transitioned to the Recirculation Mode of cooling. Any reduction in CRFC cooling capability due to reduced air flow would cause a slower containment coodown and depressurization. Although this slower containment cooldown could potentially affect the Equipment Qualification (EQ) profiles of safety-related equipment in containment, a review of the existing Ginna EQ profiles for containment indicates that sufficient margin exists during the first twenty-four hours following a DBA to accommodate a slower cooldown. Consequently, no adverse impact on past operability of qualified equipment in containment is expected to have existed.

- The Ginna Control Room and off-site dose calculations were re-evaluated assuming actual containment integrated leakage from testing performed in 1996 and actual predicted containment depressurization rates for Ginna. Based on these assumptions and continuous operation of the CRFCs in a post-LOCA environment, it is estimated that a minimum charcoal filter iodine removal efficiency of 10% would be required to maintain off-site doses below 300 Rem and Control Room thyroid doses below 30 Rem and thereby satisfy the Ginna licensing basis requirement as required by 10 CFR 100 and General Design Criterion (GDC) 19. Based on additional analysis that was performed by RG&E in 1999, charcoal filters were found to have 40% of their volume still available for iodine removal even when 100% saturated. Since the minimum required charcoal iodine removal efficiency is appreciably smaller than the minimum expected charcoal efficiency of 40% for a wetted condition, the design function of the filters as it relates to thyroids dose to on-site and off-site personnel would still have been satisfied even with the louvers installed backwards.

Based on the above and the review of past plant transients, it can be concluded that the public's health and safety was assured at all times.

V. CORRECTIVE ACTION:

A. ACTION TAKEN TO RETURN AFFECTED SYSTEMS TO PRE-EVENT NORMAL STATUS:

The moisture separator vanes were dismantled and correctly re-installed.

B. ACTION TAKEN OR PLANNED TO PREVENT RECURRENCE:

The as-left configuration of the moisture separator units does not allow the vanes to be installed incorrectly.

VI. ADDITIONAL INFORMATION:

A. FAILED COMPONENTS:

None

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B. PREVIOUS LERs ON SIMILAR EVENTS:

A similar LER event historical search was conducted with the following results: No documentation of similar LER events with the same root cause at Ginna Station could be identified.

C. SPECIAL COMMENTS:

None