

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No: 50-331
License No: DPR-49

Report No: 50-331/99002(DRS)

Licensee: IES Utilities Inc.
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Facility: Duane Arnold Energy Center

Location: Palo, Iowa

Dates: January 19-21, 1999

Inspector: R. Westberg, Reactor Engineer

Approved by: John Jacobson, Chief, Lead Engineers Branch
Division of Reactor Safety

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Report Details

III. Engineering

E8 Miscellaneous Engineering Issues (IP 92903)

E8.1 (Closed) Violation 50-331/97006-01b: Inadequate Corrective Actions. On March 23, 1995, a 3/4 inch long surface breaking linear indication (flaw) was discovered during an ASME Section XI Code required magnetic particle examination of valve to pipe weld, RH1-CF013, which was documented in Action Request (AR) 95-0464. The flaw was located in the base metal of the check valve body of the residual heat removal pump D discharge check valve, V19-001, 0.06 inches outside the Code mandated inspection boundary and was oriented circumferentially along the measured length. The valve was accepted for continued service based on an engineering evaluation using a fracture mechanics analysis which assumed an initial flaw depth of 1/2 the valve body wall thickness as an input to this calculation. This flaw depth was an assumed value without a documented nondestructive examination to validate or bound the assumption. An informational ultrasonic test (UT) was performed at the time but was not documented. The team questioned the basis for not performing a documented volumetric nondestructive examination to determine or bound the subsurface extent of this flaw.

No further actions had been taken based on the determination that the flaw was located outside the ASME Section XI boundary, related to fabrication (surface lap), not service induced, and it had been evaluated by fracture mechanics. As a result of discussions with the team during the inspection, a UT inspection was performed and documented. The flaw was ground out with minimum material removed on April 10, 1997, which confirmed the nature of the flaw as originally characterized by the licensee's engineers. This item is closed.

E8.2 (Closed) Unresolved Item 50-331/97006-02: Updated Final Safety Analysis Report (UFSAR) design values were not incorporated into surveillance test procedures (STPs). UFSAR table 6.3.2 listed a maximum Low Pressure Coolant Injection (LPCI) injection valve opening time of 18 seconds. STP 45A002-Q, "Low Pressure Coolant Injection Operability," Revision 19, listed a maximum valve opening time of 18.4 seconds for MO-2003 (inboard injection isolation valve, train B). UFSAR change request 96-104 (approved December 12, 1996), had been initiated, which changed the maximum opening time for these valves to 28 seconds per the current Loss Of Coolant Accident (LOCA) analysis. NEDC-31310P, Supplement 1, dated August 1993, "DAEC SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," had been submitted (which supported UFSAR change request 96-104) to the NRC as part of the Core Operating Limits Report (COLR) for Cycle 13. The team could not determine if using a LOCA analysis submitted as part of the COLR satisfied 10 CFR 50.59 requirements for NRC review and approval, since a written NRC approval (e.g., safety evaluation) was not issued for this COLR submittal. However, no recorded opening times for the LPCI injection valves in excess of 18 seconds were found, based on review of records dating back to 1987. This item was submitted to NRR for review on May 21, 1997.

NRR's review of the cycle 13 COLR did not identify any policy or technical problems. NRR requested the Office of General Council (OGC) to review the information provided by Region III to determine if the licensee submitted the evaluation appropriately through 10 CFR 50.46 or if an evaluation should have been performed in accordance with 10 CFR 50.59 as well. In addition, NRR reviewed the licensee's submittals related to the changing of these valves' stroke times.

OGC concluded that the licensee, in this instance, did not adequately address the 10 CFR 50.59 unreviewed safety question criteria by simply referencing an earlier determination performed in another context. However, further investigation by NRR found that the licensee had submitted a request for a license amendment for cycle 9, dated October 31, 1986. This amendment contained supporting information that identified the valves' stroke time changes in question, which the NRC approved (Amendment 142) in a letter to the licensee dated May 7, 1987. The valves' stroke times were listed in the supporting information to Amendment 142 as significant parameters to the LOCA analysis. The NRR position is that the valves' stroke times were previously reviewed and approved by the NRC in Amendment 142 and prior to the licensee changing the UFSAR. Therefore, no 50.59 review was warranted and no further regulatory action is required. This item is closed.

E8.3 (Closed) Violation 50-331/97006-04: Failure to follow procedures.

- a. A fracture mechanics calculation performed on March 29, 1995, to accept a flaw in the body of check valve V19-001, lacked a documented independent review of the calculation and a calculation control number. AR 97-1033 was generated and the calculation was verified and approved on April 10, 1997.
- b. A calculation in engineering maintenance action A26702G, dated September 19, 1996, which demonstrated the acceptability of a new relief valve on the B residual heat removal heat exchanger did not meet procedure 1206.31 requirements in that the incorrect design code was used for stress level acceptance criterion, an incorrect/nonconservative input value was used, design assumptions were not given, and the applicable code edition was not documented. Several actions were taken to enhance the calculational process as follows: 1) A detailed team review of Procedure 1203.21, "Engineering Calculations," was performed. Enhancements were made to the procedure and a new revision was issued on July 3, 1997. Enhancements included a better description of the responsibilities of supervisors, verifiers, and preparers; clearer definitions of when calculation control numbers are required; and expectations of quality for calculations performed in support of design control and action requests, and 2) A briefing was held for personnel involved in preparing and verifying calculations. The briefing highlighted the procedure changes and restated basic expectations for calculations.
- c. Following the pressure locking of valve V19-148, an operability assessment in accordance with ACP 114.5 was not documented in the associated action request, AR 97-0094. As a result of this item, a commitment was initiated to review

operability determination requirements contained in the administrative procedures and to take action as necessary. The result of this review concluded that the administrative controls for performing operability determinations was adequate. However, the specific issue relative to the pressure locking of valve V19-148 was a result of not properly documenting engineering judgement used to justify operability. An AR was initiated to develop a briefing for the engineering staff to increase awareness of the need to continuously assess operability, the need to properly document the rationale for operability, and the requirements for performing operability determinations in accordance with the existing administrative controls. The licensee planned to provide the briefing to the engineering staff by January 30, 1999.

This item is closed.

- E8.4 (Closed) Unresolved Item 50-331/97006-05: Further review of supporting documentation to confirm that reliance on operator actions to preclude a negative NPSH was consistent with the system design basis. The results of the core spray/RHR pump net positive suction head (NPSH) calculation, CAL M97-007, concluded that a negative NPSH would exist for the core spray pumps during maximum flow conditions of pump run out (4500 gpm per loop) with an initial torus temperature of 110°F. This was characterized as being an insignificant amount (-0.3 ft). Licensee engineering staff responded that the calculation concluded that the negative NPSH for the core spray pumps would only occur after thirty minutes of operation in this condition and that the operators would throttle back the core spray pumps to rated flows within fifteen minutes of the accident, consistent with the UFSAR.

Review of Section 6.3.2.2. of the UFSAR indicated that the ECCS was designed to require no operator action during the first 10 minutes following a postulated LOCA. Section 6.3.2.3 indicated that an operator may take manual control as necessary prior to or after the first 10 minutes after a postulated LOCA. Operating Instruction 151, Section 4.0 (4) requires the operators to verify that flow is <3100 gpm after the system actuates and the minimum flow bypass valve closes. Section 4.0 (5) states that as RPV pressure decreases, to throttle the core spray pumps to maintain <3100 gpm. Operation of the core spray system appears to be consistent with system design and the UFSAR in that the pumps would be throttled to maintain <3100 gpm in 15 minutes or less. This item is closed.

- E8.5 (Closed) Inspection Followup Item 50-331/97006-07: Review of revised NPSH calculation. The team questioned the validity of relying entirely on engineering judgement, which prompted the licensee to perform calculations of the NPSH available to the RHR and recirculation system pumps. Preliminary calculations indicated that adequate margins for NPSH were available to ensure cavitation would not occur in these pumps.

Calculation No. CAL-M97-010, "Available NPSH for RHR and Recirc Pumps When Both Pumps are Operated in Parallel During SDC," was approved on May 23, 1997. The calculation conclusions were as follows: 1) with one train of RHR operating at 9600 gpm

(4800 gpm per pump), the available NPSH for the RHR pumps was calculated to be about 64 ft compared to a minimum required NPSH of 10 ft; or a margin of 54 ft. The additional head loss due to operation of the B Recirc pump in parallel with the RHR pumps was about 2.5 ft. Thus, the available NPSH for the RHR pumps was adequate for this operating condition and, 2) with the B Recirc pump operating at minimum speed (7200 gpm), the available NPSH for the B Recirc pump was calculated to be about 62 ft compared to a minimum required NPSH of 20 ft; or a margin of about 42 ft. The additional head loss due to operation of one train of the RHR pumps in parallel with the B Recirc pump was about 3.0 ft. Thus, the available NPSH for the B Recirc pump was adequate for this operating condition. This item is closed.

- E8.6 (Closed) Unresolved Item 50-331/97006-08: Verification of heat up for torus suction. Specific detailed evaluations were performed for valves which were identified as susceptible to pressure locking\thermal binding (PL/TB). These evaluations considered the valve design and operating basis as described in the UFSAR, and applicable RHR operating instructions to ensure worst case conditions were considered. The team considered the general and gate valve-specific screening criteria for PL/TB scenarios consistent with concerns raised by generic letter 95-07. The evaluation concluded that four pump torus suction valves, MO-1913, MO-1921, MO-2012, and MO-2015, were potentially susceptible to pressure locking when re-aligning the system to the LPCI mode of operation. These valves were subsequently dispositioned as acceptable (e.g., requiring no corrective actions). This was based on the assumption that the heatup would be less than 10 degrees F. The temperature rise was described as less than normal ambient room temperature changes and was therefore considered insufficient to cause pressure locking. The team concluded that this assumption was unverified and potentially non-conservative.

Engineering evaluation, "Operability of MO1913/MO1921," dated June 14, 1996, concluded that the valves did not present an operability concern at the time and temperature measurements were planned for the next available opportunity to initiate shutdown cooling (Refueling outage 14, Fall 1996). Upon entering shutdown cooling mode, the valve bonnet temperatures of MO-1913 and MO-1921 were measured. The measured values exceeded the target value specified on the temperature curve provided by Program Engineering, thus demonstrating the above assumption (less than 10°F heat rise) to be invalid. As a result, a VOTES test was performed on MO-1921 while the valve was hot (higher recorded temperature present than MO-1913) to measure the valve unseating force to verify whether PL/TB was present. Review of the VOTES data indicated no evidence of pressure locking. Since the measured temperatures exceeded the target temperatures, pressure relief lines were planned to be installed on MO-1913, MO-1921, MO-2012, and MO-2015. Between October 24 - 30, 1996, the pressure relief lines were installed. While the assumption of less than 10°F heat rise was shown to be invalid, the licensee conclusion that the temperature rise was not sufficient to cause PL/TB was demonstrated. This item is closed.

- E8.7 (Closed) Unresolved Item 50-331/97006-09: Calculation modified without proper design control. During review of CAL M97-002, "V19-148 Bonnet Pressure," the team noted that numbers in an original calculation had been erased and new numbers substituted in their

place without revising the calculation and obtaining new review and approval signatures. On April 24, 1997, the licensee issued AR 97-0856 to address this issue.

Subsequent to the on-site portion of the inspection, the inspector determined that the original revision of CAL M97-002 had been performed as a "scoping" calculation to determine the effects of a pressure locking condition on valve V19-148. As such, this calculation was not subject to the administrative controls outlined in administrative control procedure (ACP) 1203.21, "Engineering Calculation. However, as a result of the interest in this item during the inspection, a number of actions were taken as follows: 1) The calculation was revised and entered into the document system during the inspection, 2) the individual was counseled by licensee management as to the requirements of ACP 1203.21, 3) a team was assembled to evaluate the calculation procedure (see E.8.3 b above), and 4) samples of recent calculations were reviewed and found to be technically sound with good detail. This item is closed.

- E8.8 (Closed) Violation 50-331/97006-10: Failure to verify input assumptions for bonnet temperature. Adequate design control measures were not used in calculation CAL M97-002, dated February 3, 1997. A non-verified input assumption was used for the bonnet temperature in CAL M97-002, which evaluated the pressure locked valve V19-148. This calculation used a straight average between the drywell temperature and the reactor coolant system with no supporting thermal analysis to confirm or bound the valve bonnet temperature heatup.

The specific issue relative to the pressure locking of valve V19-148 and the failure to verify the input assumption used for the bonnet temperature was a further result of not properly documenting engineering judgement used to justify operability (See E8.4c above). Additional inspections performed by licensee personnel and contractors relative to this issue, confirmed the original conclusion that the valve did not sustain any damage as a result of the pressure locking. This item is closed.

- E8.9 (Open) Unresolved Item 50-331/97006-11: Review results of the evaluation of AR97-967. NG-97-550 concluded that assuming the service water inlet temperature was equal to river water temperature at the inlet to the RHR heat exchanger (HX) was not valid. Based on surveillance data from March of 1997, a correction of 4.26° F for the A RHR HX and 3.5° F for the B RHR HX must be added to the measured river water temperatures to accurately predict the service water supply temperatures at the inlet to the RHR HXs. Therefore, if the river temperature reached the design basis temperature of 95° F assumed in the UFSAR, this could result in a potential inlet temperature of up to 99.4° F at the inlet of the A RHR HX. This temperature is above the 95° F assumed for the service water inlet temperature in the post-LOCA RHR modes C-1 and C-2 of UFSAR Figure 5.4-12, as well as other accident mode scenarios. The licensee issued AR 97-967 to evaluate this concern identified by the team. In addition, administrative controls were put in place to initiate action should the river temperature exceed 90°F.

In order to obtain good results for RHR HX testing, the test establishes a 40°F ΔT between the RHR and RHRSW systems under stable conditions. This initial condition is usually met when the river is frozen and the torus is used as a heat sink. Since part of the

RWS and RHRSW piping is buried below the frost line, the ground provides some heating to the service water in the winter and some cooling in the summer. However, the majority of the temperature deviation was thought to be the result of instrumentation inaccuracies. A new AR, 97-0816, was initiated to address the question of instrumentation inaccuracy in conjunction with the performance of HX testing. Pending completion and closure of AR 97-0816 and subsequent NRC review, this item remains open.

E8.10 (Closed) Unresolved Item 50-331/97006-12: Review of licensee resolution of document inconsistencies.

- a. Seven minor documentation inconsistencies were noted between the wording of the UFSAR and the plant practices, procedures and/or parameters relative to the RHR system. These inconsistencies did not affect the design or operation of the RHR system. Items 2, 5, 6, and 7 were dispositioned during the inspection as requiring no further action. Items 1 and 3 were also discussed verbally with the team during the inspection as requiring no further action. The inspector revisited these conclusions and had no further concerns. Item 4 was dispositioned by AR 8365 as closed with no changes to the UFSAR required. AR 14287 was initiated on January 21, 1999 to have Licensing coordinate with Engineering to review the responses to all items and take actions to update the UFSAR as necessary in the next scheduled update.
- b. The team identified numerous minor inconsistencies between the UFSAR, Design Basis Documents (DBDs) and supporting calculations associated with containment pressure and temperatures assumed in evaluating adequate NPSH for the RHR pumps under design basis accident mode scenarios. Previously AR 96-0480-05 had been initiated to track the work associated with the NRC Bulletin 96-03. An addendum was added to this AR with a completion date of April 30, 1999, to track the resolution of the following: 1) Completion of the debris generation calculation, 2) completion of the NPSH calculations, 3) completion of the containment pressure and temperature calculations and, 4) revision of DBD, UFSAR and other plant documentation as required. The AR will be closed and tracked to completion along with the response to Bulletin 96-03 which will be reviewed and closed by NRR.

This item is closed.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the inspection results to members of licensee management at the conclusion of the inspection on January 21, 1999. The licensee acknowledged the findings presented.

The inspector asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

S. Huebsch	Engineer, Project Engineering.
M. McDermott	Engineering Manager
R. Murrell	Regulatory Communications Supervisor
K. Peveler	Manager, Regulatory Assurance Manager

NRC

P. Prescott Senior Resident Inspector

INSPECTION PROCEDURE USED

IP 92903 Followup - Engineering

ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

50-331/97006-01b	VIO	Inadequate Corrective Actions
50-331/97006-02	URI	UFSAR design values were not incorporated into STPs
50-331/97006-04	VIO	Failure to follow procedures
50-331/97006-05	URI	Further review of supporting documentation
50-331/97006-07	IFI	Review of revised NPSH calculation
50-331/97006-08	URI	Verification of heat up for torus suction
50-331/97006-09	URI	Calculation modified without proper design control
50-331/97006-10	VIO	Failure to verify input assumptions for bonnet temperature
50-331/97006-12	URI	Review of licensee resolution of document inconsistencies

Discussed

50-331/97006-11	URI	Review results of the evaluation of AR97-967
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LIST OF ACRONYMS USED

ACP	Administrative Control Procedure
AR	Action Request
CMAR	Corrective Maintenance Action Request
COLR	Core Operating Limits Report
DBDs	Design Basis Documents
DRS	Division of Reactor Safety
ECCS	Emergency Core Cooling System
EPRI	Electric Power Research Institute
ESF	Engineered Safety Feature
GMP	General Maintenance Procedure
HX	RHR heat exchanger
I&C	Instrumentation and Controls
LOCA	Loss Of Coolant Accident
LPCI	Low Pressure Coolant Injection
MOV	Motor Operated Valve
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation
OGC	Office of General Council
PCIS	Primary Containment Isolation System
PL/TB	Pressure Locking\Thermal Binding
PMAR	Preventive Maintenance Action Request
RHR	Residual Heat Removal
STP	Surveillance Test Procedure
UFSAR	Updated Final Safety Analysis Report
UT	Ultrasonic Test