U. S. NUCLEAR REGULATORY COMMISSION

REGION III

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Report No:	50-331/99012(DRP)
Licensee:	Alliant, IES Utilities Inc. 200 First Street S.E. P. O. Box 351 Cedar Rapids, IA 52406-0351
Facility:	Duane Arnold Energy Center
Location:	Palo, Iowa
Dates:	October 1 through November 10, 1999
Inspectors:	P. Prescott, Senior Resident Inspector M. Kurth, Resident Inspector
Approved by:	M. N. Leach, Chief Reactor Projects Branch 2 Division of Reactor Projects

EXECUTIVE SUMMARY

Duane Arnold Energy Center
NRC Inspection Report 50-331/99012(DRP)

This inspection report included the resident inspectors' evaluations of aspects of licensee operations, engineering, maintenance, and plant support.

Operations

- The inspectors noted that the work control center was more effective than the previous refueling outage in coordinating work activities. The inspectors observed conservative decision making by operations management to defer turbine surveillance testing until startup from the refueling outage rather than wait for procedure revisions and challenge operators to place the plant in the proper conditions. However, the inspectors identified that no Action Request was initiated for an unexpected main turbine vibration alarm. On-shift operators subsequently initiated procedure changes for procedure deficiencies noted with plant conditions for main turbine over-speed testing and turbine load-set adjustment (Section O1.1).

- The inspectors' identification to on-shift operators of the out of calibration reactor core isolation cooling flow transmitter was appropriately addressed by the licensee (Section O2.1).

Maintenance

- There was a noticeable improvement overall in the conduct of maintenance activities from the previous refueling outage. Presently, there have been few significant issues during the refueling outage. Several minor personnel performance issues occurred during the first several weeks of the outage due to communication problems and inattention to detail. Also, as the emergent work progressed on MO-1909, the licensee lost the overall focus of the job and radiation protection and fire protection concerns developed. Although human performance concerns occurred during the beginning of this outage, the severity and magnitude of the problems were less significant than last outage. Licensee performance in planning, scheduling, coordination, and contractor controls has improved since last outage (Section M1.1).

Engineering

- Overall, the licensee's plan for removing both shutdown cooling trains from service and ensuring adequate alternate decay heat removal methods were thorough. However, the inspectors noted that adequate monitoring to prevent reactor vessel thermal stratification had not been implemented. The licensee subsequently developed a log for use by on-shift operations personnel (Section E2.1).

- The inspectors identified two surveillance test procedures that were not revised to reflect the Improved Technical Specifications. Specifically, the emergency service water system would have been declared inoperable before reaching the Technical

Specification requirement for the ultimate heat sink temperature of 95°Fahrenheit. Failure to revise the procedures was considered a Non-Cited Violation (Section E8.1).

Plant Support

- A lack of communication resulted in a maintenance worker breeching an internally contaminated valve without a radiation protection worker present. This resulted in a Non-Cited Violation for failing to follow radiation work permit requirements (Section R1.1).

Report Details

Summary of Plant Status

The licensee operated the plant at 96 percent power at the beginning of this inspection period. The reactor core was in coast-down for Refueling Outage 16. The reactor continued in coast-down, and was operated at slightly less than 91 percent power, when operators initiated a reactor shutdown on October 21, 1999, at 12:00 p.m. to begin Refueling Outage 16. On October 21, at 1:06 p.m., operators placed the reactor mode switch to startup/hot shutdown. The generator was disconnected from the grid on October 22, at 1:15 a.m. On October 22, at 8:58 a.m., operators inserted a manual scram and the mode switch was taken to shutdown. On October 26, at 11:32 a.m., maintenance technicians commenced de-tensioning the reactor vessel head closure bolts and operators placed the mode switch to refueling. The plant was still in the refueling outage at the end of the inspection report period.

I. Operations

O1 Conduct of Operations

01.1 Observations of Routine Activities and the Plant Shutdown for Refueling Outage 16

a. Inspection Scope (71707)

The inspectors conducted numerous reviews of operators and operations management during shift activities. These reviews included observations of control room shift turn-overs and operator performance during plant evolutions. The inspectors interviewed operations personnel regarding plant status, events, and reviewed daily logs. The inspectors also observed the plant shutdown on October 21, 1999, to commence Refueling Outage 16.

The following procedures and documents were reviewed for the shutdown:

- Integrated Plant Operating Instruction (IPOI) 4, "Shutdown," Revision 44
- Action Request 17051, "Planned Over-speed Testing Not Performed"
- Surveillance Test Procedure (STP) NS930003, "Main Turbine Over-speed Trip System Tests," Revision 0

b. Observations and Findings

The inspectors observed that operations personnel effectively communicated operational information, maintained accurate records, and were knowledgeable of plant and equipment status. The inspectors observed that operations personnel conducted effective shift turn-overs and properly used procedures. In general, the conduct of operations was appropriately focused on safety.

Prior to the refueling outage, the work control center was placed into service. During the previous refueling outage, the inspectors noted weaknesses in the ability of the work control center personnel to coordinate work activities and implement tag-outs. There were only minor plant work coordination and tag-out problems noted during this refueling outage. The work control center was placed into service far enough in advance for operations personnel to become familiar with the center's operation prior to the refueling outage.

The inspectors observed the operations shift crew conduct the October 21 shutdown in preparation for Refueling Outage 16. Operators proceeded with a controlled power reduction as directed by IPOI 4. Operators halted the shutdown at the procedural step in IPOI 4 that prepared for the alternate method of securing the main turbine, which was by over-speed testing using STP NS930003 instead of tripping the turbine. The plant was at 9.7 percent power with one bypass valve at 28 percent open. However, a step in STP NS930003 required that operators verify turbine bypass valve BPV-1 indicated greater than 45 percent open. Operations management discussed several possible actions, including returning to the run mode and withdrawing control rods to increase power in order to perform the over-speed trip test. Subsequently, licensee management concluded the conservative action to take would be to defer the testing to startup from Refueling Outage 16.

During the shutdown of the main turbine when the main generator output breakers were opened, turbine speed increased from 1800 revolutions per minute (rpm) to 1900 rpm. Bearing number two vibration increased from approximately 5 mils to the annunciator setpoint of 7.5 mils. The inspectors noted the next day that no Action Request was initiated and discussed this with operations management. On-shift operations personnel subsequently initiated an Action Request (AR 17411). The shift technical advisor generated a procedure work request to address the main turbine staying at 1900 rpm. The same problem was seen from the Refueling Outage 15 shutdown. This was due to the load-set control being left at the normal setting of 600 mega-watts electric (MWe). It was found that the turbine would remain at 1900 rpm until an operator reduced the load-set. If the generator was disconnected at 60 MWe on load-set, the turbine would only increase speed to 1810 rpm. The shift technical assistant submitted a procedure work request to revise procedure Operating Instruction 698,"Main Generator System," to verify turbine load-set is set slightly above generator load.

c. Conclusions

The inspectors noted that the work control center was more effective than the previous refueling outage in coordinating work activities. The inspectors observed conservative decision making by operations management to defer turbine surveillance testing until startup from the refueling outage rather than wait for procedure revisions and challenge operators to place the plant in the proper conditions. However, the inspectors identified that no Action Request was initiated for an unexpected main turbine vibration alarm. On-shift operators subsequently initiated procedure changes for procedure deficiencies noted with plant conditions for main turbine over-speed testing and turbine load-set adjustment.

O2 Operational Status of Facilities and Equipment

O2.1 General Plant Tours and System Walkdowns

a. Inspection Scope (71707)

The inspectors followed the guidance of Inspection Procedure 71707 in walking down accessible portions of two systems. The systems chosen, based on maintenance work activities and probabilistic risk significance, were:

- Control Rod Drive Hydraulic Control Units
- Reactor Core Isolation Cooling (RCIC)

b. Observations and Findings

In general, equipment operability, material condition, and housekeeping were acceptable. However, the inspectors identified that the RCIC pump remote flow gauge FS-2508 indicated 82 gallons per minute with the pump in stand-by. The inspectors notified operations shift management. On-shift operators declared the gauge and associated flow transmitter inoperable and the appropriate Technical Specification (TS) limiting condition for operability was entered. A work order was written and instrument maintenance technicians promptly identified the problem as air in the lines. The air was bled from the system. Approximately 4.5 hours later, the RCIC system was declared operable. An operability evaluation was performed as part of Action Request 16932. Action Request 16932 documented that the flow transmitter would be evaluated for drifting to indicate RCIC system flow with the pump in stand-by.

c. Conclusions

The inspectors' identification to on-shift operators of the out of calibration RCIC flow transmitter was appropriately addressed by the licensee.

II. Maintenance

M1 Conduct of Maintenance

M1.1 General Comments and Refueling Outage Observations

a. Inspection Scope (62707 and 61726)

The inspectors observed all or portions of the surveillance test activities and work request activities listed below. The applicable surveillance test or work package documentation was reviewed. The inspectors also reviewed several personnel performance issues concerning maintenance activities that occurred during the portion of the refueling outage covered by this inspection period. Specific tests and work request activities observed are listed below:

Maintenance Activities

- Corrective Maintenance Action Request (CMAR) A37278: "B" residual heat removal (RHR) heat exchanger; weld repair on "B" RHR heat exchanger divider plate for RHR service water
- CMAR A50219: RE4572F intermediate range monitor (IRM) "F" detector; replace detector
- CMAR A44403: RE4572D IRM "D" detector; replace detector
- CMAR A44687: Scram accumulator 30-31; rebuild scram water accumulator
- CMAR A39181: Inboard shutdown cooling isolation suction valve MO-1909; open, inspect and machine disc, and seat to correct leak-by
- Preventive Maintenance Action Request (PMAR) 1106545: Bus 1A2 4160 volt alternating current (VAC) nonessential switchgear; inspect bus, clean, and repair/replace bus shutter doors
- PMAR 1107454: 250 volt direct current battery resistance check and structural integrity of battery rack

Surveillance of Activities

- Equipment Monitoring Procedure IPO99-FV, "Emergency Service Water Flow Verification Test," Revision 5
- Surveillance Test Procedure (STP) 3.1.7-03, "Standby Liquid Control System Boron Concentration Test," Revision 1
- STP 3.3.8.2-01, "[Reactor Protection System] RPS [Motor Generator] MG Set and Alternate Power Source [Emergency Power System] EPS Channel Calibration," Revision 3
- STP 3.8.1-06, "Standby Diesel Generators Operability Test (Fast Start)," Revision 7
- STP 3.8.4-04, "Performance Discharge Test of Batteries 1D1, 1D2, 1D4, 1D5, 1D6, and 1D93," Revision 1

b. Observations and Findings

There was a noticeable improvement overall in the conduct of maintenance activities from the previous refueling outage. In general, the work associated with these activities was conducted in a professional and thorough manner. Technicians were knowledgeable of their assigned tasks and work document requirements. Work was performed with the appropriate radiological control measures in place. This was especially evident during the IRM removal and replacement work. The pre-job brief was

thorough and there was good health physics technician coverage of the job. Also, the inspectors observed that maintenance workers and health physics technicians did a good job of controlling contamination during work on the hydraulic control unit scram accumulators. However, the inspectors noted some weaknesses in the radiological controls for work on valve MO-1909, the residual heat removal shutdown cooling outboard isolation valve (see Section R1.1 for details).

Although the overall conduct of maintenance was noted to have improved, there were several minor personnel performance problems that occurred. The section below describes the circumstances surrounding some of the personnel performance issues that occurred during the associated maintenance activity:

- On October 30, 1999, a temporary power cart was unknowingly reconfigured so that the 480 VAC input yielded a 480 VAC output when a 120 VAC output was expected. No one was injured. The power cart was in use at the pump house. A maintenance crew attempted to plug in several electrical cords causing several breakers to trip. A ground fault interrupter circuit was damaged beyond repair. Electricians determined that the internal connections for the transformer were bypassed. The power cart had been rewired internally for a specific job and no markings or labels were used noting the reconfiguration. Action Request 17508 was initiated.

- On October 31, a fuel bundle was placed 90 degrees off from its intended orientation. The licensee discovered the mis-oriented bundle during fuel shuffle activities on November 8. Fuel movement activities were stopped and a fact finding meeting was held. Action Request 17443 was initiated. The licensee developed a plan and re-oriented the fuel bundle.

- On November 8, an emergent work plan was developed and weld measurements on reactor recirculation nozzle weld repair areas were taken incorrectly twice, which resulted in additional personnel exposure of over 600 millirem. A fact finding meeting was held prior to taking additional measurements. Action Request 13836 was initiated. It was determined that better lighting in the area and a discussion of the job activities was needed for personnel less familiar with the job task (see Inspection Report 50-331/99013 for details).

- The inspectors identified several examples of miscellaneous tools and equipment laying across the boundary between the clean and contaminated areas in the reactor building and turbine building. The licensee took appropriate action when the examples were brought to its attention. No inadvertent loose contamination was found in clean areas.

- On November 3, maintenance personnel were scheduled to disassemble the residual heat removal shutdown isolation valve MO-1909 to repair valve leakage. The valve had not been disassembled in over 25 years and disassembly work was difficult. The scope of the original work order increased. The work order was appropriately changed to reflect the increased scope. However, as detailed in Section R1.1, the inspectors identified that emergent work lacked the proper

over-sight to ensure the revised work order was performed as planned. The inspectors noted problems with health physics technician job coverage and failing to get a hot work permit.

d. Conclusions

There was a noticeable improvement overall in the conduct of maintenance activities from the previous refueling outage. Presently, there have been few significant issues during the refueling outage. However, several minor personnel performance issues occurred during the first several weeks of the outage due to communication problems and inattention to detail. Also, as the emergent work progressed on MO-1909, the licensee lost the overall focus of the job and radiation protection and fire protection concerns developed. Although human performance concerns occurred during the beginning of this outage, the severity and magnitude of the problems were less significant than last outage. Licensee performance in planning, scheduling, coordination, and contractor controls has improved since last outage.

III. Engineering

E2 Engineering Support of Facilities and Equipment

E2.1 Licensee Preparations to Remove Shutdown Cooling From Service

a. Inspection Scope (37551, 71707, and 62707)

The inspectors reviewed licensee plans to remove both residual heat removal (RHR) trains from service to perform maintenance on the inboard and outboard shutdown cooling isolation suction valves. Work scope and planned compensatory measures were discussed with the cognizant department leads assigned to the task. The following documents were reviewed:

- "[Refueling Outage] RFO 16 Schedule - Shutdown Risk Evaluation," Revision 0
- Nuclear Generating Division Program Engineering Document, "Spent Fuel Pool Decay Heat Removal Capability"
- Integrated Plant Operating Instruction (IPOI) 8, "Outage Refueling Operations," Revision 20
- DAEC Outage Management Guidelines (OMG) 7, "Outage Risk Management Guidelines," Revision 8

b. Observations and Findings

A valve motor operator overhaul and testing was planned for the inboard shutdown cooling isolation suction valve MO-1908. Also, the outboard valve, MO-1909, was scheduled for an internal seat and disk inspection and repair because of valve leak-by.

The valves were located on a common suction line for both trains of RHR. The licensee developed plans for alternate shutdown cooling of remaining fuel in the reactor vessel and stored fuel in the spent fuel pool. Licensee plans called for both trains of spent fuel pool cooling and the reactor water cleanup system to be available. Project engineering personnel compiled data on the spent fuel pool cooling and reactor water cleanup systems' decay heat removal capability. Graphs were developed based on the amount of decay heat expected with the capability of various line-ups, such as only one train or both trains of spent fuel pool cooling and with or without reactor water cleanup available. The inspectors found the engineering assumptions to be appropriate to determine the required heat removal capacities of the systems.

The licensee's contingency plans through guidance provided in IPOI 8 and OMG 7 for alternate decay heat capacity planning and implementation were adequate. However, the inspectors noted that the licensee had not established adequate monitoring to verify that reactor vessel thermal stratification did not occur. Operations management agreed with this observation and subsequently developed a log to monitor reactor vessel temperatures.

The inspectors' review of the plan for the expected work sequence and schedule constraints developed by the licensee were found to be thorough. The contingency plan documented which engineers were the leads for the troubleshooting plan and recovery, if necessary, of pressure boundary integrity. Prior to aligning to alternate shutdown cooling and beginning the maintenance activities, management conducted readiness review meetings. The meetings clearly outlined personnel responsible for outstanding items and the actions necessary to ensure completion of the items.

c. Conclusions

Overall, the licensee's plan for removing both shutdown cooling trains from service and ensuring adequate alternate decay heat removal methods were thorough. However, the inspectors noted that adequate monitoring to prevent reactor vessel thermal stratification had not been implemented. The licensee subsequently developed a log for use by on-shift operations personnel.

E8 Miscellaneous Engineering Issues (92903)

E8.1 (Closed) Unresolved Item 50-331/99011-01: Unavailability of data to support conclusions of continued operability of emergency service water (ESW) system. The inspectors noted, during a review of the daily STP 3.0.0-01, that there was acceptance criteria for the ultimate heat sink (UHS) (river water temperature) to be less than or equal to 95°F (Fahrenheit). The temperature corresponded to the requirements in TS. However, there was also acceptance criteria, established by STP NS540002, for the ESW system to be declared inoperable, which was lower than the UHS TS number. The inspectors questioned why the ESW temperature was more limiting than the UHS temperature. There was no documentation to support the licensee's position that the ESW system would remain operable above the UHS temperature in TS.

Recently, the licensee completed compiling documentation of calculations and surveillance tests on the ESW system. The inspectors found the licensee's justification for continued operability of the ESW system above 95°F to be adequate. The licensee was in the process of revising the daily STP 3.0.0-01 and STP NS540002 to incorporate the 95°F UHS temperature limit in TS. Criterion XI of 10 CFR Part 50, Appendix B, requires, in part, that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents. Contrary to the above, the inspectors noted that daily STP 3.0.0-01, "Instrument Checks," Revision 12, and STP NS540002, "Emergency Service Water Operability Test," Revision 3, did not incorporate documentation and calculations that supported the ESW system being operable above 95°F. This Severity Level IV violation (50-331/99012-01 (DRP)) is being treated as a Non-Cited Violation consistent with Section VII.B.1.a of the NRC Enforcement Policy. This violation is entered in the licensee's corrective action program as Action Request 16484. This item is closed.

IV. Plant Support

R1 Radiological Protection and Chemistry Controls

R1.1 Radiation Protection Support for Valve Disassembly

a. Inspection Scope (71750)

The inspectors assessed the radiological protection practices that supported the disassembly of the RHR shutdown cooling isolation valve MO-1909. The inspectors reviewed the following procedures:

- Administrative Control Procedure (ACP) 1411.27, "Rules of Conduct of Work in Radiological Areas," Revision 1
- ACP 1411.21, "Radiation Work Permits," Revision 7
- Radiation Work Permit (RWP) 10192, Job Step 6, "MO-1909 Valve Maintenance," Revisions 1 and 2

b. Observations and Findings

On November 3, 1999, radiation protection personnel conducted a pre-job brief with maintenance and engineering personnel to discuss MO-1909 work activities. The detailed pre-job brief covered valve disassembly, disk machining, and valve reassembly. The valve had not been disassembled since initial plant start-up (25 years) and, due to estimated radiological conditions, the potential for adverse radiological dose rate and airborne conditions existed.

Initially, the inspectors observed maintenance workers adhering to safe radiological work practices. Radiation protection personnel provided direct coverage. However, maintenance workers were unsuccessful in their initial attempts to disassemble the valve. Subsequently, the engineering and maintenance staff decided to heat the valve body. The valve body was to be heated to 800°F allowing the valve internals to loosen based on the temperature differential of valve components. The responsible radiation protection technician left the job site to take a break during the valve heat-up.

As the valve began to heat-up to 350°F, the inspectors observed a maintenance worker attempt to mechanically agitate the valve and was successful; the valve's internal top lid dropped down and the valve seal was broken. Due to a lack of communication between maintenance and radiation protection personnel, the radiation protection technician was not present during the valve breech as required by RWP. Radiation protection personnel subsequently determined that radiological conditions did not change at the job site. The inspectors determined there was confusion among radiation protection and site personnel regarding the meaning of a system "breech." However, the inspectors discussed the event with site management and it was their expectation to have a radiation protection worker present when the valve seal was broken. The radiation protection worker was unaware that maintenance personnel would attempt to work the valve prior to the valve reaching 800°F.

Technical Specification 5.4.1.a. requires, in part, that written procedures shall be implemented covering the activities recommended in Appendix A of Regulatory Guide 1.33, Revision 2, February 1978. Regulatory Guide 1.33, Revision 2, Appendix A, "Typical Procedures for Pressurized Water Reactors and Boiling Water Reactors," Section 7.e.(1), states, in part, that radiation protection procedures for access control to radiation areas, including a radiation work permit system, should be covered by written procedures. Administrative Control Procedure 1411.21, "Radiation Work Permits (RWP)," Revision 7, a procedure implemented by Section 7.e.(1) of Regulatory Guide 1.33, Step 3.1(6), requires, in part, that all personnel entering a radiologically posted area shall follow the protective actions and instructions, as specified by the RWP, during the course of performing a job. Radiation Work Permit 10192, Job Step 6, Revision 2, required that health physics personnel be present for the system breech. Contrary to the above, on November 6, health physics personnel failed to be present during the system breech of MO-1909. This Severity Level IV violation (50-331/99012-02(DRP)) is being treated as a Non-Cited Violation consistent with Section VII.B.1.a of the NRC Enforcement Policy. This violation is entered in the licensee's corrective action program as Action Request 17654.

c. Conclusions

A lack of communication resulted in a maintenance worker breeching an internally contaminated valve without a radiation protection worker present. This resulted in a Non-Cited Violation for failing to follow radiation work permit requirements.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on November 10, 1999. The licensee acknowledged the findings presented. The inspectors 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

R. Anderson, Plant Manager
J. Bjorseth, Maintenance Superintendent
D. Curtland, Operations Manager
R. Hite, Manager, Radiation Protection
M. McDermott, Manager, Engineering
K. Peveler, Manager, Regulatory Performance
G. Van Middlesworth, Site General Manager
D. Wilson, Vice President Nuclear

INSPECTION PROCEDURES USED

IP 37551:	Onsite Engineering
IP 61726:	Surveillance Observation
IP 62707:	Maintenance Observation
IP 71707:	Plant Operations
IP 71750:	Plant Support
IP 92903:	Followup - Engineering

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-331/99012-01	NCV	Unavailability of data to support conclusions of continued operability of ESW system
50-331/99012-02	NCV	Health physics technician not present for system breech

Closed

50-331/99012-01	NCV	Unavailability of data to support conclusions of continued operability of ESW system
50-331/99012-02	NCV	Health physics technician not present for system breech

Discussed

None

LIST OF ACRONYMS USED

ACP	Administrative Control Procedure
AR	Action Request
BPV	Bypass Valve
CFR	Code of Federal Regulations
CMAR	Corrective Maintenance Action Request
DAEC	Duane Arnold Energy Center
DRP	Division of Reactor Projects
ESW	Emergency Service Water
F	Fahrenheit
IP	Inspection procedure
IPOI	Integrated Plant Operating Instructions
IRM	Intermediate Range Monitor
MWe	Mega-Watts electric
NCV	Non-cited violation
NRC	Nuclear Regulatory Commission
OMG	Outage Management Guideline
PMAR	Preventive Maintenance Action Request
RCIC	Reactor core isolation cooling
RHR	Residual heat removal
rpm	revolutions per minute
RWP	Radiation Work Permit
STP	Surveillance Test Procedure
TS	Technical Specification
UHS	Ultimate Heat Sink
VAC	Volt Alternating Current