U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-331/91012(DRS)

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

Licensee: Iowa Electric Light and Power Company
Post Office Box 351
Cedar Rapids, IA 52406

Facility Name: Duane Arnold Energy Center

Inspection At: Palo, IA 52324

Inspection Conducted: June 17 through 27, 1991

Inspectors: H. A. Walker — Date: 7-18-91

N. C. Choules — Date: 7-18-91

C. A. Gainty — Date: 7-17-91

Approved By: F. J. Jablonski, Chief — Date: 7-18-91
Maintenance and Outages Section

Inspection Summary

Inspection on June 17-27, 1991 (Report No. 50-331/91012(DRS))
Areas Inspected: Routine announced inspection of maintenance activities using selected portions of NRC Inspection Procedure 62703 to ascertain whether maintenance was effectively accomplished and assessed by the licensee.
Results: Based on the items inspected, overall performance in maintenance was considered satisfactory and no violations of NRC requirements were identified.

DETAILS

1.0 Principal Persons Contacted

Iowa Electric Light and Power Company

*D. Wilson, Plant Superintendent
*R. Baldyga, Maintenance Engineer Supervisor
*D. Church, Quality Assurance Supervisor
*V. Crew, Technical Support Engineer
*T. Gordon, Electrical Maintenance Supervisor
*M. McDermott, Maintenance Superintendent
*D. McGill, Maintenance Planner
*J. Shuffield, I&C Maintenance Supervisor
*T. Sims, I&C Maintenance Engineer
J. Sweiger, Maintenance Engineer

U. S. Nuclear Regulatory Commission

*R. Hague, Section Chief, Project Section 3C
*F. Jablonski, Section Chief, Maintenance and Outages Section
*M. Parker, Senior Resident Inspector

*Indicates those individuals present at the exit meeting on June 27, 1991. Other persons were contacted as a matter of course during the inspection.

2.0 Licensee Action on Previous Inspection Findings

(Open) Violation (331/90003-1E): Motor thermal overloads were not in accordance with design drawings. Licensee personnel had completed a review of installed thermal overloads; the inspector was told that drawings would be updated to reflect the installed thermal overloads. After the drawing changes have been completed, an engineering evaluation would be performed to determine if the installed thermal overloads were correct. Since action on this item was not complete at the time of the inspection, the item will remain open pending completion of required action.

3.0 Evaluation and Assessment of Maintenance

The purpose of this inspection was to evaluate and assess the accomplishment and effectiveness of maintenance activities at the Duane Arnold Energy Center. During the first week of the inspection, the plant was at power. During the second week, the plant was in an unplanned outage due to a reactor scram. The evaluation and assessment of maintenance were accomplished by observations of material condition and maintenance work activities; review of the implementation of corrective maintenance, preventive maintenance, and predictive maintenance programs; review of completed maintenance activities; and evaluation of maintenance backlogs.

The inspectors also assessed the quality verification process related to maintenance, which was accomplished by review of audit and surveillance

reports for implementation of corrective actions, and review of documents, such as Licensee Event Reports (LERs), to verify that corrective action was adequately controlled. Results of the inspection are documented in the following sections.

3.1 Review of Maintenance Program

The inspectors reviewed equipment and systems to determine if electrical, mechanical, and instrument and control (I&C) maintenance was adequately controlled. This review included:

The extent that adequate maintenance procedures had been developed and were used.

The extent that engineering organizations supported the maintenance process.

The extent that preventive maintenance (PM) was performed and the extent that Reliability Centered Maintenance (RCM) was factored into the process.

The extent that predictive maintenance was used to detect equipment problems prior to failure.

The extent that outside source information, maintenance histories, LERs, and results of diagnostic examinations were analyzed for trends and root causes for modification of the preventive maintenance program to preclude recurrence of equipment or component failures.

3.1.1 Maintenance Procedures

The inspectors reviewed and evaluated portions of nine maintenance and maintenance related procedures for completeness, adequacy of work instructions, acceptance criteria, quality control (QC) hold points, ease of use, necessary approvals, and general conformance to NUREG/CR-1369.

The procedures reviewed were:

CRDRVE-G082-001, "Hydraulic Control Units," Revision 2

GMP-TEST-036, "Vibration Monitoring Program," Revision 1

MD-020, "Maintenance Planning," Revision 9

114.1, "Response to Corrective Action Reports," Revision 2

114.3, "Root Cause Analysis," Revision 2

1203.04, "Quality Level Determination," Revision 0

1408.1, "Maintenance Action Requests," Revision 15

1410.6, "Temporary Modification Control," Revision 0
with change notices A and B

1410.8, "Post Scram Review," Revision 1

The inspectors determined that the procedures were satisfactory in scope and content, and provided detailed instructions as appropriate for covered activities. Where applicable, acceptance criteria and recommended QC hold and witness points were included.

3.1.2 Engineering and Technical Support

The licensee had established a system engineering section with 14 system engineers and was in the process of increasing the number to 26. System engineers were involved in many aspects of maintenance; however, because of the small number of system engineers, each one was assigned several systems to follow. Those system engineers interviewed indicated that the high number of systems prevented adequate support of all assigned systems. As a result, system engineers did not perform all duties required by procedures. For example system engineers did not trend equipment failures. Instead, discipline/component engineering assigned engineers to monitor system component reliability and trend failures. The discipline/component engineering group also provided support to maintenance in a number of areas such as procurement, instrument calibrations, and component failures. Overall, technical support of maintenance should improve when the system engineer section is fully staffed.

3.1.3 Preventive Maintenance Program

The scope of the program included approximately 14,000 tasks, including inspection, calibration, replacement, lubrication, and repair for both safety related and non-safety related equipment. Plant personnel could recommend changes to the PM program by means of a PM input request form (PIR). The PIRs were evaluated to determine if PM tasks should be added or deleted and if the frequency of performance should be changed. Changes to the PM program were approved by maintenance engineering. For protected programs, such as environmental qualification (EQ) or ASME, design engineering approval was required. The PM coordinator was responsible for implementing changes to the data base and for determining PM tasks due each month.

One example of a modified PM task was preventive maintenance action request (PMAR) 1043533 for core spray pump seal replacement. The licensee conducted an evaluation of operating history, vendor recommendations, nuclear plant reliability data system (NPRDS) information, design, and effect on safety function in order to recommend that the time-based replacement of pump seals be changed to an as-required replacement based on a routine visual examination for leaks.

The inspectors reviewed the extent that RCM was factored into the maintenance process. The licensee had completed a pilot RCM study of the diesel generator and feedwater systems. The study, which was completed in January 1991, resulted in many recommendations for changes to the PM program for both

systems. A number of technical specification changes were also recommended. At the time of the inspection, work had not started to implement the RCM study results into the PM program or to request the recommended technical specification changes.

A PM enhancement program was also in place, which consisted of a review of vendor recommendations, failure histories, and other available data, to make changes and adjustments in the PM program. There were internal licensee discussions about continuing with RCM since the PM enhancement program was in place. These discussions appeared to be one reason for the delay in implementing the results of the two RCM system studies previously completed. A proposed schedule for completion of RCM studies on additional plant systems was to be completed by July 31, 1991.

The inspectors concluded that the PM program was appropriate and contributed to the safe operation of plant equipment.

3.1.4 Predictive Maintenance Program

The inspectors reviewed the program for condition monitoring and predictive maintenance. Although this program was partially in place, some areas were in the initial stages of development. Predictive maintenance was accomplished by means of vibration analysis, lubrication oil analysis, infrared thermography and other testing methods. The program was not formally defined. A procedure existed only for vibration analysis, GMP-TEST-036, "Vibration Monitoring Program," Revision 1. Maintenance personnel that performed infrared thermographic tests during the inspection were not knowledgeable of the equipment and the test requirements, and no instructions were provided. However, PMARs issued for this work were completed as scheduled and the inspector was concerned about the usefulness of the infrared test results. Cognizant licensee personnel stated that infrared thermography, like some of the other predictive maintenance methods, was still in the developmental stage. Full development and implementation of infrared thermography was to be completed before the next refueling outage.

The predictive maintenance program, although still in the developmental stages in some areas, was being performed and the licensee was in the process of continuing to develop, use and improve these maintenance methods.

3.1.5 Trending

The inspectors evaluated the methods used to detect repetitive component failures and adverse trends in plant and system performance. Both hardware failure trending and performance trending were used. Each type is discussed separately.

3.1.5.1 Failure Trending

The inspectors reviewed the methods used by the licensee to evaluate maintenance records and other documents to detect repetitive component

failures in order to expedite action to prevent recurrence. The licensee had recently developed several new programs to monitor and trend equipment and component failures:

Since March 1991, the discipline/component engineering department evaluated one component category per month in each of three disciplines, mechanical, electrical, and I&C. The evaluation included review of corrective maintenance action requests (CMAR) history for common mode failures, repeat failures, and reliability problems. Monthly reports were issued to discuss results and recommendations. As of the time of the inspection, three reports had been issued; however, no significant changes had been recommended or initiated.

The discipline/component engineers also evaluated nuclear plant reliability data system (NPRDS) failure reports and obtained component failure analysis reports from NPRDS to provide selected component trending on an industry wide basis. This information was evaluated and conclusions and recommendations were provided to the maintenance department in a quarterly report.

Since the programs discussed above were still new, the effectiveness of the programs to identify and correct significant trends could not be evaluated. The inspectors noted one weakness in the program. CMAR history may not contain all information about some repetitive problems. Procedure 1408.1, "Maintenance Action Requests," Revision 15, allowed packing adjustments, tightening of leaking fittings on any component, and work on quality level IV components to be performed without a CMAR. Therefore, maintenance history on this type work may not be available.

3.1.5.2 Performance Trending

The inspectors evaluated the extent that performance indicators were used to monitor and trend overall plant, system or personnel performance. Performance trending included overall maintenance information items such as backlogs, LERs, NRC violations and extended outage times. Some of the maintenance performance indicator trends were included in the plant monthly report to management.

System engineers trended performance of selected components and assigned systems. A predictive maintenance program was in place to evaluate measurable equipment parameters in order to trend and monitor selected equipment performance and conditions. Results of vibration monitoring and lubricating oil analysis were trended and analyzed. This information allowed determination of the possible need for repair prior to equipment failure.

3.2 Accomplishment of Maintenance

The inspectors evaluated the material condition and housekeeping of the plant, observed maintenance activities, and assessed the maintenance backlog to determine if electrical, mechanical and I&C maintenance was accomplished as required.

3.2.1 Material Condition/Housekeeping

The inspectors observed general plant areas to verify that CMARs had been initiated for identified equipment problems. The inspectors observed buildings, components, and systems for proper identification, accessibility, scaffolding, radiological controls, and unusual conditions. Unusual conditions included but were not limited to water, oil or other liquids on the floor or equipment; indications of leakage through ceiling, walls or floors; loose insulation; corrosion; excessive noise; unusual temperatures; and abnormal ventilation and lighting. The plant was at operating temperatures and pressures during the first week of the inspection. The inspection results were as follows:

- In most areas, plant housekeeping and equipment condition was very good. Most areas were clean and recently painted. No significant liquid or steam leaks were noted.

- Housekeeping in the intake structure needed improvement. The air intake screens were full of debris and there were small puddles of very dirty river water on the floor.

- Most equipment problems noted by the inspectors were minor and most had been identified by the licensee. However, the licensee was unaware of some minor problems that included disconnected and untagged wires in control room cabinets; no identification on a large feedwater valve; loose packing nuts on two pumps; and water leaks from a PH meter in the intake structure. The licensee promptly wrote CMARs to correct the inspector identified problems.

Overall, plant housekeeping and equipment condition were considered good. CMARs were written and entered into the computer for previously identified equipment problems. The material condition appeared to maintain operability of components at a level commensurate with the components' function. Few components were noted to be in need of repair.

3.2.2 Observation of Maintenance Activities

The inspectors observed ongoing work in electrical, mechanical, and I&C maintenance areas. These activities were selected from the daily plan and through discussions with maintenance foremen. Where possible, safety significant activities were chosen for follow-up.

Maintenance activities were observed to determine if those activities were adequately performed and were in accordance with required administrative and technical requirements. Work activities were assessed in the following areas: work control and planning, management presence and involvement, quality control presence and involvement, procedure availability, adequacy, and use; personnel training and qualifications, material availability, measuring and test equipment (M&TE) application and calibration, and the adequacy of post maintenance testing, including proper acceptance criteria.

The inspectors observed portions of 11 maintenance activities listed below:

CMAR A03981	Replace and calibrate the reactor low water level switch.
CMAR A05067	Replace and calibrate the standby filter unit temperature indicator.
CMAR A05150	Replace and calibrate the fuel pool pump suction pressure gauge.
CMAR A05310	Replace compressor, control building chiller
CMAR A05329	Replace "D" well water pump, determ and remove motor
CMAR A06360	Repair oil supply piping and replace oil cooler, control building chiller
CMAR A06795	Repair damaged control cable to "D" river water pump
CMAR A06854	Replace motor bearings on cooling tower pump motor
CMAR A07553	Disassemble "C" inboard MSIV and replace disk and piston
PMAR 1054500	Inspect electrical panel 1D50 for hot spots
STP-42B016-M	Perform recirculation pump monthly functional test

Concerns were noted as indicated below:

- PMAR 1054500 - Maintenance personnel, who performed an infrared thermographic test on electrical panel 1D50, were not knowledgeable of the equipment and the test requirements. No procedures or written instructions for equipment connection and use were available. As a result the personnel encountered difficulties in connecting the infrared equipment and, after connection, also had trouble with the function of the equipment. In addition, personnel were not knowledgeable of what constituted abnormalities or "hot spots". This was the first time that the individual responsible for the test had operated the equipment without other knowledgeable personnel present. The individual who previously performed this task had left the company. Labor contract agreements prohibited knowledgeable engineering personnel from performing the inspection. Electrical supervision was contacted to help resolve the problems. After discussion, personnel decided to video tape the infrared scans for final evaluation by cognizant engineering personnel. This was the first of approximately 20 infrared PMARs that were scheduled for completion by the same individuals on June 27, 1991.

- STP-42B016-M - Two instrument valves, a low pressure bleed drain valve and a high pressure bleed drain valve, were not listed on the valve position verification list included in procedure STP-42B016-M, which was

used to perform the recirculation pump monthly functional test. The procedure adequately described the valve operations required for the test and included the valve identification. However, within the procedure, the valves were shown on an information diagram for the pressure indicating switch, but were not identified. The licensee corrected the procedure to identify the valves on the diagram and on the verification list. The inspector determined that this problem was isolated and did not involve other surveillance test procedures.

The inspectors concluded that maintenance and surveillance activities in the areas inspected were adequate except as previously noted. Activities observed were accomplished by skilled and knowledgeable maintenance personnel except for the infrared testing. Maintenance personnel followed procedures and instructions.

3.2.3 Repair to MSIV Nitrogen Supply Piping

3.2.3.1 Reactor Scram Resulting from MSIV Closure

On June 22, 1991 at 2:14 am, "B" outboard main steam isolation valve (MSIV) CV4416 closed, which caused a high flux reactor scram. Initial investigations determined that the MSIV closed due to insufficient nitrogen operating pressure caused by the combination of a failed soldered joint and a loose Swagelock fitting in a non-safety related pipe.

3.2.3.2 Troubleshooting and Maintenance

The licensee pressure tested other MSIV related nitrogen piping. Several other leaking joints were identified. To preclude similar failures, the licensee decided to replace the section of the copper nitrogen header in the steam tunnel with stainless steel tubing. The replacement was controlled as a Plant Modification Package (PMP) in accordance with procedure 1203.60. "Plant Modifications," Revision 1.

The inspectors reviewed the PMP for level of detail in instructions and drawings, control of work and field changes, availability of materials, cleanliness requirements, testing acceptance requirements, and engineering involvement, including completeness of safety evaluation. The inspectors also observed portions of the associated maintenance activities.

The work instructions were somewhat vague, but were appropriate for the work involved, a non-safety related, low pressure pipe modification. The design engineer was kept aware of field changes necessary due to problems with part availability and compatibility, and the documents were properly handled in accordance with procedure 1203.60.

3.2.3.3 Corrective Actions

The licensee determined that the loss of MSIV nitrogen pressure was caused by a failed soldered joint in a two inch non-safety related copper pipe and a leak due to a loose Swagelock fitting. The soldered joint failed from stress due to thermal cycling of the pipe joint, which was located in the steam

tunnel. The cause of the loose Swagelock fitting was not determined. All Swagelock fittings in the MSIV nitrogen piping were checked and tightened as needed. The MSIV nitrogen piping was checked for leaks and several leaks were noted. The portion of the two inch nitrogen piping header in the steam tunnel was replaced with stainless steel pipe to preclude similar failures.

Since there had been a recent failure of a two inch soldered pipe joint on the plant compressed air system, plant piping systems were reviewed for two inch copper pipe. The only other place where two inch copper pipe was used was in the well water system, which was non-safety related. The well water system supplied the cooling water to the dry well coolers and was considered by the inspectors to be an important system during power operation. Since this system was not considered important to safety and was not subjected to heat, the licensee decided not to check the piping for possible leaking soldered joints.

3.2.4 Calibration Control

Previously, the licensee had problems assuring that, when instruments were calibrated, the instruments were left within the required tolerances. Most of the problems were with non-technical specification instruments. The licensee currently requires that when an instrument is calibrated, I&C technicians review the results of five previous calibrations for proper tolerance. If discrepancies are noted, I&C engineers in the discipline or component engineering organization are contacted and the discrepancies resolved. I&C technicians document the review on the CMAR or PMAR that initiated the calibration. The I&C foreman and the I&C supervisor review the completed calibration sheets to assure that the calibration is proper. QA audit I&C calibration data every 90 days.

The I&C engineers were also working on a new program to review calibration requirements for all instruments to assure that tolerances and set points were correct and to enter the information into a computer data base for future use. When the program is complete, the correct calibration data sheets with specified tolerances and set points would be obtained from the computer for use when instruments were calibrated.

3.2.5 Maintenance Backlog Assessment and Evaluation

The inspectors reviewed the amount of work accomplished compared to the amount of work scheduled. The review emphasized work that could affect the operability of safety-related equipment or equipment important to safety, which included some balance of plant components.

Maintenance backlog information was tracked to provide management with maintenance performance indicators, which would allow the detection of adverse trends in backlog levels. Overall, both CMAR and PMAR backlogs were controlled and within the capabilities of the maintenance staff. The total backlog of non-outage CMARs on May 13, 1991, based on licensee reports, was 862, which represented approximately 13 weeks of work. The current size of the backlog did not appear to be beyond the capabilities of the existing staff to complete within a reasonable time. However, the inspector noted that the

number of open non-outage CMARs had increased by more than 50% over the past year. Part of this problem appeared to be due to a decrease in staffing of maintenance personnel primarily in the mechanical and I&C areas. This matter had been noted by the licensee and actions were being taken to provide additional staffing; however, limitations imposed by labor agreements on obtaining experienced maintenance personnel appeared to prevent a short term solution to this problem especially in the I&C area.

On June 20, I991, there were 55 MARs on hold for parts and about half affected non-outage CMARs. The purchase orders for items on hold for parts were tracked by the licensee. Although the number of CMARs on hold for parts did not appear to be excessive, some work on important equipment was being unduly delayed. For example, CMAR A05461A for repair of the control building 1VCH001B chiller evaporator was on hold for parts even though this equipment had been out of service since January 1991. With this system out of service there was no redundant system to ensure that the control room would be habitable during an accident. Although this condition was not prohibited by technical specifications, a failure of the operable system during an accident could cause problems with control room habitability.

Although some corrective maintenance was occasionally rescheduled, the inspectors did not identify any significant corrective maintenance work or backlog items that had been inappropriately delayed. Other than CMAR A05461A, no backlog items appeared to affect the safe operation of the plant or have an adverse effect on plant availability.

The PMAR backlog on June 17, 1991 was 270 with 25 maintenance PMAR tasks overdue. No delayed PMARs were noted that would have an adverse effect on plant operability. The PM program was satisfactorily managed and controlled with emphasis on PM task completion.

3.3 Effectiveness of Maintenance

The inspectors determined the effectiveness of maintenance by review of completed CMARs and rework performed.

3.3.1 Review of Completed Maintenance

The inspectors reviewed approximately 35 safety related/important to safety CMARs for completeness, accuracy, and technical content. Some of the specific areas evaluated were adequacy of work instructions, engineering and technical support in the resolution of concerns identified during the performance of the work, and documentation of work performed.

The inspectors noted a number of CMARs that had been completed without the specified quality level as stipulated in procedure 1408.1, "Maintenance Action Requests", Revision 15. The licensee was reviewing CMARs to determine if any work was compromised due to lack of a specified quality level.

The inspectors concluded that the CMARs were generally satisfactory in scope and content. The inspectors noted that work performed was generally adequately documented. Thorough work instructions were generally provided.

Post maintenance testing was completed and appropriate. Part of the CMAR required operations to assess the effect the work would have on technical specifications and the plant as well as operability concerns.

3.3.2 Review of Maintenance Rework

A program had been recently initiated for tracking of maintenance rework. For rework conditions, determination of the cause and corrective action to prevent recurrence was required. Rework was tracked as a performance indicator by the maintenance superintendent.

3.4 Licensee Assessment of Maintenance (Quality Verification)

The inspector reviewed surveillance reports, corrective action documents and one audit report to evaluate the licensee's quality verification process. The documents were reviewed for root cause analysis, timely corrective action, technical assessments, and justification for close out of corrective action documents.

3.4.1 Review of Audits and Surveillances

Maintenance audits and surveillances were performance oriented with an appropriate balance between observation of work and verification that quality program requirements were implemented. During 1990, 1 audit and 67 surveillances were performed on maintenance activities. So far in I991, five surveillances had been performed. Both performance and quality program related findings were identified by the audit and surveillances. Corrective actions were generally adequate and responses were timely. QA did not always accept the initial corrective actions and required additional response for some items.

4.0 Conclusions

Based on activities described in this report, the inspectors concluded that:

- Maintenance and surveillance activities reviewed, in most cases, were adequate and were accomplished by skilled maintenance personnel.
- CMAR and PMAR backlogs were within the capabilities of the maintenance staff; however, MAR backlog numbers had been steadily increasing over the past year.
- Hiring and utilization of experienced maintenance personnel was limited by labor agreements.
- At least one of the backlog items, the control building chiller evaporator, appeared to have an adverse affect on the safe operation of the plant.
- RCM study had been completed for two systems and a PM enhancement program was in effect. The licensee was not sure that RCM studies would be performed on additional systems.

- o A predictive maintenance program was being developed and portions had been implemented.

- o Overall plant housekeeping and material condition were good.

- o Maintenance audits and surveillances were performance-oriented with an appropriate balance between observation of work and verification that quality program requirements were implemented.

5.0 Exit Meeting

The inspectors met with licensee representatives (denoted in Paragraph 1) at the Duane Arnold Energy Center on June 27, 1991, to summarize the purpose, scope, and findings of the inspection. The inspectors discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspectors during the inspection. The licensee did not identify any such documents or processes as proprietary.