U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-331/84-10(DRSS)

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

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

Facility Name: Duane Arnold Energy Center

Inspection At: Palo, Iowa

Inspection Conducted: July 31-August 2, 1984

Inspectors: William B. Gloersen
W. B. Gloersen
(Team Leader) 8/20/84
Date

G. M. Christoffer
G. M. Christoffer 8/20/84
Date

Linda L. Kers
L. L. Kers 8/20/84
Date

Approved By: M. P. Phillips, Chief
Emergency Preparedness Section 8/20/84

Inspection Summary

Inspection on July 31-August 2, 1984 (Report No. 50-331/84-10[DRSS])
Areas Inspected: Routine announced inspection of the Duane Arnold Energy Center emergency preparedness exercise involving observations by seven NRC representatives of key functions and locations during the exercise, and licensee action on a previously identified item related to emergency preparedness. The inspection involved 125 inspector-hours onsite by three NRC inspectors and four consultants.
Results: No items of noncompliance or deviations were identified.

## DETAILS

1. Persons Contacted

NRC Observers and Areas Observed

W. Gloersen, Control Room, Technical Support Center (TSC), and Emergency Operations Facility (EOF)
L. Kers, EOF
G. Christoffer, EOF
M. Good, Control Room
G. Bryan, TSC
C. Corbit, Operational Support Center (OSC)
G. Hoenes, Offsite Monitoring Teams

Iowa Electric and Areas Observed

R. McGauhy, Corporate Management Representative, EOF
P. Ward, Emergency Response and Recovery Director, EOF
D. Mineck, Emergency Coordinator, TSC
D. Wilson, Radiological and EOF Manager, EOF
D. Hingten, Emergency Planning Coordinator
C. Cox, Radiological Assessment Coordinator, EOF
T. Kevern, Lead Controller, Control Roomm and TSC
D. Barton, Control Room Controller
W. Walker, TSC Controller
S. Reilly, TSC Controller
M. Hunemuller, TSC Controller
S. Danielson, OSC Controller
T. Hestor, Controller, OSC and Offsite Teams
B. Holden, Controller, OSC and Offsite Teams
C. Crowe, EOF Controller
H. Fontecilla, EOF Controller
W. Nodean, EOF Controller

All of the above were present at the exit meeting held on August 2, 1984.

2. Licensee Action on Previously Identified Items Related to Emergency Preparedness

(Closed) Open Item No. 331/83-18-04: EPIP 1.2, Attachment 1, "Initial Notification Message," should be used by the TSC and EOF to make notifications to offsite agencies for all initial messages involving a change in emergency classifications. The licensee used this message form during the exercise in both the TSC and EOF to make offsite notifications for the Site Area and General Emergency. This item is considered closed.

3. General

An exercise of the licensee's "Duane Arnold Energy Center" and "Iowa Electric Light and Power Corporate" Emergency Plans was conducted at the Duane Arnold Energy Center on August 1, 1984, testing the integrated response of the licensee, State, and local organizations to a simulated emergency. The exercise tested the licensee's response to a significant release of radioactive noble gases with some iodine. Attachment 1 describes the scenario. The exercise was integrated with a test of the State of Iowa, Linn County, and Benton County Emergency Plans. This exercise had full-scale participation from both Linn and Benton Counties and partial participation by the State of Iowa.

4. General Observations

a. Procedures

This exercise was conducted in accordance with 10 CFR Part 50, Appendix E requirements using the licensee's Emergency Plans and the Emergency Plan Implementing Procedures used by the site (EPIPs) and Corporate (CPIPs) personnel.

b. Coordination

The licensee's response was coordinated, orderly, and timely. If the event had been real, the actions taken by the licensee would have been sufficient to permit the State and local authorities to take appropriate actions for the protection of the public's health and safety.

c. Observers

Licensee observers monitored and critiqued this exercise along with seven NRC observers and approximately 14 Federal Emergency Management Agency (FEMA) observers. FEMA will report on the responses of the State and local governments.

c. Critique

The licensee held a critique the morning after the exercise on August 2, 1984. The NRC critique immediately followed the licensee's critique. A public critique was held on August 2, 1984, to present the preliminary onsite and offsite findings of the NRC and FEMA exercise observers, respectively. The NRC and licensee identified weaknesses in their respective critiques as detailed in this report.

5. Specific Observations

a. Control Room

In general, Shift Supervisor actions were coordinated, prompt, and could have resulted in mitigating any damage to the plant. The Control Room operators promptly referred to the correct procedures and used them effectively. The Shift Supervisor immediately isolated the

residual heat removal (RHR) heat exchanger and recognized that conditions existed for a potential release (see attached scenario). Offsite notifications for the Notification of Unusual Event and the Alert were accomplished in a timely manner. Logkeeping was good as was communications and information flow to the Technical Support Center (TSC). The Shift Supervisor did an excellent job in letting the Secondary Shift Supervisor handle notifications, communications, and keeping himself focused on control of the plant.

Regarding the scenario, there were some minor data problems; however, this year's scenario was much improved over last year's. At the beginning of the exercise, there was some confusion regarding the radiological release to the discharge canal. The shift had contained the release in the cooling tower basin; however, the scenario had the release occur via the discharge canal. In addition, the Shift Supervisor initially incorrectly classified the event as an Alert because he read the wrong maximum permissible concentration (MPC) ratio on the scenario data sheet; however the classification was downgraded to a Notification of Unusual Event (NUE) prior to official declaration upon concerned looks by the controllers. The NRC was notified 53 minutes after the NUE was declared, but by this time the event had been upgraded to an Alert. Although the NUE notification was made within one hour, the notification should have been more timely and made immediately after notification of the appropriate State and local agencies as required by 10 CFR 50.72(a)(3). The inspectors noted that Attachment 1 to EPIP 1.2 did not have a place on the checklist for the communicator to call the NRC within one hour.

Plant Public Address announcements were not made for the NUE or Alert classifications. Also, the Shift Supervisor could not determine which key to give to maintenance personnel to replace a valve operator. The key log had numerous crossouts, additions, and deletions and should be updated. The inspectors noted that the approved access list in the Control Room had no approval signature and contained some crossouts. The shift recognized the contaminated, radioactive water problem in the cooling tower basin several times, but this problem was not addressed. Lastly, habitability sampling was not performed in the Control Room from 0839 to the end of the exercise. The Shift Supervisor recognized this problem and ordered a habitability survey at 1053, but it was never performed.

b. Technical Support Center (TSC)

The physical arrangement of personnel, communications equipment, status boards, and various displays prompted the efficient functioning of TSC personnel. Excellent briefings were conducted regularly by the Emergency Coordinator and other key TSC Supervisory personnel to keep all TSC personnel advised of changes in plant conditions. Tracking of both maintenance work in progress and deferred maintenance work was good. Plant area and power bloc survey maps, offsite maps, status boards, and various data displays were utilized effectively. TSC personnel checked their personnel dosimeters frequently. Security was adequate and maintained at the entrance to the TSC throughout the

entire exercise. TSC personnel performed well when assessing plant conditions and recommending mitigative actions.

Although the TSC was activated immediately following the declaration of an Alert (0510), licensee personnel did not declare the facility to be fully operational until 0642, after all administrative and auxilliary personnel were present. The licensee needs to determine what minimum staffing levels would provide sufficient technical, engineering, and senior management support so that the TSC could become fully operational within approximately one hour after activation as specified in NUREG-0737, Supplement 1.

The table of EALs used by the Emergency Coordinator, which was inserted under the glass at his desk in the TSC, was from EPIP 1.1, Revision 3, which is now obsolete. The current version of this EPIP is Revision 4, 12/12/83. It appeared that the Eberline AMS 2 air monitor was not operating properly. The instrument was operating with the flow ball centered at 13 liters/min (l/min). Instructions on the monitor required the flow ball to be centered at 30 l/min; however, a handwritten note on these instructions stated that the maximum obtainable flow was 20 l/min. This monitor and its associated instructions should be examined and revised accordingly.

After the Site Area Emergency (SAE) was declared, the TSC communicator informally contacted the NRC Operations Center and incorrectly told the NRC that the SAE declaration was based on a liquid release. Although this inaccurate report was later corrected, this problem may have been avoided if EPIP 1.2, Attachment 1, "Initial Notification Message" was used to ensure accurate delivery of information to the NRC; it is recommended that a space be added to Attachment 1 to log message delivery to the NRC. In addition, EPIP 1.2, Attachment 1, block #4, should have enough space to log what protective action recommendation was made.

The inspectors also noted an inconsistency in EPIP 1.1, Section 4.5. This section implies that the Emergency Coordinator is responsible for upgrading and downgrading event classification, but should consult the Emergency Response and Recovery Director (ER & RD), assuming the EOF has been activated, prior to upgrading an event to a General Emergency. This is not consistent with CPIP 1.3, 4.4.6(f) which gives the ER & RD responsibility to upgrade and downgrade event classification. The licensee must indicate who will have the authority and responsibility to immediately and unilaterally initiate emergency actions, including upgrading and downgrading of event classifications. If the ER & RD has this responsibility, then a note should be added that states this responsibility will be assumed by the ER & RD if the EOF has been activated. This is an Open Item (331/84-10-01).

On two occasions, the inspectors observed HP technicians in full Anti-C clothing, including rubber boots, enter the TSC for habitability monitoring. Although the technicians were considered "clean," it is not advisable to encourage the practice of having fully suited technicians surveying the relatively clean TSC.

c. Emergency Operations Facility (EOF)

The EOF, which is located on the 14th floor of the IE Towers in Cedar Rapids and is normally utilized as office space, was reconfigured, staffed, and activated in a timely manner. The reconfiguration included the rearrangement of desks, installation and functional checks of communicating equipment, placement of status boards, and the placement of an overhead projection system to display plant status telefaxes from the TSC. The EOF staff appeared to be well drilled in the mechanics of setting up the EOF. The physical configuration of the EOF was well organized and precluded non-utility representatives from interfering with key activities. The communications flow and distribution of messages was good. The presence of representatives from the State of Iowa and Linn and Benton Counties made the transmission of status changes and protective action recommendations very timely. The Emergency Response and Recovery Director briefed the State and local representatives as soon as they arrived in the EOF, even though they arrived prior to the actual activation of the EOF.

Status boards and logs were maintained consistently. Changes (if any) in plant conditions, radiological conditions, and protective action recommendations were announced regularly to the EOF at large. The exchange of offsite survey team information between Iowa Electric and the State was good. This was due to the four-way telephone conversation set up in the dose assessment room.

The dose assessment area was well organized. Individuals assigned to this area included: Radiological Assessment Coordinator, Radiological Assessment Advisors, Field Team Director, Radiological Assessment Communicator, Radiological Status Plotter, and Radiological Status Posters. The addition of the Radiological Assessment Communicator significantly reduced possible disagreement in dose projection calculations and enabled the timely sharing of actual offsite measurements between the State and licensee. The dose assessment team was able to use current meteorological data, reactor systems data, and field team data to define the plume boundaries and its direction, as well as prepare dose projections for downwind populations. Individuals assigned to make dose assessments appeared to be competent and efficiently used the computer developed for dose assessment computations. A graph was developed to trend plume center-line dose rates as a function of time for two and five miles downwind and was compared with actual field measurements at two and five miles. This same graph was also used to trend the release rate (Ci/sec) as a function of time. This information was used to estimate a worse case integrated dose at release termination. The Radiological Manager, Recovery Manager, and Radiological Assessment Coordinator functioned well as a team. Evacuation time estimates were reviewed prior to issuing any protective action recommendations. The Radiological Assessment Coordinator kept his staff informed of reactor status at all times. Briefings by the primary directors to their alternates during staff changes was good. Access control at the EOF was adequate.

The inspectors noted that the field team radio operator was not making the announcement "this is a drill" over the radio until he was reminded to do so by the controller at approximately 0800. The clocks in the EOF displayed different times and could not be seen by the TSC/EOF Communicator. As a recommendation, it may be found useful to indicate on a status board what protective action was implemented by the State in addition to the protective action recommendation made by Iowa Electric.

In addition, the EOF needs to make better use of the field teams and direct them to take specific, useful samples. For example, the inspectors noted the following:

- o Only one air sample was taken by a field team.
- o The EOF never requested the field teams to collect air samples or TLDs from the routine environmental monitoring stations.
- o At one point, the EOF requested Field Team B to transport a water sample to the ORAL which precluded this team from performing monitoring activities from approximately 1010 to 1115.
- o The EOF prematurely requested the collection of a milk sample approximately one hour following the passage of the plume.
- o At the end of the exercise, the EOF requested the field teams to transport the environmental samples to the ORAL which would have taken potentially contaminated vehicles into an uncontaminated area.

d. Operational Support Center (OSC)

The OSC is the assembly area for the maintenance and health physics emergency teams and is also the primary onsite assembly area. The security staff initiated and verified the accountability process of all shift personnel within 15 minutes after the sounding of the plant assembly/evacuation siren. Health physics and maintenance teams made use of a tag board task assignment system which worked well. Teams were briefed on plant conditions and on actions to be taken prior to their departure to perform their assignment. The OSC Supervisor showed good leadership skills and controlled both the number of individuals and the noise level in his office. The OSC Supervisor demonstrated the ability to manage repair team actions and communications with OSC teams. This individual also demonstrated good attention to ALARA and contamination control practices. A positive, aggressive attitude was exhibited by OSC supervision and team members in pursuit of the various problems the scenario presented.

In a few cases, there was some confusion about who was authorized to enter the plant access point. Also, the inspectors observed one technician occasionally allowing the pancake GM probe at the plant access area to come into contact with potentially contaminated clothing. In addition, the method employed to load the stack filter cask and cart

into the pickup truck should be improved to facilitate loading. Facility diagrams used in the OSC should be larger and more comprehensive, and consideration should be given to placing them near the point where most staff members congregate. Finally, the inspectors noted an interference problem with radio communications between the pump house and OSC. Although the interference may have been due to the heavy usage of the single radio channel, this problem should be addressed.

e. Offsite Monitoring Teams

The offsite monitoring teams assembled in the OSC and were dispatched approximately 15 minutes after the Site Area Emergency had been declared. Health physics technicians for both monitoring teams A and B made a detailed inventory of survey equipment prior to leaving the site. Communications between the field teams and the EOF worked well. The survey results were confirmed and repeated when necessary. Field team members checked their personal dosimeters periodically and were concerned about controlling their dose. Field Team A showed good judgement when they found the County Sheriff had set up a road block in the center of the plume and made a recommendation to the EOF to relocate the sheriff. The field teams generally followed procedures very well and referred to the procedures when in doubt. Both field teams demonstrated their ability to locate and track the plume.

Deployment of the offsite monitoring teams was slow. The teams did not perform any surveys until the control was transferred from the TSC to EOF. Open window/closed window measurements with the survey instrument were not performed initially by Team A. It appeared that these measurements came as an afterthought when the EOF asked for this information. On several occasions, these open window/closed window measurements were performed inside the vehicle with the windows rolled up and the air conditioner on. Additional training needs to be provided to team members so that they can properly determine if they are within the plume. This is an Open Item (331/84-10-02).

At various times during the exercise, both teams experienced some difficulty in locating the following places: (1) Team B became lost in trying to locate the Offsite Radiological and Analytical Laboratory (ORAL) in Cedar Rapids; and (2) Team A became confused regarding sample location "K5" and the location of an air sampler labeled on the map with a "5".

6. Exit Interview

The inspectors held an exit interview with licensee representatives denoted in Section 1 on the morning of August 2, 1984 to discuss the scope and findings of the inspection. During this meeting, the licensee first presented its conclusions based on its self-critique. The licensee agreed to examine the inspectors' concerns addressed in this report.

Attachment:
Exercise Scenario
Narrative Summary

# EXERCISE SCENARIO
# NARRATIVE SUMMARY

This exercise scenario initiates with a radiological liquid release which requires initial classification as an Unusual Event and subsequent escalation to an Alert. A steam line break outside containment causes a loss of containment integrity and results in a Site Area Emergency. A subsequent loss of safety systems cause a loss of reactor vessel water level and a damaged core and results in a General Emergency. A significant radiological release exists from the ruptured steam line through the standby gas treatment system (SGTS) to the environment.

Initial conditions establish that the reactor is operating at 98% power and full core flow. The core is 3/4 through end of cycle. The unit has experienced several inadvertent reactor scrams from high power during the last two weeks due to a ground fault in the electrical system. This has caused the torus water temperature and activity levels to increase above normal from relief valve operation. The RHR system is currently operating in torus cooling mode using RHR heat exchanger 1E201B, which has a pre-existing, identified tube leak. Heat exchanger 1E201A is temporarily out of service for valve maintenance and is expected to be returned to service within several hours. The condensate storage tanks (CSTs) are below normal level at 6.5 feet each (approximately 100,000 gallons total). Reactor coolant sample analyses indicate fuel leakage but sample results are within technical specifications.

An RHR to RHRSW system leak through RHR Heat Exchanger 1E201B occurs due to a loss of RHR to RHRSW pressure differential and the existing tube leak. The RHR to RHRSW system leak causes contamination in the RHRSW to the extent that an Unusual Event will be declared. Subsequently, the situation is escalated to an Alert after a sample analysis is completed of the RHRSW.

An electrical fault in a transformer causes a reactor scram and an erroneous main condenser level signal results in a trip of the condensate feed pumps. The reactor vessel water level decreases rapidly and causes activation of the plant's safety systems, including HPCI and RCIC. Shortly afterward there is indication of a steam leak in the steam tunnel area and the RCIC turbine trips. However, the inboard RCIC steam line isolation valve fails to close. A Site Area Emergency is declared due to an unisolable steam break outside of containment. HPCI maintains reactor vessel water level. Reactor pressure decreases. The Automatic Depressurization System is determined to be inoperable due to logic failure.

When HPCI suction is switched to the torus due to the CST low level, the torus isolation valve fails to open and HPCI trips on low suction pressure. The reactor water level rapidly decreases. A General Emergency is declared due to loss of two fission product barriers with potential for loss of the third. Reactor water level continues to decrease and reactor pressure is above LPCI/core spray initiation pressure. The reactor core is uncovered and extensive cladding damage results. A significant radiological release exists from the steam line rupture via the SGTS to the environment.

Reactor pressure eventually decreases low enough for LPCI and core spray to begin injecting water into the reactor vessel. Further core degradation is prevented as reactor vessel water level is regained. The radiological release continues, but the release rate decreases rapidly as reactor pressure is reduced and flow from the ruptured steam line decreases.

The release is terminated. Plant and offsite conditions are such that the emergency is deescalated. Reentry and recovery operations are commenced.

## EXERCISE SCENARIO

### SEQUENCE OF EVENTS

| Approximate Time | Scenario Time | Key Events |
|---|---|---|
| 0430 | 00/00 | Initial conditions are established. |
| 0435 | 00/05 | Initial indication is received in the Control Room of RHR Heat exchanger 1E-201B dp controller malfunction. |
| 0440 | 00/10 | Indications in the Control Room are that MO-1947 has failed to close and that the RHRSW has been contaminated.<br><br>An Unusual Event should be declared at this time due to a liquid release greater than 10CFR20 limits per EAL A-3 (EPIP 1.1). |
| 0445 | 00/15 | The dp controller on RHR Heat Exchanger 1E-201B is found to be cycling, resulting in loss of RHR to RHRSW differential pressure. The problem is in the control system and will require an instrument technician to fix.<br><br>Attempts to close MO-1998B from the Control Room are not successful. An operator team is sent to manually close MO-1947 to prevent further contamination. |
| 0500 | 00/30 | The dp controller cannot be fixed at this time. The position modulator needs to be replaced. |
| Approx 0520 | Approx 00/50 | Results of samples taken from RHRSW indicate contamination of this system and a significant liquid release to the discharge canal.<br><br>An Alert should be declared at this time due to a liquid release more than 10 times greater than 10CFR20 limits EAL B-4 (EPIP 1.1). |
| 0615 | 01/45 | A secondary winding ground fault in a transformer causes electrical isolation. This initiates:<br><br>o Main condenser circulating water pumps are de-energized<br>o Rapid loss of condenser vacuum<br>o Reactor scram<br>o Turbine trip<br>o MSIVs close<br>o Relief valves open<br>o Recirculation pumps trip |

## EXERCISE SCENARIO

### SEQUENCE OF EVENTS

| Approximate Time | Scenario Time | Key Events |
|---|---|---|
| 0620 | 01/50 | Reactor vessel low-level signal activates HPCI and RCIC. Indications in the Control Room show that there is a steam leak in the main steam tunnel. |
| 0625 | 01/55 | The RCIC turbine trips. |
| 0628 | 01/58 | A malfunctioning condenser hotwell low-level signal causes the condensate pumps to trip which subsequently causes the reactor feedwater pumps to trip. When reactor pressure blowdown is attempted with ADS, a failure in the ADS logic circuit prevents depressurization. |
| 0630 | 02/00 | MS tunnel temperature and ARMs continue to increase. HPCI maintains reactor water level. Reactor pressure decreases due to the steam leak. SGTS is running with a low-level release in progress. |
| 0635 | 02/05 | A Site Emergency should be declared due to steam break outside drywell per EAL C-2 (EPIP 1.1) |
| 0710 | 02/40 | The CST level continues to decrease. Reactor level is steady. The steam leak cannot be isolated. Reactor pressure is decreasing slowly. |
| 0810 | 03/40 | Attempt to transfer HPCI suction from CST to suppression pool on CST low-low-level alarm fails because of failure of MO-2321 to open. FS 2310 trips the HPCI pump due to low suction pressure. Reactor level drops rapidly.<br><br>A General Emergency should be declared due to loss of 2 out of 3 fission product barriers with potential loss of third per EAL (EPIP1.1). |
| 0820 | 03/50 | The reactor core is uncovered causing major fuel cladding damage. Reactor pressure is still above Core Spray and LPCI initiation pressure.<br><br>SGTS instrumentation shows rapid increase in release rate as steam leak continues. Containment accident range monitors indicate high radiation.<br><br>Maintenance teams have been dispatched in order to determine the cause of the HPCI pump trip and to attempt HPCI restart locally. |

EXERCISE SCENARIO

SEQUENCE OF EVENTS

| Approximate Time | Scenario Time | Key Events |
|---|---|---|
| 0935 | 05/05 | Reactor pressure decreases to Core Spray/LPCI activation pressure and Core Spray/LPCI begins to reflood the reactor core.. Reactor pressure continues to slowly decrease. |
| 0950 | 05/20 | SGTS monitor indicates that release is decreasing. |
| 1000 | 05/30 | Reactor water level has been reestablished. |
| 1030 | 06/00 | Reactor vessel is depressurized. SGTS monitors indicate greatly reduced release rates. |
| 1130 | 07/00 | Offsite radiation levels are at background values. Plant conditions are stable. Reentry discussions commence. |
| 1145 | 07/15 | General Emergency is de-escalated. Recovery is initiated. |
| 1230 | 08/00 | Exercise is terminated. |