ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.:	50-285
License No.:	DPR-40
Report No.:	50-285/96-13
Licensee:	Omaha Public Power District
Facility:	Fort Calhoun Station
Location:	Fort Calhoun Station FC-2-4 Adm. P.O. Box 399, Hwy. 75 - North of Fort Calhoun Fort Calhoun, Nebraska
Dates:	October 21-25, 1996
Inspectors:	Thomas H. Andrews, Jr., Radiation Specialist Gilberto L. Guerra, Jr., Radiation Specialist
Approved By:	Blaine Murray, Chief, Plant Support Branch

ATTACHMENTS:

Attachment 1: Core Location of Fuel Assemblies Containing Leaking Fuel Rods

Attachment 2: Supplemental Information

EXECUTIVE SUMMARY

Fort Calhoun Station
NRC Inspection Report 50-285/96-13

This routine, announced inspection focused upon the licensee's radiation protection program and its conduct during the Fall 1996 refueling outage. The inspection occurred during the middle of the outage, providing a good opportunity to observe ongoing activities associated with the outage.

Plant Support

- Workers wore proper personnel dosimetry. However, a concern was identified where some workers were not reading the electronic dosimeter on a regular basis while in the radiological control area. The highest individual exposure was less than 1.25 rem/year (Section R1.1).

- The licensee had established a good program for selection and use of respiratory protection. Air sampling was performed in appropriate locations to allow collection of representative samples and to alert workers to changing conditions (Section R1.2).

- Licensee control of radioactive materials and contamination, radiation surveys and monitoring were good. A few instances of poor radiological survey practices by workers were noted (Section R1.3).

- The licensee's ALARA program was appropriately implemented. Training provided to workers prior to the outage, to sensitize them to potential radiological problems associated with leaking fuel, was very good. Examples were noted where work conditions resulted in the emergent work scope being significantly increased resulting in additional, unplanned personnel exposures. Even with a substantial increase in personnel exposures, the licensee's three year average for personnel exposure should remain well below the industry average for pressurized water reactors (Section R1.4).

- The licensee trained and maintained an adequate staff of qualified contract radiation protection personnel (Section R5.1).

- Respirator training had been provided as a contingency due to leaking fuel concerns. Excellent mock-up training facilities were available (Section R5.2).

- Comprehensive and thorough assessments of the radiation protection activities were performed. The licensee performed well in identifying and implementing enhancements to the radiation protection program (Section R7.1).

- The licensee took appropriate actions to minimize the effects of leaking fuel upon workers. Two minor incidents, involving unplanned releases of radioactive gases to containment, resulted in very small exposures to workers in the immediate area. Fuel inspection results indicate that leaking fuel rods are likely to continue to occur and will continue to be a problem during the next two cycles of operation (Section R8.1).

Report Details

Summary of Plant Status

The reactor was shut down on October 5 to begin a planned 44 day refueling outage. The inspectors were onsite during day 19 - 23 of the outage. The reactor was defueled with all fuel residing in the spent fuel pool. There were no operational events that affected the results of this inspection.

III. Engineering

E2 Engineering Support of Facilities and Equipment

A recent discovery of a licensee operating their facility in a manner contrary to the Updated Final Safety Analysis Report (UFSAR) description highlighted the need for a special focused review that compares plant practices, procedures, and/or parameters to the UFSAR description. While performing the inspection discussed in this report, the inspector reviewed the applicable portions of the UFSAR that related to the areas inspected. The inspectors verified that the UFSAR wording was consistent with the observed plant practices, procedures, and/or parameters.

IV. Plant Support

R1 Radiological Protection and Chemistry Controls

R1.1 External Exposure Controls (83750)

a. Inspection Scope

The inspectors reviewed the licensee's external exposure controls and personnel dosimetry programs.

b. Observations and Findings

Workers entering the radiological control area were required to wear electronic and thermoluminescent dosimeters. The inspectors observed workers' practices in the radiological control area to ensure proper placement of these devices. No problems were noted with the proper placement of both dosimeters on the torso and in the immediate proximity to each other.

The inspectors observed workers removing protective clothing at the exit from containment. Some workers were observed to have their electronic dosimeter in plastic whirl packs and others did not. According to the licensee, the preferred method was to use the whirl packs, but there was not a high instance of contaminated dosimetry, so the practice of not using the whirl packs was considered to be acceptable.

Some workers were observed to have their electronic dosimeters inside the protective clothing. This prompted the inspectors to question workers regarding the dosimeter reading upon exiting from a contaminated area. There were several instances where workers did not know their accumulated dose for this entry into the radiological control area. It was obvious that they were not reading the dosimeter on a regular basis.

The inspectors discussed this observation with the licensee since some of the workers had been working in high radiation areas. The concern was that the workers were depending upon being able to hear the electronic dosimeter alarm if a dose or dose rate set point was exceeded. Because of high noise levels in some of these high radiation areas, there was a potential for the dosimeter to go into alarm and the individual not hear it. The inspectors referred to NUREG/CR 5569, Health Physics Position Number 328, "Proper Operation and Use of Alarm Dosimeters at Nuclear Power Plants." This position stated that an acceptable alternative to a device to attract the workers' attention to the dosimeter, or to augment the volume of the alarm, was to instruct workers to read the dosimeter on a regular basis. According to the licensee, the workers were trained to read the dosimeter on a regular basis, typically every 15 minutes. The licensee stated that they would follow up on this to ensure workers were cognizant of the need to read the dosimeters on a regular basis while in the radiological control area.

As of October 24, 1996, because of higher than usual individual exposures, there had been the need to grant administrative dose extensions to 25 workers. These extensions were well below regulatory limits. The maximum exposure received by any of these individuals was less than 1.25 rem for the year.

c. Conclusion

Workers were wearing dosimetry properly. However, a concern was identified where some workers were not reading the electronic dosimeter on a regular basis while in the radiological control area. While administrative dose extensions had been granted, the highest individual exposure was less than 1.25 rem for the year.

R1.2 Internal Exposure Controls (83750)

a. Inspection Scope

The inspectors reviewed the licensee's internal exposure controls, use of respirators, and air sampling program.

b. Observations and Findings

The licensee issued 10 respirators associated with steam generator nozzle dam installation, 5 associated with grinding on the steam generator orifice plates, and 33 associated with asbestos work. For other work, the inspectors reviewed licensee

assessments regarding the benefits of not using respirators and determined that they were acceptable. Doses resulting from the intakes of material were small compared to the external doses received from work in the area.

As part of their preparation for the outage, the licensee purchased charcoal canisters for use in iodine environments. However, iodine levels were not high enough to warrant their use. The licensee recognized that the devices were not NIOSH approved to take credit for the protection for the respirators, but recognized that the respirators would reduce the internal deposition.

During tours of the radiological control area, including containment, the inspectors observed the use and placement of air samplers and continuous air monitors. The air samplers were placed close to the work location to allow collection of representative samples. The continuous air monitors were close enough to the work areas to provide alarm functions should conditions change unexpectedly. When questioned regarding the response to an alarm from a continuous air monitor, workers indicated that they would leave the area and notify radiation protection personnel. The inspectors considered this to be the appropriate response.

c. Conclusion

The licensee had established a good program for selection and use of respiratory protection. Air sampling was performed in appropriate locations to allow collection of representative samples and to alert workers to changing conditions.

R1.3 Control of Radioactive Materials and Contamination, Surveys and Monitoring (83750)

a. Inspection Scope

The inspectors toured the licensee's facility on numerous occasions during the inspection period, focusing attention on activities within the radiological control area. The inspectors conducted discussions with workers to evaluate the licensee's radiological survey and monitoring programs.

b. Observations and Findings

The inspectors reviewed radiation survey maps and compared them with postings identified in the areas covered by the maps. During a previous inspection, it was noted that the survey maps were not being updated when radiological postings were changed. The inspectors observed that the maps accurately reflected the current postings in the areas reviewed. These changes were reflected on maps located at the entrance to areas and on the maps at the entrance to the radiological control area.

The inspectors confirmed that access to high radiation areas that have radiation levels greater than 1000 millirem per hour were controlled in accordance with technical specifications. Areas were maintained behind locked doors, or flashing red lights, and appropriate postings were observed.

During tours of the radiological control area, the inspectors verified that survey and monitoring instruments were calibrated and that performance checks were performed and documented. The inspectors observed that friskers in the radiological control area had a sticker stating that the instrument was not to be used for free release of materials. Friskers at the access point used to free release materials did not have this sticker.

A frisker with a sticker indicating that it was not to be used for free release of materials was located next to a radiological control area exit point in the radwaste building. The inspectors did not observe anyone using this instrument to remove items from the radiological control area, but expressed a concern that its placement there could tempt someone to do so. The licensee stated that they would investigate this situation to see if additional controls were needed.

On occasion, while observing workers frisking upon exit from contaminated areas, the inspectors noted that some workers were performing a whole body frisk, while others were only performing a hand and foot frisk. According to the licensee, only a hand and foot frisk is required. The inspectors observed some workers not frisking their hands prior to picking up the probe or placing the probe face down on the table when they had finished. This was identified to the licensee for their followup.

c. Conclusion

Licensee control of radioactive materials and contamination, surveys and monitoring were good. A few instances of poor survey practices by workers were noted.

R1.4 Maintaining Occupational Exposure ALARA (83750-02.10)

a. Inspection Scope

The inspectors conducted interviews of ALARA personnel and reviewed the results of selected tasks to assess the licensee's ALARA program.

b. Observations and Findings

In preparation for the outage, the licensee provided additional training to personnel regarding potential radiation protection problems resulting from leaking fuel. This was done through either requiring additional formal training, as in respirator training, or through craft meetings, staff meetings, etc. Personnel questioned, were cognizant of potential problems, indicating that the training was beneficial.

The licensee set a goal of 119 person rems for the planned 44 day outage. At the time of the inspection, the accumulated exposure was approximately 79 person rems. Emergent work associated with the steam generator tube inspection was likely to result in this goal being exceeded. During the inspection period, the steam generator tube inspection scope was increased significantly due to the discovery of a partial tube degradation on one tube. The licensee management reminded personnel of the 119 person rems goal, but recognized that it would require very aggressive actions to actually meet this goal.

The licensee set a goal of 19 person rems for the time the plant was operating. This goal had been exceeded. At the time of the inspection, the cumulative online radiation exposure was approximately 24 person rems. The trend for the past three years compared to industry average pressurized water reactors is shown below.

	1993	1994	1995	1996
Fort Calhoun - Actual	156 person rem	23 person rem	119 person rem	138 person rem
Fort Calhoun - 3 year Average	156 person rem	145 person rem	106 person rem	100 person rem
PWR - Average	195 person rem	134 person rem	157 person rem	
PWR - 3 year Average	207 person rem	180 person rem	162 person rem	

Overall, planning for jobs during the outage was good. One notable difficulty was associated with the movement of the upper guide structure. After moving the upper guide structure out of the reactor vessel to the deep end of the pool, the fuel transfer machine that moves fuel assemblies between the fuel building and the reactor containment building was being tested.

During one of the times the machine was being moved through the tube from one building to the other, power to some electrical buses was lost for a period of time. Pressure started increasing inside of containment due to temperature increasing. The licensee was aware that the increase pressure would force the water in the refueling canal downward, transferring water to the spent fuel pool in the fuel building.

Because of a concern regarding the potential for overflowing the spent fuel pool, the licensee began trying to close the valve on the tube between containment and the fuel building. The licensee suspected that the transfer machine partially obstructed this valve since the valve could not easily be closed.

To prepare for repair work on the transfer machine, the refueling pool level had to be lowered. This required moving the upper guide structure back into the reactor vessel. After the transfer machine was repaired, the upper guide structure had to again be moved from the reactor vessel to the deep end of the refueling canal. The licensee acknowledged that this extra installation and removal of the upper guide structure resulted in additional exposure to workers.

According to ALARA personnel, there was not much feedback being provided by workers associated with various jobs. The inspectors noted that there were not any job debriefs during the inspection period where ALARA input was collected. According to the licensee, more feedback typically is provided near the beginning and end of the outage, and the inspection period occurred during a low incident period.

While touring the radiological control area, the inspectors discussed ongoing activities in the radiological control area with workers. These discussions indicated that there was a good working relationship between radiation protection technicians and craft personnel.

The inspectors reviewed selected job packages and observed that the licensee had incorporated comments and suggestions from previous outages. Personnel preparing the packages were familiar with the task and included recommendations for potential dose reductions as appropriate.

c. Conclusion

The licensee's ALARA program was appropriately implemented. Training provided to workers prior to the outage to sensitize them to potential radiological problems associated with leaking fuel was very good. Examples were noted where work conditions resulted in the work scope being significantly increased, resulting in additional, unplanned personnel exposures.

R5 Staff Training and Qualification

R5.1 Training and Qualifications of Contract Radiation Protection Personnel (83750)

a. Inspection Scope

The inspectors reviewed the applicable education, experience, qualifications and training of contract radiation protection technician that were onsite to supplement the licensee's permanent staff.

b. Observations and Findings

Through interviews with licensee training staff, the inspectors learned that about 400 outage personnel had been given general employee training, and other specific training, as required (Maintenance, Confined Space, Foreign Materials Exclusion, etc.). About 60 of these workers were radiation protection or decontamination personnel. To satisfy the licensee's qualification criteria, contract personnel had to have had passed the Northeast Utilities exam for radiation protection technicians within the last three years, or take it and pass it at the licensee's facility. Also, one week of site specific training was given encompassing lessons learned, Technical Specifications, standard orders and manuals, systems, communications, and self-checking.

Training for the contract radiation protection personnel was the same as the licensee's in-house technicians and was described in the Radiation Protection Training Program, Revision 45, August 21, 1996. Proper training records for contract personnel were maintained. The inspectors noted that the licensee had qualified contract radiation protection personnel as specified in American National Standards Institute 3.1 or 18.1 technicians, as applicable, based on their training and experience. Files of resumes and experience of contract radiation protection personnel were in order and had been reviewed and approved by the radiation protection manager.

c. Conclusion

The licensee trained and maintained an adequate staff of qualified outage contract radiation protection personnel to supplement the permanent staff.

R5.2 Training and Qualifications of Contract Radiation Workers (83750-02.04)

a. Inspection Scope

The inspectors reviewed the licensees training facilities and applicable training provided for the refueling outage.

b. Observations and Findings

The inspectors learned that the licensee had provided respirator training to about 300 personnel as a contingency due to leaking fuel concerns. However, the inspectors were told that very few respirators had been used, and of the ones used, most were for industrial hazards, and a fraction, about 25 percent, for radiological concerns.

As a planning aid to the outage work, mock-up training was provided. This served to facilitate dose and stay time estimates, and provide for adequate work preparation.

c. Conclusions

Respirator training had been provided as a contingency due to leaking fuel concerns. Excellent mock-up training facilities were available.

R7 Quality Assurance in Radiological Protection and Chemistry Activities

R7.1 Audits and Appraisals (83750-02.01)

a. Inspection Scope

The inspectors reviewed reports of an audit and four surveillance performed by the licensee's quality assurance group during 1996.

b. Observations and Findings

The scope of the audit conducted in March 1996 included a thorough review of several key areas of the radiation protection program, including ALARA, instrumentation, respiratory and internal dosimetry, and radiation protection operations.

Surveillance were performed for review of contamination control, two reviews on the use of the ALARA planning work sheet, and pre-job briefings. The inspectors noted that the licensee performed well in identifying items for improvement and implementing needed corrective actions to enhance the radiation protection program.

c. Conclusion

Comprehensive and thorough assessments of the radiation protection activities were performed. The licensee performed well in identifying and implementing enhancements to the radiation protection program.

R8 Miscellaneous Radiological Protection and Chemistry Issues

R8.1 Followup on Impact of Leaking Fuel (83750)

a. Inspection Scope

The inspector reviewed the licensee's activities associated with the preparations for outage work and the removal of assemblies containing leaking fuel rods from the reactor core.

b. Observations and Findings

Prior to the outage, the licensee performed an assessment on end-of-cycle operations to reduce the impact of leaking fuel on outage activities. As a result, the licensee performed a controlled power reduction from 100 percent power to 75 percent power and held for a week, then reduced to 45 percent power and held for a week. The licensee used ORIGEN2 analyses to estimate the results of this power reduction technique. The advantage to this power reduction process was that it provided extra time at the end of the outage to make preparations and allowed coolant iodine levels to decay to a lower level prior to the start of the outage.

Earlier in the cycle, the licensee identified a potential concern associated with cesium deposition in crud in the steam generators. Spending 4 days in an acid reducing phase allowed stripping of most of the cesium out of the crud in the steam generators.

Early in the outage, the licensee identified a greater frequency of hot particle and fuel particle contaminations. This was especially prevalent around the steam generators. The area was identified as a high contamination area and double sets of protective clothing were used by workers. The largest hot particle dose to any individual was 765 millirem shallow dose equivalent.

During venting of the control element drive mechanism housings, a release of radioactive gases to containment occurred. Following this event, the licensee was sensitive to potential releases to the containment. The steam generator tubes were identified by the licensee as an area suspected of being a good trapping place for these gases. The licensee opened one manway and did not experience any alarms. However, upon opening the second manway that established an air flow pathway through the tubes, a release to containment occurred. This release resulted in a containment purge isolation.

Workers experienced a small intake of radioactive material from airborne releases. Whole body count results for these workers indicated that they had inhaled some iodine. Dose assessments performed for these workers indicated a maximum individual internal exposure of approximately 6 millirem. Air sampling in the area was adequate and the licensee had decided not to use a respirator for this job.

The licensee removed all fuel assemblies from the reactor vessel and placed them in the spent fuel pool. Fuel assemblies were "sipped" to identify potential assemblies containing leaking fuel rods.

The table below shows the list of fuel assemblies that were identified as containing leaking fuel rods. Fuel assemblies that were scheduled for reuse were tested using ultrasonic equipment to identify specific leaking fuel rods. In these cases, the number of leaking rods are listed. The table also contains a comment reflecting the licensee's plan for each assembly as of the time of the inspection.

Assembly Number	Number of Leaking Rods	Comments
R001		Scheduled for discharge (Natural Uranium)
R002		Scheduled for discharge (Natural Uranium)
R003		Scheduled for discharge (Natural Uranium)
R004		Scheduled for discharge (Natural Uranium)
R009		Scheduled for discharge
R010		Scheduled for discharge
R012		Scheduled for discharge
R019		Scheduled for discharge
R025	2	Reconstituted
R027	1	Reconstituted
R033	2	Reconstituted
R044		Scheduled for discharge
S001	2	Reconstituted
S00?	3	Reconstituted
S005	1	Reconstituted
S008	1	Reconstituted
S009	2	Alternative fuel assembly not yet identified
S010	16	Alternative fuel assembly not yet identified
S012	2	Alternative fuel assembly not yet identified
S014	4	Alternative fuel assembly not yet identified
S017	6	Alternative fuel assembly not yet identified
S021	1	Alternative fuel assembly not yet identified
S022	8	Alternative fuel assembly not yet identified
S023		Scheduled for discharge
S026		Scheduled for discharge
S027		Replaced with alternative fuel assembly
S032		Replaced with alternative fuel assembly
T007	1	Reconstituted
T045	1	Reconstituted

The assemblies with numbers beginning with the letter "R" were inserted at the beginning of cycle 14, "S" were inserted at the beginning of cycle 15, and "T" were inserted at the beginning of cycle 16.

The inspectors observed a video tape showing two fuel rods removed from assembly S001. Clear indications of fretting from the spacer grids were observed on the fuel rod at all spacer grid locations on these two rods. According to the licensee, the fuel rods that failed in cycle 15 exhibited fretting marks similar to this at a couple of locations along the length of the rod. Therefore, it appeared that the fretting indications observed this cycle were much worse than those observed previously.

The cycle 16 core location of assemblies containing leaking fuel rods is depicted in the figure in Attachment 1. Based upon the locations of leaking fuel rods from the end of cycle 15, the licensee anticipated fuel failures on the periphery of the core. The location map shown in Attachment 1 shows that cycle 16 fuel assemblies on the periphery and inner regions of the core experienced leaking fuel.

All fuel assemblies that were to be reused during cycle 17 were sipped and did not contain leakers. Sipping only gives indication of existing failures, not an estimate of the potential for failure. The only way to do that would be to perform eddy current testing on each of the fuel rods. This would have been very time consuming and costly, therefore, not economically justifiable by the licensee.

c. Conclusion

The licensee took appropriate actions to minimize the affects of leaking fuel upon workers. Two minor incidents involving unplanned releases of radioactive gases to containment resulted in very small exposures to workers in the immediate area. Fuel inspection results indicate that leaking fuel rods are likely to continue to occur and will continue to be a problem during the next two cycles of operation.

V. Management Meetings

X1 Exit Meeting Summary

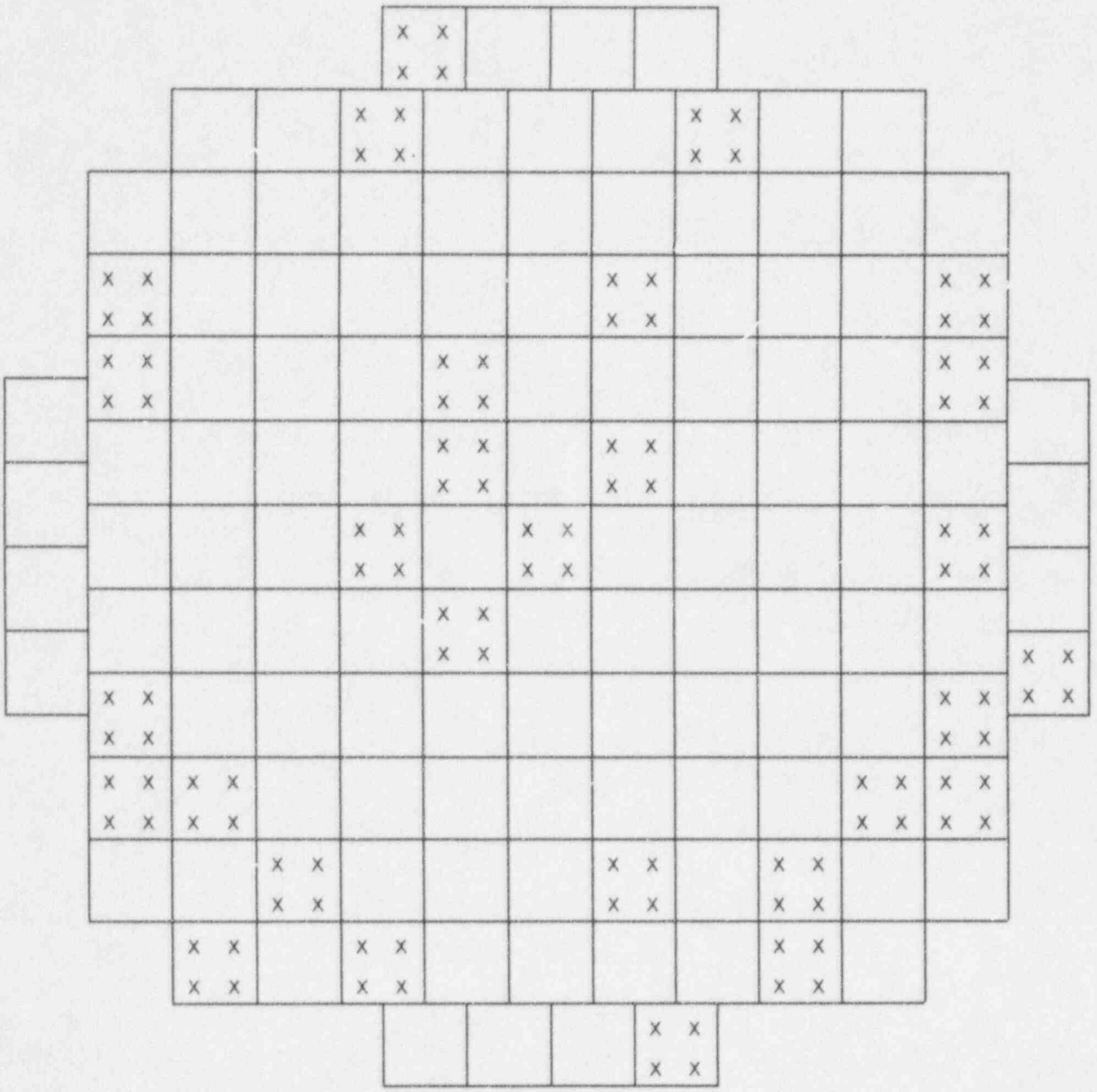
The inspectors presented the results of the inspection to members of licensee management at the conclusion of the inspection on October 25, 1996. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether materials examined during the inspections should be considered proprietary. No proprietary information was identified.

ATTACHMENT 1

Fort Calhoun

Fall 1996 Refueling Outage
Location of Assemblies Containing Leaking Fuel Rods



X X
X X

Indicates the relative core location of fuel assembly with leaking fuel rods.

ATTACHMENT 2

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

R. Andrews, Division Manager, Nuclear Services
G. Cook, Supervisor, Licensing
S. Gebers, Manager, Radiation Protection
R. Haug, Corporate Health Physicist

INSPECTION PROCEDURE USED

IP 83750 Occupational Radiation Exposure

Documents Reviewed

Radiation Protection Training Program Manual, Revision 45, August 21, 1996

Quality Assurance Surveillance Report H2-96-1, "Contamination Control," August 28, 1996.

Emergent QA Surveillance Report H-96-3, "Use of ALARA Planning Work sheet," June 19, 1996.

Emergent QA Surveillance Report H-96-2, "Use of ALARA Planning Work sheet," May 22, 1996.

Emergent QA Surveillance Report H-96-1, "Pre-job Briefings for Radiation Protection and Chemistry," May 21, 1996.

Quality Assurance Audit Report #58, "Radiation Protection and ALARA," April 19, 1996.

Quality Assurance Audit Report #58, "Radiation Protection and ALARA," May 3, 1995.

1996 Refueling Outage Documents

Operations Control Center Shift Schedule
Outage Meeting Schedule
Daily Report