



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION IV  
611 RYAN PLAZA DRIVE, SUITE 400  
ARLINGTON, TEXAS 76011-8064**

October 4, 2000

EA-00-208

Garry L. Randolph, Vice President and  
Chief Nuclear Officer  
Union Electric Company  
P.O. Box 620  
Fulton, Missouri 65251

**SUBJECT: CALLAWAY PLANT -- NRC INSPECTION REPORT NO. 50-483/00-17**

Dear Mr. Randolph:

On August 11, 2000, the NRC completed an inspection at your Callaway Plant. The purpose of the inspection was to review your ALARA planning and controls. The enclosed report presents the results of that inspection which were discussed with you and members of your staff at the end of the inspection and with Mr. Ron Affolter and others by telephone on September 5, 2000.

This inspection was an examination of activities as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspection consisted of a selected examination of procedures and representative records, observations of activities, and interviews with personnel.

This report discusses issues of low to moderate safety significance. The issues involved the failure to maintain radiation doses as low as reasonably achievable, which constitutes an apparent violation of 10 CFR 20.1101(b). As described in Section 2OS2 of this report, six jobs that accrued more than 5 person-rem each during Refueling Outage 10 exceeded their projected job doses by more than 50 percent because of a number of performance problems. This apparent violation was assessed using the Occupational Radiation Safety Significance Determination Process and was found to consist of three apparent findings, each preliminarily determined to be white. White issues have some increased importance to safety and may require additional NRC inspection. These issues have low to moderate safety significance because your 3-year rolling average, collective dose was greater than 135 person-rem for the period 1997 through 1999, which is indicative of a continuing problem with radiation dose control.

You provided your position on the preliminary inspection findings in a letter dated August 21, 2000, (ULNRC-4298) and while we believe that we have sufficient information to make our final significance determination for these preliminary inspection findings and the associated apparent violation, we are giving you the opportunity to provide us additional information on the apparent violation's significance, either in writing or at a regulatory conference. If you choose to provide

additional information in writing, you should do so within 30 days of the date of this letter. Please contact Ms. Gail Good at (817) 860-8215 as soon as possible, but within 7 days of the date of this letter, to notify us of your intent. If we have not heard from you within the time specified, excepting a granted extension, we will continue with our significance determination and enforcement decision and you will be advised by separate correspondence of the results of our deliberations on this matter.

Since the NRC has not made a final determination in this matter, no Notice of Violation is being issued for these inspection findings at this time. In addition, please be advised that the characterization of the apparent violation described in the enclosed inspection report may change as a result of further NRC review. If the NRC concludes that a violation occurred, the violation will be treated in accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions" (Enforcement Policy), NUREG-1600. The current Enforcement Policy can be found on the NRC's website at [www.nrc.gov/OE](http://www.nrc.gov/OE).

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/NRC/ADAMS/index.html> (the Public Electronic Reading Room).

Sincerely,

**/RA/**

Arthur T. Howell III, Director  
Division of Reactor Safety

Docket No.: 50-483  
License No.: NPF-30

Enclosure:  
NRC Inspection Report 50-483/2000-17

cc w/enclosure:  
Professional Nuclear Consulting, Inc.  
19041 Raines Drive  
Derwood, Maryland 20855

John O'Neill, Esq.  
Shaw, Pittman, Potts & Trowbridge  
2300 N. Street, N.W.  
Washington, D.C. 20037

Union Electric Company

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Mark A. Reidmeyer, Regional  
Regulatory Affairs Supervisor  
Quality Assurance  
Union Electric Company  
P.O. Box 620  
Fulton, Missouri 65251

Manager - Electric Department  
Missouri Public Service Commission  
301 W. High  
P.O. Box 360  
Jefferson City, Missouri 65102

Ronald A. Kucera, Director  
of Intergovernmental Cooperation  
P.O. Box 176  
Jefferson City, Missouri 65102

Otto L. Maynard, President and  
Chief Executive Officer  
Wolf Creek Nuclear Operating Corporation  
P.O. Box 411  
Burlington, Kansas 66839

Dan I. Bolef, President  
Kay Drey, Representative  
Board of Directors Coalition  
for the Environment  
6267 Delmar Boulevard  
University City, Missouri 63130

Lee Fritz, Presiding Commissioner  
Callaway County Court House  
10 East Fifth Street  
Fulton, Missouri 65151

Alan C. Passwater, Manager  
Licensing and Fuels  
AmerenUE  
One Ameren Plaza  
1901 Chouteau Avenue  
P.O. Box 66149  
St. Louis, Missouri 63166-6149

Union Electric Company

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J. V. Laux, Manager  
Quality Assurance  
Union Electric Company  
P.O. Box 620  
Fulton, Missouri 65251

Jerry Uhlmann, Director  
State Emergency Management Agency  
P.O. Box 116  
Jefferson City, Missouri 65101

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David Diec (**DTD**)  
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**ENCLOSURE**

U.S. NUCLEAR REGULATORY COMMISSION

REGION IV

Docket No(s): 50-483  
License No(s): NPF-30  
Licensee: Union Electric Company  
Facility: Callaway Plant  
Report No: 2000-17  
Location: Junction Highway CC and Highway O  
Fulton, Missouri  
Date(s): August 7-11, 2000  
Inspector: Larry Ricketson, P.E., Senior Health Physicist  
Approved by: Gail M. Good, Chief, Plant Support Branch  
Division of Reactor Safety

**ATTACHMENTS:**

Attachment 1: Supplemental Information  
Attachment 2: NRC's Revised Reactor Oversight Process

## **SUMMARY OF FINDINGS**

Callaway Plant  
NRC Inspection Report No. 50- 483/2000-17

IR 05000483-00-17; on 08/07-08/11/2000; Union Electric Co.; Callaway Plant. Occupational Radiation Safety Report; ALARA planning and controls.

This report documents an inspection of ALARA planning and controls conducted by a regional specialist. The significance of issues is indicated by its color (green, white, yellow, red) and was determined by the Significance Determination Process in Inspection Manual Chapter 0609.

### **Cornerstone: Occupational Radiation Safety**

- TBD. Because of poor planning and preparation, as well as other causes, six jobs that accrued more than 5 person-rem each during Refueling Outage 10 exceeded their projected job doses by more than 50 percent. The licensee scheduled outage activities to reduce the outage duration rather than to reduce dose, failed to properly train workers in dose reduction methods, and failed to ensure good communications between radiation protection personnel and other work groups. Because of these performance problems and the licensee's history of high collective radiation doses, the NRC identified the issue as an apparent violation of 10 CFR 20.1101(b), which requires that the licensee use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable.

Using the Occupational Radiation Safety Significance Determination Process, the NRC preliminarily determined that the violation was composed of three parts, each of low to moderate risk significance (white). Of the six jobs that exceeded their dose projections by more than 50 percent, two jobs accrued actual doses greater than 25 person-rem. Thus, because the licensee's 3-year rolling average, collective dose exceeded 135 person-rem (but did not exceed 340 person-rem) each was an apparent white finding. In addition, since there were more than two other jobs that accrued more than 5 person-rem (but less than 25 person-rem), these constituted an additional apparent white finding, for a total of three apparent white findings.

## Report Details

### 2. **RADIATION SAFETY** **Cornerstone: Occupational Radiation Safety**

#### 2OS2 ALARA Planning and Controls 71121.02

##### a. Inspection Scope

The inspector interviewed radiation workers and radiation protection personnel involved in high dose rate and high exposure jobs throughout the radiological controlled area during Refueling Outage 10. Independent radiation surveys of selected work areas within the radiological controlled area were performed. No work with potentially high exposure was conducted during the inspection. The following items were reviewed and compared with regulatory requirements:

- ALARA program procedures
- Processes used to estimate and track exposures
- Plant collective exposure history for the past 3 years, current exposure trends, and 3-year rolling average, collective dose information
- Six radiation work permit packages from Refueling Outage 10 which resulted in the highest personnel collective exposures during the inspection period
- Use of engineering controls to achieve dose reductions
- Individual exposures of selected work groups
- Hot spot tracking and reduction program
- Plant related source term data, including source term control strategy
- Radiological work planning
- ALARA-related items in Audit Report AP00-02
- Selected corrective action documentation involving higher than planned exposures and radiation worker practice deficiencies since the last inspection in this area
- Declared pregnant worker dose monitoring controls

Additionally, the criteria in NRC Manual Chapter 0610\*, "Reactor Inspection Reports," Appendix E, Group 2 Questions, were used to determine whether a potential ALARA finding affected the Occupational Radiation Safety Cornerstone and whether the finding



should be analyzed by the Occupational Radiation Safety Significance Determination Process. The cornerstone was affected if:

- The actual job dose associated with the finding exceeded the projected dose by greater than 50 percent;
- The licensee's 3-year rolling average, collective dose exceeded 135 person-rem/unit (for a pressurized water reactor); and
- The actual job dose associated with the finding exceeded 5 person-rem.

b. Findings

The inspector found that doses for some jobs conducted during Refueling Outage 10 were not maintained as low as was reasonably achievable. From the licensee's Refuel 10 ALARA Outage Report, the inspector determined that some jobs exceeded their dose projections by more than 50 percent and exceeded 5 person-rem per job. The following examples were noted:

Job	Radiation Work Permit	Estimated Dose (Rems)	Actual Dose (Rems)
Scaffolding in the reactor building	99-50903	22.000	46.345
Remove and install steam generator manway covers and inserts	99-53321	3.992	8.543
Eddy current/robotic plugging/stabilizing/electrosleeving	99-53323	21.185	57.659
Health physics support for primary and secondary steam generator activities	99-53324	2.463	5.641
Foreign object search and retrieval	99-53022	1.500	6.388
Reactor coolant pump seal removal and replacement	99-52520	6.605	12.869

An axial offset anomaly contributed to higher than projected outage dose rates. Axial offset is a measure of the difference between power in the upper and lower portions of the core. The cause of the axial offset anomaly has been attributed to a crud buildup on fuel assemblies in the upper portion of the reactor core. (See NRC Inspection Report 50-483/97-19.) A chemical, thermal, or hydraulic shock can drive radioactive crud from the reactor core and allow it to be transported throughout the reactor coolant system where it may plate out and raise dose rates in surrounding areas.

However, the licensee acknowledged that this factor was responsible for only approximately 25 percent of the dose overrun. The licensee conducted post job reviews and identified additional causes for higher-than-projected doses. Some of the causes were common to more than one job. The inspector reviewed the post job reviews, received additional explanation of the licensee's findings from the ALARA supervisor, and reached the following conclusions:

- Some activities were not scheduled or sequenced optimally to reduce personnel dose. In an effort to advance the outage schedule, steam generator work was started three to four days earlier than normal, providing less time for radioactive decay. The licensee set up platforms around the steam generators while reactor coolant system cleanup was still in progress and before steam generator bowl drains were flushed. This also contributed to higher dose rates (Radiation Work Permits 99-53321, 99-53323, and 99-53324).
- In the original outage schedule, all reactor coolant pump seal work was to occur when the steam generator secondary sides were full. However, because all four seals had to be worked, this was not possible. To support the revised schedule, some seal work was continued with the generators empty. In past outages when this work was conducted, "an orderly proces" was followed by moving from pump to pump. This process resulted in lower personnel dose by minimizing tool movement. In Refueling Outage 10, work crews moved from pump to pump as the other work allowed. This forced the crews to move their tooling multiple times (Radiation Work Permit 99-52520).
- Insufficient mockup training was conducted to familiarize the workers with plant equipment, use of tools, and techniques to reduce dose. Workers spent more than the expected staff-hours in high dose areas because "the crews were inexperienced" and "used poor ALARA practices." Additional mockup training should have been provided to individuals that installed and removed steam generator manways and inserts and those that used robotic eddy current equipment (Radiation Work Permits 99-53321, 99-53323, and 99-53324).
- Communication between radiation protection personnel and primary contractor personnel was "poor." Radiation protection personnel "seldom" knew job status or the schedule for the upcoming shift. Therefore, they could not plan their activities to reduce dose (Radiation Work Permits 99-53324 and 99-53022).
- There was a "lack of involvement and ownership" of the scaffolding program by craft supervisors. Reviews of scaffolding packages were not completed in a timely manner. Alternatives to scaffolding erection were not pursued. Scaffolding was allowed to be erected during times in the outage when dose rates were high, such as during reactor coolant system cleanup (Radiation Work Permit 99-50903).

The inspector also found that high collective radiation dose has been a continuing problem. The licensee's 3-year rolling average, collective dose exceeded 135 person-rems in 1999 and increased from 1997 through 1999. Dose information obtained from the licensee is shown in the following chart.

	1996	1997	1998	1999
Annual Collective Dose	248	12.5	200.7	320
Outage Dose	232	NA	185	305
	1994-1996	1995-1997	1996-1998	1997-1999
3-Year Average Collective Dose	149.8	149.2	153.7	177.7

The inspector determined through conversations with members of the Office of Nuclear Reactor Regulation that the licensee's 3-year rolling average, collective dose for 1997 through 1999 was the second highest among pressurized water reactors. This will be documented in NUREG 0713, Volume 21, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 1999."

10 CFR 20.1101(b) requires that the licensee use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA). Because the licensee had a history of high collective doses, scheduled outage activities to reduce the outage duration rather than to reduce dose, failed to properly train workers in dose reduction methods and failed to ensure good communications between radiation protection personnel and other work groups, the inspector identified the failure to maintain doses resulting from six Refueling Outage 10 jobs as low as was reasonably achievable as an apparent violation of 10 CFR 20.1101(b). Specifically, it appears that the licensee did not use, to the extent practical, procedures and engineering controls based on sound radiation protection principles to achieve occupational doses ALARA. This finding is in the licensee's corrective action program as Suggestion Occurrence Solution 00-0377 (50-483/0017-01).

The inspector used the Occupational Radiation Safety Significance Determination Process and preliminarily determined that the violation was composed of three parts, each of low to moderate risk significance (white). Of the six jobs that exceeded their dose projections by more than 50 percent, two jobs accrued actual doses greater than 25 person-rems. Thus, because the licensee's 3-year rolling average, collective dose exceeded 135 person-rems (but did not exceed 340 person-rems) each was an apparent white finding. In addition, since there were more than two other jobs that accrued more than 5 person-rems (but less than 25 person-rems), these constituted an additional apparent white finding, for a total of three apparent white findings.

#### **4. OTHER ACTIVITIES**

##### **4OA6 Management Meetings**

##### **.1 Exit Meeting Summary**

The inspector presented the inspection results to Mr. G. Randolph, Vice President and Chief Nuclear Officer, and other members of licensee management at the conclusion of the inspection on August 11, 2000. The licensee disagreed with the potential

significance of the findings presented and submitted its position to the NRC in a letter dated August 21, 2000 (ULNRC-4298).

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

During a telephone conference on September 5, 2000, the inspector informed Mr. R. Affolter and other members of the licensee staff that the findings were an apparent violation of 10 CFR 20.1101(b).

**ATTACHMENT 1**

Supplemental Information

PARTIAL LIST OF PERSONS CONTACTED

Licensee

R. Affolter, Plant Manager  
R. Farnam, Supervisor, Health Physics Operations  
K. Gilliam, Supervisor, Radiation Protection and Chemistry  
J. Hiller, Engineer, Quality Assurance  
J. Laux, Manager, Quality Assurance  
G. Randolph, Vice President and Chief Nuclear Officer  
M. Reidmeyer, Supervisor, Regional Regulatory Affairs  
R. Roselius, Superintendent, Radiation Protection and Chemistry  
W. Witt, Assistant Plant Manager

NRC

B. Baca, Health Physicist  
J. Hanna, Resident Inspector  
M. Shannon, Senior Health Physicist

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-483/0017-01	AV	Failure to maintain radiation doses as low as is reasonably achievable (Section 20S2)
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Opened and Closed During this Inspection

None

Previous Items Closed

None

Previous Items Discussed

None

DOCUMENTS REVIEWED

Refuel 10 ALARA Outage Report

RCS Shutdown and Startup Evaluation for Refuel 8

Audit Report AP00-02

APA-ZZ-01000, "Callaway Plant Health Physics Program," Revision 15

APA-ZZ-01001, "Callaway Plant ALARA Program," Revision 6

APA-ZZ-01102, "Pre-Job ALARA Planning and Briefing," Revision 15

HTP-ZZ-01103, "Post-Job ALARA Review," Revision 12

HTP-ZZ-01201, "Preparation and Maintenance of General and Specific Radiation Work Permits," Revision 30

HTP-ZZ-01203, "RWP Access Control," Revision 27

Supplemental Information - Inspection Report No. 50-483/2000-012 (ULNRC-4298) dated August 21, 2000 (the report number changed due to the need to issue a stand-alone report).

## ATTACHMENT 2

### **NRC's REVISED REACTOR OVERSIGHT PROCESS**

The federal Nuclear Regulatory Commission (NRC) recently revamped its inspection, assessment, and enforcement programs for commercial nuclear power plants. The new process takes into account improvements in the performance of the nuclear industry over the past 25 years and improved approaches of inspecting and assessing safety performance at NRC licensed plants.

The new process monitors licensee performance in three broad areas (called strategic performance areas): reactor safety (avoiding accidents and reducing the consequences of accidents if they occur), radiation safety (protecting plant employees and the public during routine operations), and safeguards (protecting the plant against sabotage or other security threats). The process focuses on licensee performance within each of seven cornerstones of safety in the three areas:

#### **Reactor Safety**

- Initiating Events
- Mitigating Systems
- Barrier Integrity
- Emergency Preparedness

#### **Radiation Safety**

- Occupational
- Public

#### **Safeguards**

- Physical Protection

To monitor these seven cornerstones of safety, the NRC uses two processes that generate information about the safety significance of plant operations: inspections and performance indicators. Inspection findings will be evaluated according to their potential significance for safety, using the significance determination process, and assigned colors of GREEN, WHITE, YELLOW or RED. GREEN findings are indicative of issues that, while they may not be desirable, represent very low safety significance. WHITE findings indicate issues that are of low to moderate safety significance. YELLOW findings are issues that are of substantial safety significance. RED findings represent issues that are of high safety significance with a significant reduction in safety margin.

Performance indicator data will be compared to established criteria for measuring licensee performance in terms of potential safety. Based on prescribed thresholds, the indicators will be classified by color representing varying levels of performance and incremental degradation in safety: GREEN, WHITE, YELLOW, or RED. GREEN indicators represent performance at a level requiring no additional NRC oversight beyond the baseline inspections. WHITE corresponds to performance that may result in increased NRC oversight. YELLOW represents performance that minimally reduces safety margin and requires even more NRC oversight. And RED indicates performance that represents a significant reduction in safety margin but still provides adequate protection to public health and safety.

The assessment process integrates performance indicators and inspection so the agency can reach objective conclusions regarding overall plant performance. The agency will use an action matrix to determine in a systematic, predictable manner which regulatory actions should be taken based on a licensee's performance. The NRC's actions in response to the significance (as represented by the color) of issues will be the same for performance indicators as for inspection findings. As a licensee's safety performance degrades, the NRC will take more and increasingly significant action, which can include shutting down a plant, as described in the action matrix.

More information can be found at: <http://www.nrc.gov/NRR/OVERSIGHT/index.html>.