



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

AUG 02 1985

Report Nos.: 50-369/85-22 and 50-370/85-23

Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Docket Nos.: 50-369 and 50-370

License Nos.: NPF-9 and NPF-17

Facility Name: McGuire 1 and 2

Inspection Conducted: June 10 - 14, 1985 and Enforcement Conference July 12, 1985

Inspector: C. M. Hosey
R. E. Weddington

8/2/85
Date Signed

Accompanying Personnel: T. G. Lee

Approved by: C. M. Hosey
C. M. Hosey, Section Chief
Division of Radiation Safety and Safeguards

8/2/85
Date Signed

SUMMARY

Scope: This special, unannounced inspection involved 34 inspector-hours on-site responding to a report of an apparent exposure to the skin of the whole body of a licensee employee in excess of the limits of 10 CFR 20.101(a).

Results: Two violations were identified: (1) exposure to 1 cm² of the skin of the whole body of a licensee employee in excess of the limits of 10 CFR 20.101(a) and (2) failure to post a radiation area.

8508150089 850802
PDR ADOCK 05000369
G PDR

REPORT DETAILS

1. Persons Contacted

Licensee Employees

- *T. L. McConnell, Plant Manager
- *J. W. Foster, Station Health Physicist
- *N. McCraw, Compliance Staff
- *W. F. Byrum, Health Physics Staff
- *B. Hamilton, Superintendent of Technical Services
- *B. Travis, Scheduling
- *D. J. Rains, Superintendent of Maintenance
- *P. B. Nardoci, General Office Licensing Staff
- T. Keane, Corporate Health Physicist

Other licensee employees contacted included two foremen, six technicians, a mechanic, a nuclear equipment operator and two office personnel.

NRC Resident Inspectors

- *W. Orders, Senior Resident Inspector
- R. Pierson, Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on June 17, 1985, with those persons indicated in paragraph 1 above. The following issues were discussed in detail: (1) an apparent violation for exposure to the skin of the whole body of a licensee employee in excess of the limits of 10 CFR 20.101(a) (paragraph 3) and (2) an apparent violation for failure to post a radiation area (paragraph 4). The licensee acknowledged the inspection findings and took no exceptions. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspector during this inspection.

3. Overexposure Investigation (92700)

On June 7, 1985, the licensee notified Region II that a licensee employee had apparently received an exposure to the skin of his whole body of 10.6 Rems, which is in excess of the quarterly skin exposure limit of 7.5 Rems given in 10 CFR 20.101(a). The exposure was caused by a single cobalt-60 (Co-60) particle that was discovered on the worker's skin when he exited the Unit 1 containment.

Through discussions with licensee representatives, the inspector determined that the individual in question was a contractor employee supporting the

Unit 1 steam generator tube plugging. At approximately 2200 hours on June 5, 1985, the individual exited the Unit 1 lower containment access after having assisted another contractor employee who was plugging tubes inside the 1-D steam generator. The individual had primarily worked from the steam generator platform with video cameras. The licensee had positioned an Eberline PCM-1 portal monitor in the vicinity of the containment exit to perform a preliminary contamination check prior to personnel going to the whole body frisking station in the vicinity of the change room. After removing his protective clothing at the containment exit, the worker stepped into the portal monitor and set off the alarm. Health physics personnel determined that the worker was contaminated in the vicinity of his left arm pit by using a RM-14 portable frisker with hand-held probe, however, the amount of contamination could not be quantified due to it exceeding the maximum scale of the instrument (50,000 counts per minute). A survey was then performed using an Eberline RO-2 beta-gamma survey meter which indicated that the contamination was reading 0.5 millirem per hour gamma and 58 millirem per hour beta.

The worker was decontaminated by wiping the contaminated area with a wet paper towel. The decontamination material was retained and was determined by analysis on a GeLi detector to be a single 1.2 microcurie particle of Co-60.

It appeared that the Co-60 particle had remained on the inside of the protective clothing worn by the worker after they were laundered and was subsequently transferred to the worker's skin after he put them on. The individual had worn a plastic suit over the top of his protective clothing inside the containment and there was no evidence that the plastic suit had been torn or damaged.

Personnel from the licensee's corporate health physics staff performed calculations to determine the amount of exposure the individual had incurred due to this contamination event. It was assumed that the exposure was received over an approximately two hour period from the time the protective clothing was put on in the dressing room until the contamination was successfully removed. The resulting exposure estimate was 10.6 Rem to the skin of the whole body distributed over a one square centimeter area, which when added to the previous skin of the whole body exposure during the current calendar quarter of 580 millirem, gave the individual a total dose for the calendar quarter of 11.18 Rem to the skin of his whole body.

The licensee believed that the high activity Co-60 particles were produced by neutron activation of elemental cobalt found in stellite. During previous outages valves composed of stellite had been lapped in place inside the containment. Studies performed by the licensee indicated that as much as 40 percent of the debris produced by this process remained on the valve seat even after cleaning. This material was transported through the reactor core by the primary coolant and subsequently plated out on the interior of the primary piping. Smears performed by the licensee inside containment during the current outage were determined to contain high activity Co-60

particles mixed with other contaminants. Licensee surveys of the facility revealed the only place that these high activity Co-60 particles were discovered disassociated from other contaminants was in the contaminated laundry area. On June 7, 1985, a 0.5 microcurie Co-60 particle was found on the floor of the laundry area while performing a massolin mopping of the area. A licensee representative stated that a high activity Co-60 particle had also been discovered inside one of the clothing dryers. Since the laundry area was the only place that these high activity Co-60 particles had been identified disassociated from other contaminants, the licensee determined that the likely source of the personnel contamination was the laundered protective clothing. The circumstances surrounding the event of June 5, 1985, and other previous contamination events also support the conclusion that high activity Co-60 particles remained on the protective clothing after laundering and was the source of the personnel contamination.

The licensee had documented seven other contamination events that they believed were similar and that occurred prior to the one that had caused the apparent overexposure. These events occurred during the period April 12 through May 31, 1985. Five of the seven events involved personnel contaminations discovered after individuals had worked in protective clothing. The contamination levels associated with these events ranged from 6000 counts per minute to a single particle reading 490 millirem per hour beta. The exposure estimates to the skin of the whole body of the contaminated individuals ranged from 15 to 5510 millirem.

As these contamination events occurred the licensee initiated a number of actions to identify and eliminate the source of the contamination. The laundry operation was identified as a likely source of the problem early on in the licensee's investigation. Independent of the personnel contamination problem, the licensee had started using an off-site contractor to laundry used protective clothing. The licensee was using the off-site contractor laundry service when the second and third contamination events occurred on May 2 and 3, 1985. The licensee terminated the service contract and began laundering used protective clothing on-site again to preclude any possibility that the licensee's protective clothing was being cross contaminated at the contractor laundry by washing with contaminated clothing from other facilities.

The permissible level of contamination the licensee permitted on laundered protective clothing was one millirem per hour. The survey on laundered protective clothing had consisted of a frisk with a portable beta-gamma survey meter with hand held probe paying close attention to the knees, elbows, arms and seat with the rest of the clothing receiving a less detailed scan. When the licensee began laundering protective clothing again on-site in mid May 1985, they began a detailed survey of the outside of each item of clothing after it came from the dryer. They also, for a period of time, surveyed the protective clothing in the dressing room immediately prior to the individual putting it on. After the apparent overexposure event on June 5, 1985, they began to perform detailed frisks of the inside and outside of each item of protective clothing after it was laundered. After several days, the surveys were relaxed to just the outside of each

item. On June 13, 1985, the licensee informed the inspector that they were going back to frisking both the inside and outside of the laundered garments based on a corporate health physics staff evaluation of the question. As a long term solution to the problem, the licensee stated that they are pursuing obtaining an automated clothing scanner.

The licensee had required that personnel working in the laundry wear a labcoat and rubber gloves, which was changed to a full set of protective clothing in mid May 1985. A frisker was also installed at the exit from the laundry and all personnel leaving the area were required to perform a whole body frisk.

The licensee also changed several of their limits within the laundry area. The licensee had permitted protective clothing contaminated up to 50 millirem per hour to be laundered. The licensee decreased the limit to 25 millirem per hour, however, a licensee representative stated that they would further decrease the limit to 10 millirem per hour by July 1, 1985. The licensee also surveyed the washer and dryer for contamination after each load was removed. Massolin moppings of the laundry area floor every shift was implemented.

The licensee implemented a color coding and segregation procedure for protective clothing. White protective clothing was worn next to the worker's skin and was worn as the outer garment in areas of low contamination potential. Yellow protective clothing was used as the outer suit when double layers of protective clothing were required. A yellow plastic suit was also required over the double layer of protective clothing in areas of high levels of contamination, such as inside the steam generator. The yellow and white protective garments were segregated after use and laundered separately. The licensee also replaced all of their old protective clothing with new protective clothing on June 10, 1985.

The licensee had placed a portal monitor at the entrance to the radiologically controlled area to determine if personnel were being contaminated by these high activity Co-60 particles from some unidentified source outside of the controlled area. No problem of this nature was detected and the use of the entrance portal monitor was discontinued.

The licensee conducted an inventory of all their sealed sources, particularly those used in radiography, and determined that none were missing. Leak checks also revealed that all of the Co-60 sources were intact. During the inspection, the inspector examined the source storage area and accountability log and determined that proper source control was being maintained and that there were no records of missing sources.

The licensee had conducted a special grid survey of the facility to determine if there was some previously unidentified source of the contamination. No such source was identified. The licensee also implemented periodic massolin moppings of the uncontrolled areas of the auxiliary building, laundry, changeroom, and the pathway from the main room to the containment accesses. On June 7, 1985, a 0.5 microcuries Co-60 particle was discovered

in the protective clothing laundry area. This was the only area that pure Co-60 contamination was discovered during these surveys. Contamination was discovered on three other occasions during the period June 8 - 11, 1985 in uncontrolled areas of the auxiliary building by these mop surveys. The contamination was isolated spots up to 6000 counts per minute and contained a number of other radionuclides in addition to Co-60. These three instances were not significant considering the number of surveys that had been performed and their relatively small activity and was not indicative of any programmatic weaknesses in the licensee's contamination control program.

The inspector interviewed six of the eight personnel who had received skin exposures as a result of the previously discussed contamination events, including the worker who had received an apparent overexposure on June 5, 1985. The worker's account of the events were consistent with the licensee's investigation reports. It appeared that the laundered protective clothing was the likely source of most of the contamination events.

During tours of the facility, the inspector observed activities in progress in the protective clothing laundry area, at the Unit 1 containment accesses, the hot machine shop and in the change rooms. Work was performed in conformance with posted radiation work permits. Housekeeping appeared very good, particularly since the unit was in an outage. Acceptable contamination controls were observed while removing material from contaminated areas. Health physics personnel were observed closely following work in contaminated areas. Personnel were also observed performing thorough whole body frisks upon exiting contaminated areas. The surveys of laundered protective clothing were being performed by health physics personnel. Only a small number of garments were being discarded because of excessive residual contamination.

The inspector reviewed the licensee's reports of personnel skin contaminations for the period January through May 1985. A total of 268 events were documented during this period. Thirty-four of these events resulted in the licensee assigning skin of the whole body doses to the employees concerned. The majority of the dose assignments were less than 100 millirem. Only 8 of these 34 events, as discussed previously, involved high activity isolated Co-60 particles and potentially contaminated laundered protective clothing as a likely source of the contamination. No other pattern or evidence of a programmatic type problem was observable in the description of these events.

Based on the above, it was determined that seven workers had received exposures from skin contamination due to high activity isolated Co-60 particles being transferred from the interior of laundered protective clothing. One of these events, the one of June 5, 1985, had resulted in an exposure to the skin of an employee's whole body of 10.6 Rem, which when added to his previous skin exposure for the calendar quarter of 580 millirem, resulted in his receiving a dose of 11.18 Rems to the skin of his whole body. 10 CFR 20.101(a) requires that no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation a total occupational

dose in excess of 7.5 Rems to the skin of the whole body. The exposure event of June 5, 1985, which resulted in a licensee employee receiving a total exposure of 11.18 Rems to the skin of his whole body, was identified as an apparent violation of 10 CFR 20.101(a)(50-369/85-22-01 and 50-370/85-23-01).

On July 5, 1985, the licensee submitted a Licensee Event Report (LER) describing the circumstances of the exposure event and giving the employee's total quarterly exposure to the skin of the whole body as 11.18 Rems.

4. Control of Radiation Areas (83724)

10 CFR 20.203(b) requires that each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words: "Caution-Radiation Area."

During the inspection, the inspector performed surveys in the auxiliary and service buildings, in the radioactive waste area and in areas around the plant site outside of the buildings.

On June 13, 1985, the inspector discovered an area along the south wall of Room 637 on the 716' elevation of the auxiliary building that had dose rates of 72 millirem per hour at near contact with the interface area of the wall and floor and 6 millirem per hour at 18 inches and at approximately waist height in the vicinity of the source. The survey was performed with XETEX 305B, portable beta-gamma survey meter, serial number 3685, calibration due March 20, 1986. The area was not posted as a radiation area. The licensee verified the radiation levels with their own survey instruments and posted the area. A licensee representative stated that the likely source of the radiation area was a pipe trench that ran under the floor that connected the Units 1 and 2 valve galleries. The pipe trench contained piping that had required shielding in the past. Failure to post the radiation area was an apparent violation of 10 CFR 20.203(b) (50-369/85-22-02 and 50-370/85-23-02).

5. Enforcement Conference

An Enforcement Conference was held at NRC Region II on July 12, 1985, to discuss the exposure of a licensee employee apparently in excess of the skin of the whole body quarterly exposure limits given in 10 CFR 20.101(a). The following persons were in attendance:

a. Duke Power Company

H. B. Tucker, Vice President, Nuclear Production
 W. A. Haller, Manager, Nuclear Technical Services
 T. L. McConnell, Station Manager
 J. Foster, Station Health Physicist
 N. McCraw, Station Compliance Engineer
 R. Gill, McGuire Licensing, General Office

b. Nuclear Regulatory Commission

J. Nelson Grace, Regional Administrator
 J. P. Stohr, Director, Division of Radiation Safety and Safeguards
 R. D. Walker, Director, Division of Reactor Projects
 G. R. Jenkins, Director, Enforcement and Investigation Coordination
 B. W. Jones, Regional Counsel
 D. M. Collins, Chief, Emergency Preparedness and Radiological
 Protection Branch
 C. M. Hosey, Chief, Facilities Radiation Protection Section
 H. C. Dance, Chief, Reactor Projects Section 2A
 R. E. Weddington, Radiation Specialist
 C. W. Burger, Project Engineer
 T. G. Lee, Radiation Specialist
 L. Trocine, Enforcement Specialist

During the meeting, licensee personnel presented discussions of the sequence of events leading up to the personnel exposure in question and detailed the corrective steps taken and planned to preclude recurrence of such exposures. Licensee representatives stated that their skin exposure calculations were based on several very conservative assumptions and that there are now more technically sound methods of determining skin dose than those used as the basis of the regulations. The licensee maintained that it was unlikely that an overexposure had occurred and that the employee's exposure was not safety significant.

NRC personnel expressed concern that the licensee's surveys of laundered protective clothing had not been adequate to discover residual contamination in the clothing that could cause significant personnel exposures. It was further stated that the NRC technical staff would carefully review and evaluate what had been presented by the licensee.

6. Staff Evaluation of Licensee Position Taken in the Enforcement Conference

The licensee discussed in the Enforcement Conference on July 12, 1985, six alternatives to the possibly conservative means of determining the licensee employee's skin exposure used as the basis for submitting their LER of July 5, 1985.

Three of the alternatives proposed discussed the technical basis for the regulations in regard to at what tissue depth does the skin contain tissues at risk for cancer inducement (i.e., 7 mg/cm² in the regulations as opposed to 40 mg/cm² or 125 mg/cm² suggested by recent animal studies) and the appropriate exposure limit to the skin of the whole body (7.5 Rems/quarter over any one square centimeter of the skin as opposed to 50 Rems/year averaged over ten square centimeters in the proposed revision to 10 CFR 20).

For regulatory purposes, the NRC continues to view skin exposure as that dose which penetrates through a tissue equivalent layer of 7 mg/cm² over any one square centimeter with a corresponding quarterly exposure limit of

7.5 Rems. However, the staff does consider the positions presented by the licensee useful in viewing the safety significance of the event and agrees that the exposure likely would produce no adverse health effects in the individual.

The other three proposals presented by the licensee varied the assumptions regarding the circumstances of the exposure event. The licensee assumed that the Co-60 particle was transferred to the employee's skin as soon as he donned the protective clothing and did not move over more than a one square centimeter area of the skin during the two hour duration of the exposure. If the radioactive particle was not transferred immediately onto the employee, a shorter exposure time (one hour for the statistical mean or 0.5 hours based on work he had performed) would result in a calculated skin exposure below the regulatory limit. Similarly, if the particle would have moved during the two hour period over greater than a one square centimeter area, no overexposure would have occurred. It is the NRC position that in the absence of any objective evidence to the contrary, that conservative assumptions are appropriate. However, the NRC agrees that the exposure would not likely produce any adverse health effects.