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

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Report Nos.: 50-259/86-38, 50-260/86-38, and 50-296/86-38

Licensee: Tennessee Valley Authority
6N38 A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Docket Nos.: 50-259, 50-260 and 50-296 License Nos.: DPR-33, DPR-52, and DPR-68

Facility Name: Browns Ferry 1, 2, and 3

Inspection Conducted: October 15-17, 1986

Inspector: Roy E Weddington 12/4/86
R. E. Weddington Date Signed

Approved by: C M Hosey 12/4/86
C. M. Hosey, Section Chief Date Signed
Division of Radiation Safety and Safeguards

SUMMARY

Scope: This was a special, unannounced onsite inspection in response to the reported loss of five fission counters containing special nuclear material.

Results: Six violations characterized in the aggregate as a single significant issue were identified for failure to adequately control special nuclear material and to comply with transportation and disposal requirements for special nuclear material.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*H. P. Pomrehn, Site Director
*R. L. Lewis, Plant Manager
*D. C. Mims, Technical Services Superintendent
*A. W. Sorrell, Site Radiological Control Supervisor
*J. E. Swindell, Unit Superintendent
*R. D. Schulz, Compliance Manager
*T. D. Cosby, Unit Superintendent
*R. McKeon, Unit Superintendent
*E. A. Grimm, Plant Staff
*J. M. Corey, Radiological Control Supervisor
*D. C. Smith, Chemistry Supervisor
*D. A. Pullen, Office of Nuclear Power Site Representative
*J. Savage, Licensing
*R. R. Davis, Licensing
*S. Jones, Plant Operations Review Staff
*P. Whitt, Radwaste Engineer
*D. S. Hixson, Radwaste Supervisor
*R. Burns, Instrumentation and Control
*R. H. Albright, Radiological Control Supervisor
*J. Shaw, Shift Technical Advisor Supervisor
M. Totten, General Foreman
C. Hill, Boilermaker Foreman
M. Miller, Shift Engineer
S. Hinkle, Special Nuclear Material Custodian's Aide
J. Lewis, Special Nuclear Material Custodian

Other licensee employees contacted included technicians, security force members, and office personnel.

Nuclear Regulatory Commission

*G. L. Paulk, Senior Resident Inspector
*C. A. Patterson, Resident Inspector
*C. Brooks, Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on October 17, 1986, with those persons indicated in Paragraph 1 above. Six violations characterized in the aggregate as a single significant issue for failure to adequately control special nuclear material and to comply with transportation and

disposal requirements for special nuclear material (Paragraph 3) were discussed in detail. The licensee acknowledged the inspection findings and stated that they believed there was no deficiency in their reporting of the apparent loss of special nuclear material in that they had felt that the material was onsite and would be located during their search. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspector during this inspection.

3. Apparent Loss of Special Nuclear Material (93700)

a. Background

This special inspection was performed to determine the circumstances surrounding the apparent loss of five fission counters containing special nuclear material (SNM). The fission counters, also known as "dunking chambers" or fuel loading chambers (FLCs), consisted of approximately 3-inch diameter and 12-inch long cylindrical detectors internally coated with two grams of uranium enriched in the isotope U-235 to 92.58 percent. The fission counter body had attached a hose to supply N_2 gas to the detector and a conduit containing instrumentation leads. Four of the fission counters were attached to approximately 14-feet long control rod guide blades. The fission counters were used to provide a source count rate during refuelings when the installed source range monitors (SRMs) would approach the lower limit of their detection capability. The licensee's fuel assembly reloading pattern was changed in 1984 so that source count rate would always be on the SRM scale, making further use of the fission counters unnecessary during refuelings.

Through review of records and discussions with licensee representatives, the inspector determined the history of the fission counters while they were at the licensee's facility. The five fission counters were received on April 1, 1976, from General Electric and entered into the licensee's SNM accountability system. The fission counters were loaned to Cooper Nuclear Station on September 21, 1976. On September 10, 1977, the fission counters were returned to the licensee's facility. The fission counters were stored on the refueling floor until they were moved for use to Unit 1 on July 27, 1981. On February 25, 1982, they were moved to Unit 3, on January 25, 1983, they were moved to Unit 2 and on November 1, 1983, they were moved to Unit 1. Following their last use, the four fission counters attached to guide blades were stored in a wooden box approximately 4-feet square and 14-feet long. The fifth fission counter, in an approximately 18-inch square box, was stored with the larger box. The boxes were stored on the refueling floor or in one of the unit's equipment pits when they were drained.

On July 25, 1986, the licensee attempted to conduct a physical inventory of the fission counters. The fission counters could not be located on the initial search of the refueling floor. Subsequent expanded searches were also unsuccessful. On October 10, 1986, the

licensee appointed an internal investigations officer to coordinate the search for the fission counters, to collect historical data related to their whereabouts and to obtain written statements from personnel. On October 14, 1986, Region II was informed that the fission counters were potentially lost.

b. Licensee Investigation

The licensee's investigation into the potential loss of the fission counters was still officially in progress at the time of the inspection, but was essentially complete except for drafting a report. The inspector discussed the circumstances surrounding the event with the investigations officer and other licensee representatives, reviewed the documents relating to the fission counters that had been assembled and conducted interviews with selected licensee employees.

The licensee had concluded that the five fission counters had been inadvertently shipped on March 4, 1985, to the low level radioactive waste disposal site near Richland, Washington in a package containing radioactive waste. The inspector reviewed the documents, statements, and other basis for the licensee's conclusion.

On July 23, 1984, the Plant Manager issued a memorandum discussing the state of housekeeping on the refueling floor and directing that the area be cleaned such that protective clothing would not be required for access to any area on the refueling floor. For approximately the next seven months, two shifts of workers were assigned to decontaminate and clear the refueling floor of unneeded material. A waste disposal station was established in the drained Unit 3 equipment pit. The pit was covered and a portable band saw was used to section material, which was then loaded into metal waste boxes that had been lowered into the equipment pit.

The inspector reviewed a series of Special Work Permits (SWPs) that had been prepared for the disposal work during the period January 22-28, 1985. Licensee representatives stated that no other SWPs could be found for the cleanup work which referred to the fission counters (dunking chambers). SWP No. 01-2-24216, dated January 22, 1985, was titled "Cut Unit 3 Equipment Pit (Dunking Chambers) Equipment" and gave the radiation and contamination levels on the fission counters. SWP No. 01-2-24216, dated January 23, 1985, was titled "Cut Up Dunking Chambers Unit 3 Equipment Pit." SWP No. 01-2-24226, dated January 27, 1985, was titled "Package Metal and Hoses in Rad Waste Container" and gave radiological data on the dunking chambers. SWP No. 01-2-24228, dated January 28, 1985, was titled "Refuel Floor Unit 3 Equipment Pit Load LSA Box" and gave radiological data on the dunking chambers. A special instruction on the SWP also stated that the chambers were to be loaded with slings.

The inspector reviewed the written statements from personnel who had been involved in this work. No one recalled who directed that the

fission counters be prepared for disposal or specifically recalled placing the fission detectors in the waste box. Several workers did recall portions of activities, such as cutting up the guide blades and placing them in the waste box and also placing in the waste box other smaller boxes (possibly containing the fifth fission counter).

The licensee was able to trace the movement of the waste box after it was removed from the equipment pit from radiation survey records and log book entries. The waste box remained on the refueling floor for a period of two to four weeks. At the latter part of February 1985, the box was moved to the equipment airlock on the 565' elevation and then to the radioactive waste staging area located on the southside of the plant.

Radiation surveys that had been performed on the refueling floor of the waste box indicated that the box had radiation levels of 150 millirem/hour at contact and 50 millirem/hour at three feet. The licensee reviewed records of radioactive waste shipments that had been made during the end of February and March 1985. All waste shipments were sent to the disposal site near Richland, Washington during this period. Shipment No. 2886 on March 4, 1985, consisted of ten metal waste boxes, of which one had radiation levels recorded on the shipping papers comparable to those measured on the box while it was still on the refueling floor. No unique identification number was assigned to waste boxes until they were in the shipping staging area so that tracking by radiation levels measured on the box was the only means of determining in what shipment the fission counters were likely included.

Based on the records and statements reviewed and on discussions with licensee representatives, the inspector also concluded that the five fission counters were likely included in the radioactive waste box that was shipped on March 4, 1985.

c. Regulatory Implications

(1) Special Nuclear Material Control and Accounting

(a) Procedures

10 CFR 70.51(c) requires that each licensee who is authorized to possess at any one time special nuclear material in a quantity exceeding one effective kilogram of special nuclear material shall establish, maintain, and follow written material control and accounting procedures which are sufficient to enable the licensee to account for the special nuclear material in his possession under license.

The inspector reviewed NRC License Nos. DPR-33, 52 and 68 for the Browns Ferry facility. Paragraph 2.B(2) of the license authorized receipt, possession and use at any time up to

600 kilograms of contained uranium-235 in connection with operation of the facility.

The inspector reviewed licensee procedure TI-14, Special Nuclear Material Control, Revision 4, dated September 25, 1986, which detailed the licensee's special nuclear material control and accounting procedures.

Paragraph 5.0 of TI-14 required that except as noted, all inventories will be documented by use of an "SNM Inventory Form" (Attachment C).

The inspector reviewed the inventory records for SNM other than fuel. The fission counter inventories were annotated on the "History Form" for the item, which was a summary form showing receipt and transfers of the items. However, there was no SNM Inventory Form for the fission counters and licensee representatives stated that none had been maintained for the items since they had been received by the licensee on April 1, 1976. Failure to document the fission counter inventories on an SNM Inventory Form as required by licensee procedure was identified as an apparent violation of 10 CFR 70.51(c) (50-259/260/296/86-38-01).

Paragraph 2.4 of TI-14 defined SNM storage areas as the new fuel storage vault, spent fuel storage pool, reactor and warehouse.

Based on record reviews, the inspector determined that the five fission counters were stored on the Unit 3 refueling floor and in the Unit 3 equipment pit during the period November 1, 1983, to January 22, 1985. These areas were not designated as authorized SNM storage areas. Storage of SNM outside of areas designated for such material by licensee procedure was identified as an additional example of an apparent violation of 10 CFR 70.51(c) (50-269, 260, 296/86-38-01).

The inspector determined that it was the licensee's practice to complete an NRC Form 741 for nonfuel SNM, such as the fission counters, movements from one unit location to another if the item was going to be used in the new location. If the movement was for storage, no NRC Form 741 was required. For this reason, no authorization paperwork was required when the fission counters were moved to the Unit 3 equipment pit and apparently placed in the waste disposal box. The history forms for the items indicated they were assigned to a given unit, but in some cases were actually located within another unit. The licensee's procedure did not address prior authorizations and paperwork required to move nonfuel SNM, although it was the licensee's practice to use NRC Form 741

to document some movements. Failure of the licensee to establish adequate procedural controls for nonfuel SNM movements was identified as an additional example of an apparent violation of 10 CFR 70.51(c) (50-259, 260, 296/86-38-01).

(b) Records of Transfer

10 CFR 70.54(a) requires that each licensee who transfers special nuclear material shall follow the requirements set forth in the 10 CFR 74.15(a).

10 CFR 74.15(a) requires each licensee who transfers special nuclear material shall complete and distribute a Nuclear Material Transaction Report on DOE/NRC Form 741. This should be done in accordance with the printed instructions for completing the form whenever the licensee transfers a quantity of special nuclear material of 1 gram or more of contained uranium-235.

The five fission counters that were apparently transferred to the disposal site each contained two grams of uranium enriched in the isotope U-235 (92.58 percent). Since the licensee did not know at the time that the fission counters were in the waste box, no NRC Form 741 was prepared for the transfer. Failure of the licensee to prepare a transfer report was identified as an apparent violation of 10 CFR 70.54(a) (50-259, 260, 296/86-38-01).

(c) Report of Loss

10 CFR 70.52(a) requires that each licensee shall report immediately any loss, other than normal operating loss, of special nuclear material.

The five fission counters could not initially be found on July 25, 1986, during the annual physical inventory. Licensee management was notified that the fission counters were not where they were thought to have been on approximately August 5, 1986. Searches for the items continued through early October 1986, when an internal investigations officer was appointed.

The inspector reviewed licensee reportable event determination (LRED) 86-0-617 dated October 12, 1986. The LRED was a form used by the licensee to document the evaluation of an event's reportability. The determination documented on the form was that the potential loss was not reportable pursuant to 10 CFR Part 73 and licensee procedures because the items would not pose a substantial hazard to

persons in unrestricted areas and the loss did not occur during transportation.

On the morning of October 14, 1986, Region II was informed of the problem and the licensee investigation that was being conducted. The inspector informed the licensee that the apparent loss was reportable pursuant to 10 CFR 70.52(a). The licensee then officially reported the apparent loss later that day.

Licensee representatives stated that the apparent loss of the fission counters was not reported sooner because they had wanted to explore all possible leads in their search for the items and everyone believed that the items had to be somewhere onsite. The inspector stated that he understood the licensee's desire to make a thorough search, however, a 12-week reporting delay from when the items could not initially be located was excessive in light of the immediate reporting requirement. Failure of the licensee to immediately report the loss of the fission counters was identified as an apparent violation of 10 CFR 70.52(a) (50-259, 260, 296/86-38-01).

(d) Transfer of Special Nuclear Material

10 CFR 70.42(c) requires that before transferring special nuclear material to a licensee of the Commission or an Agreement State, the licensee transferring the material shall verify that the transferee's license authorizes receipt of the type, form and quantity of special nuclear material to be transferred.

Since the licensee did not know the fission counters were in the waste disposal box shipped on March 4, 1985, no verification was made that the licensee was authorized to receive the material. The licensee did not have a copy of the disposal site's NRC Special Nuclear Material License onsite, but one was located at the Corporate Office and verified that the fission counters did not contain SNM of a type, form or quantity contrary to the disposal site's license possession limits. Failure of the licensee to verify that the disposal site was authorized to receive the type, form and quantity of SNM transferred prior to the shipment was identified as an apparent violation of 10 CFR 70.42(c) (50-259, 260, 296/86-38-01).

(2) Transportation of Special Nuclear Material and 10 CFR Part 61

(a) Shipping Papers

10 CFR 71.5(a) requires that each licensee who transports licensed material outside of the confines of its plant or other place of use, shall comply with applicable requirements of the regulations appropriate to the mode of transport of the Department of Transportation (DOT) in 49 CFR Parts 170 through 189.

49 CFR 172.203(d) requires that the description for a shipment of radioactive material on a shipping paper must include the name of each radionuclide in the radioactive material, the activity contained in each package and the words "Fissile Exempt" if the package is exempt pursuant to 49 CFR 173.453.

49 CFR 173.453(a) states that fissile material packaging requirements do not apply to a package containing not more than 15 grams of fissile radionuclides.

The inspector reviewed the shipping papers for the March 4, 1985 Shipment (Number 2886) to the disposal site near Richland, Washington which apparently included the fission counters.

The inspector determined that the names of the radionuclides within the radioactive material listed on the shipping paper failed to include the uranium-235 that was present. The activity listed as being contained within the package did not include the activity of the uranium-235 within the fission counters. The fission counters contained less than 15 grams of fissile radionuclides (i.e., 10 grams U-235) and therefore met the fissile material packaging exemption, however, the shipping paper was not annotated "Fissile Exempt." These deficiencies in the shipping papers for Shipment Number 2886 were identified as an apparent violation of 10 CFR 71.5(a) (50-259, 260, 296/86-38-01).

(b) 10 CFR Part 61

10 CFR 20.201(b) requires that each licensee shall make or cause to be made such surveys as may be necessary for the licensee to comply with the regulations in 10 CFR Part 20.

10 CFR 20.311(d)(1) requires that radioactive wastes be classified according to 10 CFR Part 61.55.

During review of statements from workers involved in loading of the material in the equipment pit into waste boxes, the inspector noted that the waste box which apparently contained

the fission counters had reportedly been shielded internally with scrap sheet lead that was also in the equipment pit awaiting disposal. The inspector also noted that the same dose to curie conversion factor had been used to estimate the activity within all ten boxes which comprised Shipment Number 2886, although the differences in shipping weights for each box given on the shipping papers indicated that some of the boxes may have been shielded internally. Licensee radioactive waste personnel stated that, at the time the shipment was made in 1985, there was no control in place to make the person performing the activity calculation aware that a box was shielded. Failure to take this into account would result in an underestimatation of the activity within the package.

The activity within the box which apparently contained the fission counters (Package Number FB-85-2638) was listed on the shipping papers as being 0.047 curies. Licensee radioactive waste personnel recalculated the package activity based on radiation survey data that was available for components that had been placed in the package and determined that the package had contained approximately 1.9 curies of activity. The licensee also determined, and the inspector verified, that this change in activity would not have resulted in a change in the waste classification, calculated pursuant to 10 CFR Part 61, for the package, although the potential for improper classification did exist since nuclide concentrations were calculated based on the product of the percent abundance of each nuclide and the total activity within the package. Failure of the licensee to perform an adequate evaluation of the activity within the package was identified as an apparent violation of 10 CFR 20.201(b) (50-259, 260, 296/86-38-01).

4. Enforcement Conference

An Enforcement Conference was held on November 4, 1986, at the licensee's Browns Ferry facility to discuss the circumstances surrounding the loss of the five fission counters and the licensee's corrective actions for the special nuclear material control and accounting and transportation violations identified during the inspection. The following persons were in attendance:

a. Tennessee Valley Authority

H. P. Pomrehn, Site Director
R. L. Lewis, Plant Manager
C. G. Robertson, Director, Nuclear Services
R. L. Gridley, Director, Nuclear Safety and Licensing
J. Robertson, Chief, Nuclear Fuel Engineering

M. J. May, Manager, Site Licensing
D. C. Mims, Technical Services Superintendent
J. L. Lewis, Special Nuclear Material Custodian
S. Hinkle, Special Nuclear Material Custodian's Aide
R. D. Shulz, Compliance Manager
J. Shaw, STA Supervisor
D. A. Pullen, Office of Nuclear Power Site Representative
C. W. Beasley, Information Officer
T. A. Ippoleto, Licensing Consultant

b. Nuclear Regulatory Commission

J. P. Stohr, Director, Division of Radiation Safety and Safeguards
D. M. Collins, Chief, Emergency Preparedness and Radiological Protection Branch
K. P. Barr, Chief, TVA Projects Branch
R. E. Weddington, Senior Radiation Specialist
G. L. Paulk, Senior Resident Inspector
J. W. York, Senior Resident Inspector (Bellefonte)
C. A. Patterson, Resident Inspector
C. R. Brooks, Resident Inspector
A. H. Johnson, Project Engineer

Licensee personnel acknowledged that there had been an apparent breakdown in their control of nonfuel special nuclear material. Corrective actions at the site and corporate level to preclude recurrence were presented. These actions included a hundred percent records and physical accounting of all nonfuel special nuclear material that had been received at the facility, procedural and program changes to enhance identification and control of special nuclear material, training of personnel, increased controls on the packing of radioactive waste containers and actions directed to improving the effectiveness of the radwaste group. Licensee personnel stated, in regard to reporting the apparent loss of the material, that they had not intentionally delayed reporting the loss since the deficiencies in their accountability program had made it difficult for them to ascertain that the items were in fact not present.

NRC personnel asked questions related to the identification of root causes and generic implications of the event. The need for improvements in the transportation area was also emphasized. Licensee personnel stated that their formal internal and corporate investigation reports would be sent shortly to Region II and that the reports would contain a detailed discussion of the corrective actions they had taken or planned.