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Report to Congress on Abnormal Occurrences

October – December 1990

U.S. Nuclear Regulatory Commission

Office for Analysis and Evaluation of Operational Data

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ABSTRACT

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event that the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from October 1 through December 31, 1990.

The report discusses five abnormal occurrences, none of which involved a nuclear power plant. Two involved significant overexposures to the hands of two radiographers, two involved medical therapy misadministrations, and one involved a medical diagnostic misadministration. No abnormal occurrences were reported by the Agreement States. The report also contains information that updates a previously reported abnormal occurrence.

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PREFACE

Introduction

The Nuclear Regulatory Commission reports to the Congress each quarter under provisions of Section 208 of the Energy Reorganization Act of 1974 on any abnormal occurrences involving facilities and activities regulated by the NRC. An abnormal occurrence is defined in Section 208 as an unscheduled incident or event that the Commission determines is significant from the standpoint of public health or safety.

Events are currently identified as abnormal occurrences for this report by the NRC using the criteria listed in Appendix A. These criteria were promulgated in an NRC policy statement that was published in the *Federal Register* on February 24, 1977 (Vol. 42, No. 37, pages 10950–10952). In order to provide wide dissemination of information to the public, a *Federal Register* notice is issued on each abnormal occurrence. Copies of the notice are distributed to the NRC Public Document Room and all Local Public Document Rooms. At a minimum, each notice must contain the date and place of the occurrence and describe its nature and probable consequences.

The NRC has determined that only those events described in this report meet the criteria for abnormal occurrence reporting. This report covers the period from October 1 through December 31, 1990. Information reported on each event includes date and place, nature and probable consequences, cause or causes, and actions taken to prevent recurrence.

The Regulatory System

The system of licensing and regulation by which NRC carries out its responsibilities is implemented through rules and regulations in Title 10 of the *Code of Federal Regulations.* This includes public participation as an element. To accomplish its objectives, NRC regularly conducts licensing proceedings, inspection and enforcement activities, evaluation of operating experience, and confirmatory research, while maintaining programs for establishing standards and issuing technical reviews and studies.

In licensing and regulating nuclear power plants, the NRC follows the philosophy that the health and safety of the public are best ensured through the establishment of multiple levels of protection. These multiple levels can be achieved and maintained through regulations specifying requirements that will ensure the safe use of nuclear materials. The regulations include design and quality assurance criteria appropriate for the various activities licensed by the NRC. An inspection and enforcement program helps ensure compliance with the regulations.

Reportable Occurrences

Actual operating experience is an essential input to the regulatory process for assuring that licensed activities are conducted safely. Licensees are required to report certain incidents or events to the NRC. This reporting helps to identify deficiencies early and to ensure that corrective actions are taken to prevent recurrence.

For nuclear power plants, dedicated groups have been formed both by the NRC and by the nuclear power industry for the detailed review of operating experience to help identify safety concerns early; to improve dissemination of such information; and to feed back the experience into licensing, regulations, and operations. In addition, the NRC and the nuclear power industry have ongoing efforts to improve the operational data systems, which include not only the type and quality of reports required to be submitted, but also the methods used to analyze the data. In order to more effectively collect, collate, store, retrieve, and evaluate operational data, the information is maintained in computer-based data files.

Two primary sources of operational data are Licensee Event Reports (LERs) and immediate notifications made pursuant to 10 CFR 50.72.

Except for records exempt from public disclosure by statute and/or regulation, information concerning reportable occurrences at facilities licensed or otherwise regulated by the NRC is routinely disseminated by the NRC to the nuclear industry, the public, and other interested groups as these events occur.

Dissemination includes special notifications to licensees and other affected or interested groups, and public announcements. In addition, information on reportable events is routinely sent to the NRC's more than 100 local public document rooms throughout the United States and to the NRC Public Document Room in Washington, D.C. The Congress is routinely kept informed of reportable events occurring in licensed facilities.

Another primary source of operational data is reports of reliability data submitted by licensees under the Nuclear Plant Reliability Data System (NPRDS). The NPRDS is a voluntary, industry-supported system operated by the Institute of Nuclear Power Operations (INPO), a nuclear utility organization. Both engineering and failure data are submitted by nuclear power plant licensees for specified plant components and systems. The Commission considers the NPRDS to be a vital adjunct to the LER system for the collection, review, and feedback of operational experience; therefore, the Commission periodically monitors the NPRDS reporting activities.

Agreement States

Section 274 of the Atomic Energy Act, as amended, authorizes the Commission to enter into agreements with States whereby the Commission relinquishes and the States assume regulatory authority over byproduct, source, and special nuclear materials (in quantities not capable of sustaining a chain reaction). Agreement State programs must be comparable to and compatible with the Commission's program for such material.

Presently, information on reportable occurrences in Agreement State licensed activities is publicly available at the State level. Certain information is also provided to the NRC under exchange of information provisions in the agreements.

In early 1977, the Commission determined that abnormal occurrences happening at facilities of Agreement State licensees should be included in the quarterly reports to Congress. The abnormal occurrence criteria included in Appendix A are applied uniformly to events at NRC and Agreement State licensee facilities. Procedures have been developed and implemented, and abnormal occurrences reported by the Agreement States to the NRC are included in these quarterly reports to Congress.

Foreign Information

The NRC participates in an exchange of information with various foreign governments that have nuclear facilities. This foreign information is reviewed and considered in the NRC's assessment of operating experience and in its research and regulatory activities. Reference to foreign information may occasionally be made in these quarterly abnormal occurrence reports to Congress; however, only domestic abnormal occurrences are reported.

REPORT TO CONGRESS ON ABNORMAL OCCURRENCES OCTOBER–DECEMBER 1990

Nuclear Power Plants

The NRC is reviewing events reported at the nuclear power plants licensed to operate. For this report, the NRC has not determined that any events were abnormal occurrences.

Fuel Cycle Facilities
(Other Than Nuclear Power Plants)

The NRC is reviewing events reported by these licensees. For this report, the NRC has not determined that any events were abnormal occurrences.

Other NRC Licensees
(Industrial Radiographers, Medical Institutions, Industrial Users, etc.)

There are currently about 9,000 NRC nuclear material licenses in effect in the United States, principally for use of radioisotopes in the medical, industrial, and academic fields. Incidents were reported in this category from licensees such as radiographers, medical institutions, and byproduct material users. The NRC is reviewing events reported by these licensees. For this report, the NRC has determined that five events were abnormal occurrences.

90–21 Medical Therapy Misadministration

The following information pertaining to this event is also being reported concurrently in the *Federal Register.* Appendix A (see the overall criterion) of this report notes that an event involving a moderate or more severe impact on public health or safety can be considered an abnormal occurrence.

Date and Place—August 29, 1990; University of Cincinnati; Cincinnati, Ohio.

Nature and Probable Consequences—On August 29, 1990, 86 iodine–125 seeds (small sealed radiation sources) were permanently implanted in an 86-year-old patient. The seeds totaled 27.5 millicuries of iodine–125. A dose of 16,000 rads was prescribed for the prostate gland. The seeds were to be implanted in the prostate using an ultrasonic probe to view and position the implants.

Subsequent review by the licensee determined that most of the seeds had been implanted too deeply and had passed through the prostate into the surrounding tissue. Many of the seeds were 5 to 10 centimeters beyond the prostate gland. As a result, the radiation dose to the prostate was negligible compared to the prescribed dose of 16,000 rads. The licensee estimated a dose of 15,000 rads to the tissue beyond the prostate gland, considerably greater than the dose which would have been received if the seeds had been positioned as intended.

The licensee does not anticipate any significant effects to the patient as a result of the misadministration. Further treatment, including a repeat of the implant procedure, was planned.

Cause or Causes—The iodine–125 seed implant procedure was relatively new for the licensee, although it had been used 13 times previously. The attending radiation oncologist is an authorized-user who is certified in therapeutic radiology by the American Board of Radiology. The primary cause of the misadministration appears to be the difficulty in viewing the prostate area using the ultrasonic probe. Ultrasonic imaging is often difficult and inexact, especially when attempting to visualize a soft tissue organ like the prostate.

Actions Taken to Prevent Recurrence

Licensee—The licensee has adopted revised procedures to prevent recurrence of the misplacement of the iodine–125 seeds in procedures of this nature. The revisions include an improved measuring technique to ensure proper seed depth placement and improved ultrasonic image analysis. The attending radiation oncologist traveled to the research center where the implant procedure had been developed to evaluate the procedure and to gather further information to improve the licensee's implant techniques.

NRC—An inspection was conducted in November and December 1990 to review the full scope of NRC-licensed activities at the University of Cincinnati, including this misadministration (Ref.1). Although unrelated violations and deficiencies in the licensee's program were identified, there were no violations associated with this misadministration. The licensee's corrective actions were determined to be acceptable.

This item is considered closed for the purposes of this report.

90–22 Radiation Overexposure of a Radiographer

The following information pertaining to this event is also being reported concurrently in the *Federal Register.* Appendix A (see Example 1 of "For All Licensees") of this report notes that an exposure of the feet, ankles, hands or forearms of any individual to 375 rem or more of radiation can be considered an abnormal occurrence.

Date and Place—October 5, 1990; Western Stress, Inc.; Houston, Texas; the radiation overexposure occurred at a temporary jobsite in Bordentown, New Jersey.

Nature and Probable Consequences—During the evening of October 5, 1990, the licensee notified the NRC that an incident had occurred earlier that evening while a radiographer and his assistant were working at a temporary jobsite. The radiographic operation involved the use of a radiography device containing an 80.5–curie iridium–192 sealed source. (A radiography device uses a radioactive sealed source to make x-ray-like images of welds and heavy metal objects. The position of the source is controlled by a drive cable that is used to crank the source out of the exposure device and to retract it back to the shielded position within the device via an unshielded source guide tube.)

The licensee reported that the source became disconnected from the drive cable and remained in the guide tube. The radiographer retracted the drive cable unaware that the source was no longer attached to it. At this point, the radiographer removed his personnel dosimetry and approached the end of the guide tube to adjust the guide tube end-cap and collimator. As he removed the end-cap, the source chain containing the iridium–192 source fell to the ground. The radiographer immediately retreated from the area. The licensee notified the NRC, and two NRC Region I inspectors were sent and arrived on site at midnight to investigate the incident. The circumstances associated with the radiation overexposure are described below.

Radiographic operations to perform 35 exposures of welds on a waste water storage tank were planned. The source guide tube end-cap and attached collimator were clamped to a stand that was magnetically mounted to the exterior surface of the tank wall. The stand was moved along the weld for each successive 45–second exposure.

After cranking out the source for the sixth exposure, the radiographer heard a crash and saw that the magnetically mounted stand, that held the collimator and end-cap, had fallen from the side of the tank and was lying on the concrete pad. The source guide tube end-cap with the collimator had been approximately 10 feet above the concrete pad for this exposure.

The radiographer attempted to crank the source back into the camera but found that the drive cable could only be retracted a short distance. He then looked around the tank and noticed the guide tube was looped. The radiographer then dragged the camera back by pulling on the drive cable housing in order to straighten out the guide tube. After straightening the guide tube, the radiographer was able to fully retract the cable, and consequently thought that the source was in the camera. Subsequently, the radiographer removed the chain from around his neck that held his two 200 millirem self-reading pocket dosimeters and his thermoluminescent dosimeter badge and laid the chain and dosimeters near the crank handle. The radiographer later admitted that he took this action to conceal the radiation exposure he would later receive.

The radiographer walked up to the end of the source guide tube with his survey meter in his hand, but did not refer to the instrument for any indication of radiation. At this time he grasped the end of the source guide tube with his left hand. With his right hand he removed the tape which held the collimator in place and cast the collimator aside. He then began to unscrew the source guide tube end-cap from the source guide tube to exchange the end-cap for a lighter end-cap assembly. As he removed the cap, the source chain containing the sealed source fell out of the end-cap assembly onto the concrete pad. The radiographer then dropped the source guide tube and end-cap, and rapidly left the immediate area.

A source recovery team from the camera manufacturer was sent to the site and safely recovered the source.

Based on interviews conducted with the radiographer and the Corporate Radiation Safety Officer, NRC inspectors determined that the radiographer received exposures in excess of regulatory limits. Dose estimates performed by the NRC indicated a whole body exposure to the radiographer of about 8.9 rem and an extremity exposure of about 1070 rem. The licensee

sent the radiographer to a physician for examination and blood tests. No clinical manifestations of the overexposure were evident.

Cause or Causes—The radiographer failed to conduct a radiation survey of the exposure device after the exposure. Without a radiation survey, the radiographer was not aware that the source was disconnected and had not returned to the shielded position. His willful removal of dosimetry devices complicated subsequent dose calculations.

Actions Taken to Prevent Recurrence

Licensee—The licensee's proposed corrective actions include temporarily removing the radiographer from radiography duties, doubling the number of management audits and safety meetings, revising company policy on the number of hours worked, and increasing safety training from 16 hours per year to 32 hours per year.

NRC—NRC Region IV transmitted its inspection report on December 9, 1990 (Ref. 2), and conducted an Enforcement Conference with the licensee on December 7, 1990, to discuss the event. Escalated enforcement action is pending. NRC issued an immediately effective order on January 28, 1991 (Ref. 3), prohibiting the radiographer from engaging in NRC-licensed activities on behalf of the licensee for a period of 1 year.

Future reports will be made as appropriate.

90–23 Medical Therapy Misadministration

The following information pertaining to this event is also being reported concurrently in the *Federal Register*. Appendix A (see the overall criterion) of this report notes that an event involving a moderate or more severe impact on public health or safety can be considered an abnormal occurrence.

Date and Place—October 15, 1990; William Beaumont Hospital; Royal Oak, Michigan.

Nature and Probable Consequences—On October 10, 1990, a 60-year-old female patient was referred to the nuclear medicine department for iodine-131 thyroid ablation therapy after undergoing a thyroidectomy for cancer. After reviewing the clinical data on the patient, the authorized physician-user prescribed 175 millicuries of iodine-131 to be administered orally on October 15.

On October 15, the licensee received the patient's oral iodine-131 solution from a distributor. In addition, the licensee also received a second vial containing 140 millicuries of iodine-131. This vial is a weekly standing-order for the hospital and is used as needed during the week.

The two vials were assayed by a technologist. The one vial contained 180 millicuries, and this amount was later approved by the authorized physician for the patient's treatment. The standing-order vial contained 140 millicuries. After the assay, the technologist placed both vials side by side in the fume hood located in the nuclear pharmacy. Both were still in their original leaded shields and labeled as to their contents.

At 10:30 a.m., the authorized physician-user was ready to administer the iodine-131 to the patient, and called for the material. Since the technologist who had prepared the dosage was not readily available, another technologist went to the pharmacy to obtain the radiopharmaceutical. The technologist who had prepared the dosage did not indicate to the administering technologist how many vials were to be administered. The administering technologist picked up both vials, assuming they were to be administered to the patient. The technologist did not review the labels on the containers, assuming they were the proper doses. The technologist also did not consider the administration of more than one vial to be unusual since this was a common occurrence at this facility.

After reviewing the dosage record, the authorized physician instructed the technologist to administer the dose to the patient. The technologist then proceeded with the administration of both vials containing 320 millicuries. The physician did not review the labeling on the containers, believing that since the patient's unit dose record was complete and indicated a dosage of 180 millicuries, the two vials were the proper ones for administration.

On October 16, the nuclear pharmacist received a request for 25 millicuries of iodine-131, but could not find the standing-order vial. The resulting investigation determined that the vial had been erroneously administered the previous day. The patient and her doctor were subsequently informed of the misadministration. The licensee's radiation safety officer also was notified.

NRC Region III contracted with a medical consultant to evaluate the potential medical effects on the patient as a result of the misadministration. The consultant's evaluation indicated that the misadministration should not have any significant medical effects on the patient; the estimated bone marrow dose received by the patient was between 40 and 50 rads, which should be well tolerated by the patient.

Cause or Causes—The three primary causes were: (1) the stock solution of iodine–131 was stored in the same location as the patient's dose, (2) the administering-technologist was never informed by the technologist who actually prepared the dose that only one vial was to be used, and (3) the administering technologist and physician did not review the labels on the container.

Actions Taken to Prevent Recurrence

Licensee—On October 18, 1990, the hospital requested that its NRC license be amended to include the following modifications to its iodine–131 administration procedures: (1) on all iodine–131 therapy doses, the person administering the dose must either be present in the radiopharmacy when the dose is assayed, or the person must personally assay the dose before it is taken out of the radiopharmacy; (2) the dose sheeting must indicate the number of vials that comprise the dose; (3) just prior to the administration, the physician will verify the assay dose activity with the prescribed dose and initial the dose sheet; and (4) the standing order of therapeutic iodine–131 will be stored in the hot locker and will be placed in the fume hood only when needed for dispensing. On October 29, 1990, these new procedures were incorporated into the hospital's NRC license via an amendment.

NRC—NRC Region III conducted an inspection at the facility on October 17, 1990 (Ref. 4). Although no violations of NRC requirements were identified, concerns were expressed over the storage of stock iodine–131 with the patient's intended dose and the lack of communication between the technologist who prepared the dose and the technologist who administered the dose. The NRC medical consultant indicated that the licensee's corrective action program was appropriate. Corrective actions will be examined by the NRC Region III during future inspections.

This item is considered closed for the purposes of this report.

90–24 Radiation Overexposure of a Radiographer

The following information pertaining to this event is also being reported concurrently in the *Federal Register*. Appendix A (see Example 1 of "For All Licensees") of this report notes that an exposure of the feet, ankles, hands or forearms of any individual to 375 rem or more of radiation can be considered an abnormal occurrence.

Date and Place—November 12, 1990; Tumbleweed X-Ray Company; Greenwood, Arkansas; the radiation overexposure occurred at a temporary jobsite in Burns Flat, Oklahoma.

Nature and Probable Consequences—On November 26, 1990, the licensee notified the NRC that on November 12, 1990, a radiographer's assistant may have sustained a possible radiation overexposure to his right hand. The licensee stated that it was not informed of the incident by the radiographer until the morning of November 25, 1990, because the radiographer did not think an overexposure had occurred until the assistant radiographer's right hand became red and his fingers began to swell. On the day of the incident, the radiographer and his assistant were performing radiographic operations at a temporary jobsite with a radiography device that contained a 49–curie iridium–192 sealed source. NRC Region IV sent an inspector to investigate the incident; based on interviews with the radiographer, the assistant, and the owner of the company, the circumstances associated with the radiation overexposure are described below.

The radiographer and his assistant were performing radiographic exposures of welds on a 48–inch diameter tank at a fabrication shop. After the sixth exposure, the radiographer left the immediate area to load film in a belt. While the radiographer was away, the assistant set up the seventh exposure and cranked out the source. The assistant had turned the crank about two or three turns when he saw that the magnetically mounted stand, that held the guide tube near the exterior of the tank, had fallen.

The assistant radiographer's alarming personnel dosimeter (chirper) had alarmed loudly when the guide tube had fallen. The assistant stated that he froze for about 5 seconds, then he cranked the source back to the shielded position. The assistant's chirper had quit alarming, so he thought the source was in the shielded position in the radiography device. The assistant radiographer then stated that he failed to pick up and use his survey instrument to perform a survey of the radiography device and the source guide tube, because his chirper was not alarming. (The licensee later reported that the chirper had been dropped a couple of times that night and upon subsequent testing was found to be malfunctioning due to a shorted ground wire.) Instead, he walked over to the tank and repositioned the magnetic stand and source guide tube. After the assistant radiographer correctly positioned the guide tube with his right hand, he returned to the crank handle to proceed with the exposure.

When he performed this exposure, he noted that his chirper did not alarm when the source was cranked out. Because of this, after the exposure was completed, he looked at his pocket dosimeter and noticed that it was off scale (greater than 200 millirem). At about the same time, the radiographer returned and the assistant told him what had happened and that his

pocket dosimeter had gone off scale. The assistant told the radiographer that he did not think that he had received an overexposure, but that he thought his pocket dosimeter was off scale because he had bumped it earlier. The radiographer and his assistant continued to work and did not inform the Radiation Safety Officer of the incident until after the assistant's hand showed clinical signs of a radiation injury.

The assistant radiographer stated that he grasped the guide tube with his right hand just below where the guide tube was taped to the magnetic stand. The radiation injuries that the assistant radiographer sustained to his hand indicated that he grasped the guide tube with the thumb, index, and middle fingers, and that the source had to be directly beneath the point grasped. This information may indicate that the assistant radiographer mistakenly cranked the source out, instead of in, when the incident first occurred. From reenactments, clinical observations, and calculations, the dose to the assistant radiographer's hand was estimated by the NRC to be between 1500 to 3000 rem. The whole body dose to the assistant, as measured by his thermoluminescent dosimeter, was 365 millirem. Blood samples were taken from the assistant for cytogenetic tests; the results indicated an equivalent whole body exposure of less than 10 rem.

On November 29, 1990, the NRC inspector noted that the assistant's thumb, index, and middle fingers were severely blistered and swollen. On this date the assistant was admitted to a burn center in Oklahoma City, Oklahoma, for medical care. The assistant remained in the hospital for approximately two weeks, and during that period had a skin graft performed on his index finger. On January 22, 1991, the physician contacted NRC and stated that the assistant's middle finger and thumb appeared to be healing and that the index finger was grafted due to lesions that were not healing. The physician also stated that the assistant would remain under his care, and he would supply NRC with periodic reports.

Cause or Causes—The radiographer failed to supervise the assistant properly, and the assistant failed to conduct a radiation survey of the exposure device.

Actions Taken to Prevent Recurrence

Licensee—The assistant radiographer is no longer employed by the licensee. Additional actions to be taken by the licensee will be discussed at an upcoming enforcement conference with the NRC.

NRC—During the investigation of this event, an Order modifying the license was issued on December 4, 1990, prohibiting the radiographer and the assistant from participating in licensed activities (Ref. 5). NRC Region IV issued an inspection report to the licensee on February 5, 1991 (Ref. 6) and plans to conduct an enforcement conference with the licensee.

Future reports will be made as appropriate.

90–25 Medical Diagnostic Misadministration

The following information pertaining to this event is also being reported concurrently in the *Federal Register*. Appendix A (see the general criterion) of this report notes that an event involving a moderate or more severe impact on public health or safety can be considered an abnormal occurrence.

Date and Place—November 26, 1990; Veterans Administration Medical Center; San Diego, California.

Nature and Probable Consequences—On November 26, 1990, a patient scheduled for the administration of 5 millicuries of indium–111 labeled anti-CEA monoclonal antibody for diagnostic imaging of colorectal cancer was mistakenly administered 168 millicuries of technetium–99m pertechnetate.

Prior to the administration, a nuclear medicine physician instructed his technical assistant to obtain the indium–111 from the Nuclear Medicine Preparation Lab. However, the assistant erroneously picked up a syringe containing the technetium–99m pertechnetate. The physician failed to positively identify the label on the syringe before injecting the contents of the syringe into the patient.

The error was discovered by the licensee within minutes after the misadministration and the patient was administered 10 drops of iodide and 1 gram of perchlorate to block and flush the thyroid gland respectively.

The patient was placed in an isolated room normally used for therapy for two days. The patient was scanned approximately thirty hours after the misadministration and the thyroid gland showed no elevated radioactivity. A small residual amount of technetium–99m was detected in the bladder. Following the scan, the patient was noted to be clinically unchanged and was discharged from the licensee's medical center.

Had the blocking and flushing agents not been administered, the organ receiving the highest exposure would have been the stomach wall, receiving an estimated 42 rem compared to about 5 rem for indium–111. Administration of the blocking and flushing agents reduced the radiation exposure to all organs except the bladder wall. It is estimated the bladder wall received about 17 rem from the technetium–99m compared to about 3 rem for indium–111.

Cause or Causes—The main cause of the misadministration was the failure of the nuclear medicine physician and his technical assistant to read the label on the technetium-99m syringe at the time of the injection. A contributing cause of the misadministration was inadequate training of the physician's technical assistant who was provided a description of the radiopharmaceutical based only on the color and shape of a container and not the label.

Actions Taken to Prevent Recurrence

Licensee—The physician's privilege to inject patients has been temporarily revoked. Additional training of the nuclear medicine staff is planned. Recommendations of a licensee internal quality assurance investigation board are currently being considered.

NRC—A special NRC team inspection was conducted at the licensee's facility following the misadministration. An inspection report was issued on January 3, 1991 (Ref. 7) and an Enforcement Conference was held with the licensee on January 10, 1991. On March 13, 1991, a Notice of Violation was issued to the licensee for violations identified during the inspection (Ref. 8). None of the violations pertained to the misadministration and no civil penalty was proposed.

Unless new, significant information becomes available, this item is considered closed for the purposes of this report.

Agreement State Licensees

Procedures have been developed for the Agreement States to screen unscheduled incidents or events using the same criteria as the NRC (see Appendix A) and report the events to the NRC for inclusion in this report. For this period, the Agreement States reported no events as abnormal occurrences.

REFERENCES

1. Letter from Charles E. Norelius, Director, Division of Radiation Safety and Safeguards, NRC Region III, to Donald Harrison, M.D., Senior Vice President and Provost for Health Affairs, University of Cincinnati, forwarding Inspection Report No. 30-02764/90001 (DRSS), Docket No. 30-2764, License No. 34-06903-05, dated January 23, 1991.*

2. Letter from A. Bill Beach, Director, Division of Radiation Safety and Safeguards, NRC Region IV, to Paul Abat, President, Western Stress, Inc., forwarding Inspection Report No. 30-30175/90-04, Docket 30-30175, License No. 42-26900-01, December 9, 1990.*

3. Letter from Hugh L. Thompson, Jr., Deputy Executive Director for Nuclear Materials Safety, Safeguards, and Operations Support, NRC, to Paul Abat, President, Western Stress, Inc., forwarding Order Modifying License (Immediately Effective), Docket 30-30175, License No. 42-26900-01, January 28, 1991.*

4. Letter from John A. Grobe, Chief, Nuclear Materials Safety Branch, NRC Region III, to Larry Randolph, Associate Hospital Director, William Beaumont Hospital, forwarding Inspection Report No. 30-02006/90-001 (DRSS), Docket No. 30-02006, License No. 21-01333-01, November 8, 1990.*

5. Letter from Hugh L. Thompson, Jr., Deputy Executive Director for Nuclear Materials Safety, Safeguards, and Operations Support, NRC, to Otho G. Jones, Owner, Tumbleweed X-Ray Company, forwarding Order Modifying License (Effective Immediately), Docket No. 30-28741, License No. 03-23185-01, December 4, 1990.*

6. Letter from A. Bill Beach, Director, Division of Radiation Safety and Safeguards, NRC Region IV, to Otho G. Jones, Owner, Tumbleweed X-Ray Company, forwarding Inspection Report No. 30-28741/90-02, Docket No. 30-28741, License No. 03-23185-01, February 5, 1991.*

7. Letter from Ross A. Scarano, Director, Division of Radiation Safety and Safeguards, NRC Region V, to Thomas Trujillo, Medical Center Director, Veterans Administration Medical Center, forwarding Inspection Report No. 30-08456/90-03, Docket No. 30-08456, License No. 04-15030-01, January 3, 1991.

8. Letter from Ross A. Scarano, Director, Division of Radiation Safety and Safeguards, NRC Region V, to Thomas Trujillo, Medical Center Director, Veterans Administration Medical Center, forwarding a Notice of Violation, Docket No. 30-08456, License No. 04-15030-01, March 13, 1991.*

*Available in NRC Public Document Room, 2120 L Street, NW (Lower Level), Washington, D.C., for public inspection and copying.

APPENDIX A

ABNORMAL OCCURRENCE CRITERIA

The following criteria for this report's abnormal occurrence determinations were set forth in an NRC policy statement published in the *Federal Register* on February 24, 1977 (Vol. 42, No. 37, pages 10950–10952).

An event will be considered an abnormal occurrence if it involves a major reduction in the degree of protection of the public health or safety. Such an event would involve a moderate or more severe impact on the public health or safety and could include but need not be limited to:

1. Moderate exposure to, or release of, radioactive material licensed by or otherwise regulated by the Commission;
2. Major degradation of essential safety-related equipment; or
3. Major deficiencies in design, construction, use of, or management controls for licensed facilities or material.

Examples of the types of events that are evaluated in detail using these criteria are:

For All Licensees

1. Exposure of the whole body of any individual to 25 rem or more of radiation; exposure of the skin of the whole body of any individual to 150 rem or more of radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rem or more of radiation [10 CFR 20.403(a)(1)], or equivalent exposures from internal sources.
2. An exposure to an individual in an unrestricted area such that the whole body dose received exceeds 0.5 rem in one calendar year [10 CFR 20.105(a)].
3. The release of radioactive material to an unrestricted area in concentrations which, if averaged over a period of 24 hours, exceed 500 times the regulatory limit of Appendix B, Table II, 10 CFR Part 20 [CFR 20.403(b)(2)].
4. Radiation or contamination levels in excess of design values on packages, or loss of confinement of radioactive material such as (a) a radiation dose rate of 1000 mrem per hour three feet from the surface of a package containing the radioactive material, or (b) release of radioactive material from a package in amounts greater than the regulatory limit.
5. Any loss of licensed material in such quantities and under such circumstances that substantial hazard may result to persons in unrestricted areas.
6. A substantiated case of actual or attempted theft or diversion of licensed material or sabotage of a facility.
7. Any substantiated loss of special nuclear material or any substantiated inventory discrepancy that is judged to be significant relative to normally expected performance and that is judged to be caused by theft or diversion or by substantial breakdown of the accountability system.
8. Any substantial breakdown of physical security or material control (i.e., access control, containment, or accountability systems) that significantly weakened the protection against theft, diversion, or sabotage.
9. An accidental criticality [10 CFR 70.52(a)].
10. A major deficiency in design, construction, or operation having safety implications requiring immediate remedial action.
11. Serious deficiency in management or procedural controls in major areas.
12. Series of events (where individual events are not of major importance), recurring incidents, and incidents with implications for similar facilities (generic incidents) that create major safety concern.

For Commercial Nuclear Power Plants

1. Exceeding a safety limit of license technical specifications [10 CFR 50.36(c)].
2. Major degradation of fuel integrity, primary coolant pressure boundary, or primary containment boundary.
3. Loss of plant capability to perform essential safety functions such that a potential release of radioactivity in excess of 10 CFR Part 100 guidelines could result from a postulated transient or accident (e.g., loss of emergency core cooling system, loss of control rod system).
4. Discovery of a major condition not specifically considered in the safety analysis report (SAR)

or technical specifications that requires immediate remedial action.

5. Personnel error or procedural deficiencies that result in loss of plant capability to perform essential safety functions such that a potential release of radioactivity in excess of 10 CFR Part 100 guidelines could result from a postulated transient or accident (e.g., loss of emergency core cooling system, loss of control rod system).

For Fuel Cycle Licensees

1. A safety limit of license technical specifications is exceeded and a plant shutdown is required [10 CFR 50.36(c)].
2. A major condition not specifically considered in the safety analysis report or technical specifications that requires immediate remedial action.
3. An event that seriously compromised the ability of a confinement system to perform its designated function.

APPENDIX B

UPDATE OF PREVIOUSLY REPORTED ABNORMAL OCCURRENCES

During the October through December 1990 period, NRC licensees, Agreement States, Agreement State licensees, and other involved parties, such as reactor vendors and architect-engineering firms, continued with the implementation of actions necessary to prevent recurrence of previously reported abnormal occurrences. The referenced Congressional abnormal occurrence report below provides the initial and any subsequent updating information on the abnormal occurrence discussed. (The updating provided generally covers events that took place during the report period; some updating, however, is more current as indicated by the associated event dates.) Open items will be discussed in subsequent reports in the series.

Other NRC Licenses

90–16 Medical Therapy Misadministration

This abnormal occurrence, which occurred at Muskogee Regional Medical Center in Muskogee, Oklahoma, involved radiation therapy to the wrong side of a patient's neck. The event was originally reported in NUREG–0090, Vol. 13, No. 3, "Report to Congress on Abnormal Occurrences: July—September 1990." As previously reported, an NRC Region IV inspector conducted a special safety inspection on October 3 and 5, 1990, of the circumstances associated with the misadministration, and identified violations of NRC requirements as well as deviations from the licensee's documented procedures (Ref B–1). On October 10, 1990, the NRC issued a Confirmation of Action Letter confirming a commitment made by the licensee to conduct a review of patient treatments completed during the previous 12 months to determine if similar treatment errors had occurred and gone unrecognized (Ref. B–2).

The licensee reported on November 5, 1990, that the investigation of treatments initiated or completed during this period revealed no further misadministrations, although a few documentation errors had been identified and corrected. On December 13, 1990, an enforcement conference was conducted with licensee representatives to review the circumstances which contributed to the misadministration, the violations identified during NRC's investigation of the incident, and the licensee's corrective actions taken in response to NRC's findings. The licensee had implemented corrective actions for each of the violations identified during the inspection and had addressed other concerns related to licensed activities as documented in NRC Inspection Report 30– 11571/90–02 (Ref. B–1).

On December 20, 1990, the NRC issued a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $1,250 for two violations associated with the therapy misadministration (Ref. B–3). These included: (1) a failure by the licensee to require its staff to follow the instructions of the supervising physician, and (2) a failure on the part of the licensee, through its Radiation Safety Officer, to ensure that radiation safety activities were being performed in accordance with approved procedures and regulatory requirements in the daily operations of its byproduct material program. These violations were jointly categorized as a Severity Level III problem (on a scale in which Severity Levels I and V are the most and least significant, respectively) and assessed a civil penalty of $1,250. A third violation, involving the failure to notify NRC of the therapy misadministration within the time allotted by NRC regulations, was categorized as a Severity Level IV violation and was not assessed a civil penalty.

The licensee has paid the civil penalty and has responded to the Notice, acknowledging each of the violations. NRC will review the effectiveness of the licensee's corrective actions during future, routine inspections.

This item is considered closed for the purposes of this report.

APPENDIX C

OTHER EVENTS OF INTEREST

The following items are described because they may possibly be perceived by the public to be of public health or safety significance. The items did not involve major reductions in the level of protection provided for public health or safety; therefore, they are not reportable as abnormal occurrences.

1. Inadvertent Lifting of Two Irradiated Fuel Assemblies at Indian Point Unit 3

On October 4, 1990, the licensee (Power Authority of the State of New York) for Indian Point Unit 3 was attempting to remove the upper core support structure (upper internals package—UIP) from the reactor vessel in preparation for refueling the core. (Indian Point Unit 3 is a Westinghouse—designed pressurized water reactor located in Westchester County, New York.) After first raising the UIP out of the reactor vessel, lateral movement of the UIP was commenced and then stopped when the licensee discovered that two peripheral fuel assemblies were suspended from the bottom of the upper core plate which is part of the UIP. Because of poor lighting, water clarity, and camera location, the two suspended fuel assemblies were not recognized earlier during the underwater video inspection. The licensee immediately suspended the manipulation of the UIP and notified the NRC of the event.

A Confirmatory Action Letter (CAL) was issued to confirm the licensee's commitments to develop a safe and controlled retrieval of the two fuel assemblies and to obtain NRC agreement prior to: (1) moving the upper core internals with two assemblies attached; and, (2) degrading the containment integrity and degrading vital safety systems. The CAL also confirmed the licensee's commitment to restrict containment access to personnel required to monitor and recover the fuel. An NRC Special Inspection Team was sent to the site from October 5 to October 19, 1990, to provide an independent assessment of the licensee's actions for recovery of the fuel assemblies, including procedures and safety analyses (Ref. C–1).

The two assemblies were attached to the UIP by bent fuel assembly locating pins (guide pins). The locating pins extend downward from the upper core plate and insert into the fuel assembly upper nozzle guide pin holes when the upper core internal structure is properly aligned over the top of the core. On each of the suspended fuel assemblies, one locating pin was found bent and not engaged into the fuel assembly upper flow nozzle hole; the other locating pin was bent and suspended the assembly at an angle of approximately 7 degrees.

The licensee's fuel assembly retrieval scheme included: a static lift of the UIP until the fuel assemblies were approximately 1 foot above the vessel flange, rotating the UIP in order to move the fuel assemblies outside of the vessel flange (one at a time), and positioning the assemblies such that they could be lowered into fabricated-steel baskets that were located in the deep-end of the reactor cavity. One of the assemblies dropped into its basket when the brakes to the overhead crane were applied and before the assemblies could be lowered into the baskets. The licensee lowered and freed the remaining assembly without incident. The dropped assembly resulted in no radiological release or breach of fuel integrity. These efforts were monitored by the NRC Special Inspection Team.

Following recovery of the fuel assemblies, an NRC Augmented Inspection Team (AIT) was sent to the site from October 24 through November 16, 1990. This inspection focused on ascertaining the relevant facts and probable cause(s), and evaluating the licensee's analyses and proposed corrective actions for the October 4, 1990 event (Ref. C–2). In parallel with the AIT efforts, on October 22, 1990, the licensee organized a Root Cause Team (RCT) to investigate the circumstances associated with the event and to determine its causes. The RCT, as well as the AIT, concluded that the damage to the guide pins occurred during previous refueling operations on May 27, 1989, when the UIP inadvertently bumped into the storage stand. Subsequent inspections of the fuel assembly that had not been dropped during the recovery process showed sustained mechanical deformation of portions of its fuel rods, attributed to improper guide pin insertion and bending of the fuel assembly upper flow nozzle. This outwardly bent fuel rod deformation was also the apparent cause of fuel rod mechanical deformation in an adjacent fuel assembly. The damaged guide pins were not discovered during the May 1989 refueling which resulted in the fuel assemblies being used during the subsequent fuel cycle without appropriate safety analyses.

Once the mechanism of the guide pin bending was determined, the licensee began preparations for reloading of the reactor core and reinstallation of the UIP. The AIT then became intimately involved in reviewing the various aspects of licensee readiness to take these steps. This review included an assessment

of such factors as: the acceptability of reactor operation with some fuel assemblies having missing guide pins, the adequacy of training and procedures, and review of the core reload analysis.

From its review of the 1989 refueling outage activities as well as activities observed while on site during the 1990 outage, the AIT identified the following as the principal contributing factors to this fuel assembly event: inadequate overview by the licensee of safety related work performed by a contractor, and deficiencies in the level of detail embodied in refueling procedures for the purpose of ensuring that the UIP guide pins are precluded from being damaged during transit and storage of the UIP outside of the reactor vessel.

On January 31, 1991, an enforcement conference was conducted with the licensee at the NRC Region I Office to discuss issues associated with the event. On February 22, 1991, the NRC issued to the licensee a copy of the enforcement conference report together with a Notice of Violation (Ref. C–3). No civil penalty was proposed for the violation. The violation consisted of four examples of either the failure to follow procedures, or the failure to provide adequate guidance or criteria in procedures, concerning the removal and reinstallation of the upper internals.

On December 12, 1990, the NRC issued Information Notice No. 90–77 ("Inadvertent Removal of Fuel Assemblies from the Reactor Core") to all holders of operating licenses or construction permits for pressurized-water reactors (Ref. C–4). The notice described the event at Indian Point Unit 3, as well as events of a similar nature that have occurred at other plants. In addition, the notice offered suggestions on avoiding future such incidents. Additional information regarding the Indian Point Unit 3 event was issued on February 4, 1991 in Supplement 1 to NRC Information Notice No. 90–77 (Ref. C–5).

2. Mislabeling of Diagnostic Radiopharmaceuticals

On November 23, 1990, 12 individual dosages of a radiopharmaceutical containing technetium–99m were mislabeled and distributed to area hospitals by the Syncor Corporation radiopharmacy in Akron, Ohio. The individual dose labels indicated that the material was technetium–99m–MDP, a bone imaging agent. In fact, the material was technetium–99m–DTPA, a kidney imaging radiopharmaceutical. (The radioactive element, technetium, is the same in both forms; the other chemicals in the pharmaceutical, however, determine which organ the pharmaceutical tends to be deposited in.)

The doses were distributed to 8 Akron area hospitals and 8 were used for diagnostic tests on patients. The error was discovered when the hospitals reported that the test results were different than those anticipated.

The error was attributed to conflicting markings on the bulk quantity of the radiopharmaceutical. The outer vial shield was incorrectly marked "MDP". The inner vial label, which was difficult to read through the tinted glass shield, was correctly marked as "DTPA".

The radiation doses associated with the misadministrations are within the normal range for diagnostic tests of the kidney (i.e., about 2 rem). However, in order to obtain valid test results, the studies would have to be repeated using the correct form of the radiopharmaceutical.

As corrective actions, the licensee has revised the label on both the inner vial containing the radioactive pharmaceutical and the outer vial shield to better describe the contents. Personnel have also been instructed to double check the labels of each radiopharmaceutical vial and the outer shield.

An NRC inspection was conducted on December 18 and 20, 1990, to review the circumstances of the mislabeling as well as other aspects of the licensee's activities. On January 15, 1991, a Notice of Violation was issued to the licensee for one violation involving the incorrect labeling of the radiopharmaceutical (Ref. C–6)

The item is of interest because it illustrates how a single error can result in multiple misadministrations, involving multiple hospitals. In addition, since the diagnostic test results were invalid, the patients received unnecessary exposure to radiation; however, the radiation doses associated with such diagnostic procedures are small.

3. Diagnostic Dose of Iodine–131 and Technetium–99m Administered to a Pregnant Patient

On December 7, 1990, St. John Medical Center, of Tulsa, Oklahoma, reported that a pregnant patient had received oral administration of 30 microcuries of iodine–131 in combination with an intravenous dose of 14 millicuries of technetium–99m. The patient was administered the prescribed diagnostic radiopharmaceutical doses on September 7, 1990, for a thyroid uptake and scan. The licensee's staff was unaware that the patient was pregnant at that time.

The referring physician had examined the patient on August 28, 1990, and had referred her for a thyroid

examination with a suspected diagnosis of Grave's disease. In preparation for the examination, the physician questioned the patient regarding the possibility of pregnancy, and was informed by the patient that she was not pregnant. Likewise, the licensee's staff also confirmed that the patient did not believe she was pregnant prior to administering the radiopharmaceuticals.

The patient was seen in the hospital emergency room one month later by the physician for other medical concerns, and the physician observed that she was pregnant. At this time, the patient's complete medical history was unavailable and the physician questioned the patient as to whether the thyroid examination had been performed. The patient misunderstood the physician's question (she does not speak English fluently), and replied that it had not been performed. During a later examination on December 7, 1990, the physician discovered that the examination had been completed on September 7, 1990, and that due to a clerical error at the physician's office, the results had not been brought to the physician's attention. The physician notified the licensee of the problem and requested assistance in evaluating the potential extent of fetal thyroid damage resulting from the radiopharmaceutical dosages.

The licensee reported that the fetal age was determined to have been 11 weeks at the time that the thyroid test was performed. The licensee's radiation safety officer (RSO) made an initial dose assessment on December 10, 1990. Due to the difficulty in accurately determining the dose to the fetal thyroid, and because of uncertainties involving fetal age, percentage uptake of radioiodine by fetal thyroid tissue, and the concurrent effects of maternal thyroid hormones, a range of dose estimates was made. The best case assumes a non-functioning fetal thyroid resulting in no dose to the thyroid and 164 millirem whole body absorbed dose. The worst case assumes a functioning thyroid resulting in a thyroid dose of 21 rem and 160 millirem whole body absorbed dose. The NRC is continuing to evaluate the estimated absorbed fetal dose. The RSO plans to consult with a pediatric endocrinologist for further guidance in monitoring the infant through follow-up evaluations.

The event remains under review by both the licensee and the NRC. NRC staff has determined that the licensee did follow procedures concerning precautions necessary to determine whether female patients of child-bearing age are pregnant prior to administering radiopharmaceutical doses and will review the licensee's evaluation during a future inspection.

REFERENCES FOR APPENDICES

B–1 Letter from A. Bill Beach, Director, Division of Radiation Safety and Safeguards, NRC Region IV, to William Kennedy, CEO, Muskogee Regional Medical Center, forwarding Inspection Report No. 30–11571/90–02, Docket No. 30–11571, License No. 35–13157–02, November 30, 1990.*

B–2 Confirmatory Action Letter from Robert D. Martin, Regional Administrator, NRC Region IV, to William Kennedy, CEO, Muskogee Regional Medical Center, Docket No. 30–11571, License No. 35–13157–02, October 10, 1990.*

B–3 Letter from Robert D. Martin, Regional Administrator, NRC Region IV, to William Kennedy, CEO, Muskogee Regional Medical Center, forwarding a Notice of Violation and Proposed Imposition of Civil Penalty, Docket No. 30–11571, License No. 35–13157–02, December 20, 1990.*

C–1 Letter from Marvin W. Hodges, Director, Division of Reactor Safety, NRC Region I, to Joseph Russell, Resident Manager, New York Power Authority, forwarding NRC Inspection Report No. 50–286/90–19, Docket No. 50–286, December 13, 1990.*

C–2 Letter from Marvin W. Hodges, Director, Division of Reactor Safety, NRC Region I, to Joseph Russell, Resident Manager, New York Power Authority, forwarding NRC Region I Augmented Inspection Team Inspection Report No. 50–286/90–80, Docket No. 50–286, January 8, 1991.*

C–3 Letter from Thomas T. Martin, Regional Administrator, NRC Region I, to J. Brons, Executive Vice President—Nuclear Generation, New York Power Authority, forwarding Notice of Violation and Enforcement Conference Report, Docket No. 50–286, February 22, 1991.*

C–4 U.S. Nuclear Regulatory Commission, NRC Information Notice No. 90–77, "Inadvertent Removal of Fuel Assemblies from the Reactor Core," December 12, 1990.*

C–5 U.S. Nuclear Regulatory Commission, NRC Information Notice No. 90–77, Supplement 1: "Inadvertent Removal of Fuel Assemblies from the Reactor Core," February 4, 1991.*

C–6 Letter from William H. Schultz, Chief, Nuclear Materials Safety Section 1, NRC Region III, to Steven Shipper, Manager, Syncor Corporation, forwarding a Notice of Violation, Docket No. 30–15203, License No. 34–19008–01 MD, January 15, 1991.*

* Available in NRC Public Document Room, 2120 L Street, NW (Lower Level), Washington, D.C., for public inspection and copying.

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Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health and safety and requires a Quarterly report of such events to be made to Congress. This report covers the period October 1 through December 31, 1990. The report discusses five abnormal occurrences, none of which involved a nuclear power plant. Two involved significant overexposures to the hands of two radiographers, two involved medical therapy misadministrations, and one involved a medical diagnostic misadministration. No abnormal occurrences were reported by the Agreement States. The report also contains information that updates a previously reported abnormal occurrence.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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