UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICE OF THE
CHAIRMAN

August 26, 1985

The Honorable Thomas P. O'Neill, Jr.
Speaker of the United States
House of Representatives
Washington, DC 20515

Dear Mr. Speaker:

Enclosed is the NRC report on abnormal occurrences at licensed nuclear facilities, as required by Section 208 of the Energy Reorganization Act of 1974 (PL 93-438), for the first calendar quarter of 1985.

In the context of the Act, an abnormal occurrence is an unscheduled incident or event which the Commission determines is significant from the standpoint of public health or safety. The report states that for this report period, there was one abnormal occurrence at the nuclear power plants licensed by the NRC to operate; the event involved a premature criticality during reactor startup. There were three abnormal occurrences at the other NRC licensees. Two events involved diagnostic medical misadministrations and the other event involved unlawful possession of radioactive material. There were four abnormal occurrences reported by an Agreement State (Texas). Three events involved radiation overexposures; the other event involved a well logging source which was apparently stolen, but later was recovered.

The report also contains information updating some previously reported abnormal occurrences.

In addition to this report, we will continue to disseminate information on reportable events. These event reports are routinely distributed on a timely basis to the Congress, industry, and the general public.

Sincerely,

Nunzio J. Palladino
Chairman

Enclosure:
Report to Congress on
Abnormal Occurrences
NUREG-0090, Vol. 8, No. 1

NUREG-0090
Vol. 8, No. 1

Report to Congress on Abnormal Occurrences

January - March 1985

U.S. Nuclear Regulatory Commission

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ABSTRACT

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 or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from January 1 to March 31, 1985.

The report states that for this reporting period, there was one abnormal occurrence at the nuclear power plants licensed to operate; the event involved a premature criticality during reactor startup. There were three abnormal occurrences at the other NRC licensees. Two events involved diagnostic medical misadministrations and the other event involved unlawful possession of radioactive material. There were four abnormal occurrences reported by an Agreement State (Texas). Three events involved radiation overexposures; the other event involved a well logging source which was apparently stolen, but later was recovered.

The report also contains information updating some previously reported abnormal occurrences.

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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 which 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 delineated in Appendix A. These criteria were promulgated in an NRC policy statement which 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 with copies distributed to the NRC Public Document Room and all local public document rooms. At a minimum, each such notice contains the date and place of the occurrence and describes its nature and probable consequences.

The NRC has reviewed Licensee Event Reports, licensing and enforcement actions (e.g., notices of violations, civil penalties, license modifications, etc.), generic issues, significant inventory differences involving special nuclear material, and other categories of information available to the NRC. The NRC has determined that only those events, including those submitted by the Agreement States, described in this report meet the criteria for abnormal occurrence reporting. This report covers the period from January 1 to March 31, 1985.

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. 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. The NRC's role in regulating represents a complete cycle, with the NRC establishing standards and rules; issuing licenses and permits; inspecting for compliance; enforcing license requirements; and carrying on continuing evaluations, studies and research projects to improve both the regulatory process and the protection of the public health and safety. Public participation is an element of the regulatory process.

In the licensing and regulation of nuclear power plants, the NRC follows the philosophy that the health and safety of the public are best assured through the establishment of multiple levels of protection. These multiple levels can

be achieved and maintained through regulations which specify requirements which will assure the safe use of nuclear materials. The regulations include design and quality assurance criteria appropriate for the various activities licensed by NRC. An inspection and enforcement program helps assure compliance with the regulations.

Most NRC licensee employees who work with or in the vicinity of radioactive materials are required to utilize personnel monitoring devices such as film badges or TLD (thermoluminescent dosimeter) badges. These badges are processed periodically and the exposure results normally serve as the official and legal record of the extent of personnel exposure to radiation during the period the badge was worn. If an individual's past exposure history is known and has been sufficiently low, NRC regulations permit an individual in a restricted area to receive up to three rems of whole body exposure in a calendar quarter. Higher values are permitted to the extremities or skin of the whole body. For unrestricted areas, permissible levels of radiation are considerably smaller. Permissible doses for restricted areas and unrestricted areas are stated in 10 CFR Part 20. In any case, the NRC's policy is to maintain radiation exposures to levels as low as reasonably achievable.

REPORTABLE OCCURRENCES

Actual operating experience is an essential input to the regulatory process for assuring that licensed activities are conducted safely. Reporting requirements exist which require that licensees report certain incidents or events to the NRC. This reporting helps to identify deficiencies early and to assure 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 system which include not only the type, and quality, of reports required to be submitted, but also the methods used to analyze the data. Two primary sources of operational data are reports submitted by the licensees under the Licensee Event Report (LER) system, and under the Nuclear Plant Reliability Data (NPRD) system. The former system is under the control of the NRC while the latter system is a voluntary, industry-supported system operated by the Institute of Nuclear Power Operations (INPO), a nuclear utility organization.

Some form of LER reporting system has been in existence since the first nuclear power plant was licensed. Reporting requirements were delineated in the Code of Federal Regulations (10 CFR), in the licensees' technical specifications, and/or in license provisions. In order to more effectively collect, collate, store, retrieve, and evaluate the information concerning reportable events, the Atomic Energy Commission (the predecessor of the NRC) established in 1973 a computer-based data file, with data extracted from licensee reports dating from 1969. Periodically, changes were made to improve both the effectiveness of data processing and the quality of reports required to be submitted by the licensees.

Effective January 1, 1984, major changes were made to the requirements to report to the NRC. A revised Licensee Event Report System (10 CFR § 50.73) was established by Commission rulemaking which modified and codified the former LER system. The purpose was to standardize the reporting requirements for all nuclear power plant licensees and eliminate reporting of events which were of low individual significance, while requiring more thorough documentation and analyses by the licensees of any events required to be reported. All such reports are to be submitted within 30 days of discovery. The revised system also permits licensees to use the LER procedures for various other reports required under specific sections of 10 CFR Part 20 and Part 50. The amendment to the Commission's regulations was published in the Federal Register (48 FR 33850) on July 26, 1983, and is described in NUREG-1022, "Licensee Event Report System," and Supplement 1 to NUREG-1022.

Also effective January 1, 1984, the NRC amended its immediate notification requirements of significant events at operating nuclear power reactors (10 CFR § 50.72). This was published in the Federal Register (48 FR 39039) on August 29, 1983, with corrections (48 FR 40882) published on September 12, 1983. Among the changes made were the use of terminology, phrasing, and reporting thresholds that are similar to those of 10 CFR § 50.73. Therefore, most events reported under 10 CFR § 50.72 will also require an in-depth follow-up report under 10 CFR § 50.73.

The NPRD system is a voluntary program for the reporting of reliability data by nuclear power plant licensees. Both engineering and failure data are to be submitted by licensees for specified plant components and systems. In the past, industry participation in the NPRD system was limited and, as a result, the Commission considered it may be necessary to make participation mandatory in order to make the system a viable tool in analyzing operating experience. However, on June 8, 1981, INPO announced that because of its role as an active user of NPRD system data, it would assume responsibility for management and funding of the NPRD system. INPO reports that significant improvements in licensee participation are being made. The Commission considers the NPRD system to be a vital adjunct to the LER system for the collection, review, and feedback of operational experience; therefore, the Commission periodically monitors the progress made on improving the NPRD system.

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 at licensed facilities.

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). Comparable and compatible programs are the basis for agreements.

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 report to Congress. The abnormal occurrence criteria included in Appendix A is 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 which 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

JANUARY-MARCH 1985

NUCLEAR POWER PLANTS

The NRC is reviewing events reported at the nuclear power plants licensed to operate during the first calendar quarter of 1985. As of the date of this report, the NRC had determined that the following was an abnormal occurrence.

85-1 Premature Criticality During Startup

The following information pertaining to this event is also being reported concurrently in the Federal Register. Appendix A (see Example 9 of "For All Licensees") of this report notes that an accidental criticality can be considered an abnormal occurrence. (For a reactor, an "accidental criticality" can be defined as a criticality which is achieved when the approach to criticality is not being properly controlled by the plant operators.)

Date and Place - On February 28, 1985, during a plant startup at about 1:30 p.m., the Virgil C. Summer Nuclear Station Unit 1 experienced an unanticipated transient which resulted in a high flux positive rate trip (automatic shutdown). The plant, which is operated by South Carolina Electric and Gas Company (the licensee), utilizes a Westinghouse-designed pressurized water reactor. The plant is located in Fairfield County, South Carolina.

Nature and Probable Consequences - During a nuclear power plant startup, control rods are withdrawn in a predetermined sequence to achieve criticality. In order to avoid rapid increases in power, three barriers of defense are used, i.e., personnel performance, procedural control, and reactor instrumentation to automatically scram (trip) the reactor. For the February 28, 1985, event, the first two barriers failed. Consequently, attaining criticality was not recognized and rod withdrawal was continued until the startup rate approached, by later estimates, 16 to 17 decades per minute (dpm).

At about six percent power, a reactor trip occurred on the high flux positive rate trip. The plant responded as designed to the reactor protection system actuation. The positive rate trip is derived from an increase of five percent of rated thermal power (RTP) within a two-second period. The limiting safety system setting is 6.3 percent of rated thermal power increase in two seconds. To obtain a positive rate trip during startup requires a reactivity insertion rate much greater than usually encountered. Since this was an uncommon occurrence, NRC Region II management directed that a special inspection be conducted of the circumstances associated with the event.

Both the licensee's and the NRC's investigations concluded that the event was caused by both personnel error and procedure deficiencies as discussed below in the sequence leading up to the positive rate trip.

Prior to a startup, a critical control rod bank position is estimated. This is done by first calculating reference critical data (RCD) to determine samarium and xenon reactivity effects. This data is then used to calculate estimated critical conditions (ECC). Poison concentrations and reactivities are corrected for buildup and decay from shutdown to the estimated time of criticality. Changes in control rod positions, boron concentration, and temperature are also taken into consideration. The calculation is considered acceptable by the licensee if the actual critical rod position is within 50 steps of predicted, otherwise an investigation of the cause of the error is required.

The reactor startup on February 28, 1985, at about 1:30 p.m. was preceded by a startup that same day at 6:30 a.m. The reactor was critical for approximately three hours prior to shutdown. The RCD was based on data taken for the brief period of criticality rather than data for equilibrium conditions from the previous power history. Therefore, when the ECC was calculated for the reactor startup at 1:30 p.m., the incorrect values of reactivity worth of poisons in the core were used. Additionally, the value used for control rod worth in the ECC calculation was based on middle of life (MOL) rod worth curves instead of beginning of life (BOL) rod worth curves. The station curve book provides rod worth curves for three times during core life: beginning, middle, and end of life. The reactor was between BOL and MOL in Cycle 2 at the time of the event, and the BOL curve would have more accurately reflected rod worth. These two factors contributed to the miscalculation of the estimated critical condition by 128 control rod steps. The ECC predicted criticality at 168 steps on the Bank D control rods, while the actual critical rod height was later determined to be at 40 steps on Bank D.

Under the direct supervision of the shift supervisor, the control rods were withdrawn by an operator trainee with no previous reactor or simulator experience at this facility in withdrawing rods. The shift supervisor, believing the reactor would go critical at about 168 steps on Bank D, instructed the trainee to withdraw the bank to 100 steps. This position, had the ECC been correctly calculated, would have left the reactor subcritical, even allowing for the 50 step margin of error discussed previously.

However, the trainee was not adequately instructed in the need to anticipate criticality any time rods were being withdrawn or to closely monitor the available instrumentation for indication of criticality. Neither did the shift supervisor provide the necessary attentiveness or monitoring himself. Consequently, attaining criticality at 40 steps on Bank D was not recognized and rod withdrawal was continued until the reactor scrammed on the high flux positive rate trip. This occurred when Bank D reached 76 steps.

Two other licensed operators were on duty in the control room at the time. The operator at the controls was engaged in other startup-related activities on another part of the control board. The control room supervisor, a licensed senior operator, was at his assigned station, which afforded a good overview of the control room; however, his view of instrumentation important to this event was blocked by the shift supervisor and the trainee.

The actual safety consequences of the event were minimal. It is estimated that even if the positive rate trip had not occurred (failure of instrumentation or failure of the rods to scram), power in the core for Bank D at 76 steps would have peaked at about 32% RTP due to the Doppler effect. In addition, if rod

motion for Bank D had continued to 100 steps (the shift supervisor's instructions to the trainee), and a positive rate trip had not occurred, the power peak is estimated to be about 43% RTP (again due to the Doppler effect).

However, the event is significant because it represented an unnecessary challenge to the reactor protection system, and because the reactor was not being properly controlled during plant startup.

Cause or Causes - The cause was primarily due to the failure of the shift supervisor (who was responsible for the trainee's actions) to be fully aware of plant status, to closely monitor instrumentation and to anticipate criticality whenever rods were being withdrawn as required by station procedures.

Contributing to, but not justifying the failure to monitor and anticipate criticality, was a calculated estimated critical position which was in error by more than 125 rod steps. The error in estimated critical position resulted, primarily, from procedural inadequacies.

Actions Taken to Prevent Recurrence

Licensee - The shift supervisor was removed from duty until the licensee completed an evaluation of the event, its causes, and the supervisor's capability to continue licensed operator duties. The supervisor was given formal counseling for failure to maintain an awareness of plant conditions during reactor startup. The supervisor resumed licensed operator duties on March 13, 1985.

Since there were deficiencies in the methods of estimating critical rod position for reactor startups, procedures used for the calculation of ECCs were revised to provide improved guidance for data usage and limitations for determination of core conditions for reactor startups. The station control rod curve book was also revised to clearly label burnup dependent curves with the appropriate burnup windows. This will provide a more accurate means of selecting the appropriate curves for ECC calculations.

NRC - As mentioned previously, an inspector from NRC Region II performed a special inspection from March 4-8, 1985, of the circumstances associated with the event. The inspection consisted of selected examinations of procedures and representative records, interviews with licensee personnel and observation of activities in progress.

As a result of the inspection, two violations of NRC requirements were identified: (1) failure of the shift supervisor to closely monitor instrumentation and anticipate criticality whenever rods were being withdrawn, and (2) inadequate procedures to estimate critical rod position within reasonable limits when the reactor was operated on an intermittent schedule at varying power levels. A notice of these violations, together with the inspection report, were forwarded to the licensee on April 3, 1985 (Ref. 1).

This incident is closed for purposes of this report.

FUEL CYCLE FACILITIES

(Other than Nuclear Power Plants)

The NRC is reviewing events reported by these licensees during the first calendar quarter of 1985. As of the date of this report, the NRC had not determined that any events were abnormal occurrences.

OTHER NRC LICENSEES

(Industrial Radiographers, Medical Institutions, Industrial Users, etc.)

There are currently more than 8,000 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 during the first calendar quarter of 1985. As of the date of this report, the NRC had determined that the following events were abnormal occurrences.

85-2 Diagnostic Medical Misadministration

The following information pertaining to this event is also being reported concurrently in the Federal Register. Appendix A (see the general criteria) 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 - On January 7, 1985, a representative of St. Luke's Hospitals, Chesterfield, Missouri, reported to the NRC Region III that on December 19, 1984, a female patient received a radioactive material other than that prescribed for a scheduled diagnostic medical test. As a result, the patient's thyroid received a therapeutic dose in the range of 6,500 to 9,000 rads.

Nature and Probable Consequences - The office of the patient's physician telephoned the hospital's Outpatient Radiology Department to schedule the patient for mammograms and a radioactive "iodine scan." What the physician intended, and for which he prepared a requisition, was a radioactive "thyroid scan." In the licensee's normal terminology, a radioactive "iodine scan" is a whole body scan performed with 5 millicuries of iodine-131. A radioactive "thyroid scan," in the licensee's terminology, is routinely performed using radioactive technetium-99m pertechnetate.

The patient reported to the Outpatient Radiology Department on December 19, 1984, and received the mammographic examination. Then, even though the physician's written requisition had not yet arrived at the hospital, a technologist gave her an iodine-131 capsule. Dispensing the capsule without a requisition was contrary to the Department's rules. The patient was told to return the following day for the scanning procedure.

On December 20, 1984, a technologist, other than the one who dispensed the iodine-131 capsule, performed the scanning and the patient was discharged. Meanwhile, the physician's requisition arrived at the hospital.

Subsequently, the two technologists met to perform the necessary paperwork functions. At this time, the technologist saw the physician's requisition and realized that the patient had received the wrong radioactive material. The technologist immediately reported the incident to the nuclear radiologist who informed the patient's physician, as required by NRC regulations.

The calculated radiation exposure to the thyroid from the 5 millicurie iodine-131 dosage would be in the range of 6,500 to 9,000 rads, compared to about a 200 millirad dose that would be expected from the normal technetium-99m pertechnetate diagnostic dosage of 100 microcuries.

The patient did not exhibit any apparent immediate injury. However, an NRC medical consultant, after considering the circumstances of the misadministration, has concluded that the patient has a perhaps 50% chance of developing hypothyroidism in the future. This possible decrease in thyroid function, however, is not life threatening. The patient's age (54 years) was to her advantage since the amount of iodine-131 absorbed by the thyroid during such testing generally decreases with age. The consequences of such an incident would likely have been more serious for a patient who was younger and/or pregnant.

Cause or Causes - The licensee reported that the misadministration was caused by the technologist, contrary to the Department's rules, dispensing the iodine-131 capsule without a written requisition specifying the drug or the dosage.

Actions Taken to Prevent Recurrence

Licensee - The licensee's Radiation Safety Committee held a special meeting to discuss the incident and means of preventing recurrence. Based on this meeting, the licensee distributed a memorandum to all radiology physicians and technologists reiterating the existing rule that no medical study can be performed in the department, nor can any radioactive pharmaceutical be administered, without the proper written requisition signed by the physician.

NRC - NRC Region III conducted a special inspection at the licensee's facility to review the circumstances surrounding the misadministration. No violations of NRC requirements were identified in the inspection, and the licensee's corrective action and retraining activities were considered satisfactory. In addition, as discussed previously, NRC Region III discussed the event with an NRC consultant.

This incident is closed for the purposes of this report.

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85-3 Diagnostic Medical Misadministration

The following information pertaining to this event is also being reported concurrently in the Federal Register. Appendix A (see the general criteria) 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 - On March 11, 1985, a representative of Tolfree Memorial Hospital of West Branch, Michigan, reported that a patient had received a diagnostic

radiation exposure on March 7, 1985, that was approximately 10 times the intended exposure.

Nature and Probable Consequences - On March 7, 1985, the patient who had a history of possible substernal thyroid received a diagnostic thyroid test using radioactive iodine-131, which is the standard radioactive substance used for such testing. Instead of the normal amount of 100 microcuries, however, the patient was administered 1,000 microcuries. A microcurie, which is one millionth of a curie, is a standard measure of radioactivity.

Although the radiation dose to the thyroid was significantly larger than the intended amount, the licensee reported that no biological harm would be expected because of the patient's age (70 years). (The percentage of iodine-131 uptake generally decreases with age.) An NRC medical consultant also considered the circumstances of the case, and concluded that the medical effects, if any, would be minimal. The patient's physician was informed of the misadministration, as required by NRC regulations.

Cause or Causes - The licensee reported that the misadministration occurred because of the relatively low frequency that tests of this nature are administered by the hospital. In addition, there was some question about the proper iodine-131 dosage. The causes of the misadministration will be examined further in an upcoming NRC inspection.

Actions Taken to Prevent Recurrence

Licensee - The licensee has revised its procedures to include a listing of the standard dosages for all types of thyroid examinations. The procedural changes will require that the dosages be checked against this standard before they are administered.

NRC - NRC Region III conducted a special inspection at the licensee's facility to review the circumstances surrounding the misadministration. The procedural changes adopted by the hospital were found to be satisfactory. No violations of NRC requirements were identified in the inspection. In addition, as discussed previously, NRC Region III discussed the event with an NRC medical consultant.

This incident is closed for the purposes of this report.

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85-4 Unlawful Possession of Radioactive Material

The following information pertaining to this event is also being reported concurrently in the Federal Register. Appendix A (see the general criteria) 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 - On March 26, 1985, John C. Haynes, doing business as John C. Haynes Company ("the licensee"), Newark, Ohio, was arrested by agents of the Federal Bureau of Investigation on charges of illegal possession and use of radioactive material and for making false statements to the NRC.

On April 5, 1985, the NRC issued an Order (Ref.2) to the licensee requiring him to provide access to his laboratory facility for cleanup and removal of

radioactively contaminated equipment. Subsequent to the cleanup, the license is to be revoked.

Nature and Probable Consequences - As stated in the April 5, 1985, Order, the licensee is the holder of a byproduct material license which currently authorizes the licensee to possess americium-241 for storage only. During the 1970's, the licensee's facility was used to irradiate diamonds and other gemstones using unsealed americium-241 for the purpose of inducing color changes. At one time the licensee possessed up to 25 curies of americium-241 and 2 curies of cerium-144. Subsequently, the licensee advised NRC that all radioactive material was properly disposed of at an authorized disposal facility with the exception of a small residual amount in the form of contamination of the licensee's laboratory facility. The laboratory occupied a portion of a residence in a rural area about 10 miles from Newark, Ohio. During 1981, the license was modified to limit activities to storage only of about 150 millicuries of americium-241 in the form of residual contamination.

During 1984, a Show Cause Order was issued to the licensee requiring him to submit a decontamination plan for his facility. He responded that he was financially unable to undertake the cleanup. During February of 1985, NRC Region III received an allegation that Mr. Haynes still had significant quantities of americium-241 in his possession and was continuing to use the americium to color gems in apparent violation of his license. On March 26, 1985, Mr. Haynes was arrested and a team of FBI and NRC personnel confiscated a quantity of americium in loose powder form -- estimated to be 2 to 4 curies -- at Mr. Haynes' laboratory facility. Teams of FBI and NRC personnel also visited four other locations where additional quantities of americium might have been stored or where additional information might be obtained. A larger quantity of americium -- perhaps 10 curies -- was seized at one of these locations. The confiscated americium and four diamonds with some minor surface contamination were transported to Mound Laboratories, a Department of Energy facility in Miamisburg, Ohio. A Department of Energy radiological assistance team provided technical assistance at the laboratory site and in handling the confiscated americium.

Surveys of areas surrounding the laboratory, and analyses of soil and water samples, showed no evidence of any offsite contamination. Onsite surveys disclosed soil contamination in an area where waste incineration occurred in the past and also at several other locations, principally in the area of waste water tanks for the laboratory. The living quarters portion of the residence (outside the laboratory) -- which was occupied until late March 1985 -- showed no evidence of contamination in the areas accessible to the residents. Radiation surveys of the laboratory area itself identified extensive contamination of the laboratory facility and equipment.

Americium-241 is hazardous in powder form if it becomes airborne and is inhaled by an individual. Lodged in the body, the americium may cause cancer over a long period of time. The principal hazard outside the laboratory would be the spread of americium through fire, vandalism, or other means. Such dispersion of americium could represent a significant health hazard outside the house, but the hazard would diminish substantially with distance.

A U.S. magistrate released Mr. Haynes from custody on his own recognizance, with the condition that he not go to the laboratory facility. On May 7, 1985, the U.S. District Court dismissed the charges against Mr. Haynes because a

preliminary hearing was not conducted within 30 days as required by law. Dismissal of the charges also lifted the court's prohibition of Mr. Haynes from going to the facility. Since the facility was still extensively contaminated and remained a safety hazard, the NRC considered it necessary to prevent unauthorized individuals from entering the controlled areas; such unauthorized entry could result in interferance with decontamination activities, spread of contamination, and unnecessary radiation exposures.

Therefore, on May 10, 1985, the NRC issued an immediately effective Order (Ref. 3) to the licensee which prohibited access to him, as well as other individuals, from the controlled areas unless the prior approval of the NRC Region III Regional Administrator or his designee is obtained.

Actions Taken to Prevent Recurrence

NRC -- The NRC and the U.S. Environmental Protection Agency (EPA) have initiated a cleanup of areas of significant contamination in the laboratory and contaminated areas outside the facility. The cleanup is being financed by up to $150,000 from the EPA's Superfund. The cleanup, which began in mid-April 1985, is being performed by personnel from Oak Ridge Associated Universities and Battelle Memorial Institute. NRC inspectors have been monitoring the cleanup effort. The State of Ohio Disaster Services Agency has been monitoring the unrestricted areas offsite.

Once the facility is decontaminated to levels suitable for unrestricted use, Mr. Haynes' NRC license is to be revoked under the April 5, 1985, Order (Ref. 2).

Unless new significant information becomes available, this incident 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. During the first calendar quarter of 1985, an Agreement State (Texas) reported the following four abnormal occurrences to the NRC.

For all four events, the "Agency" mentioned in the text refers to the Texas Department of Health, Bureau of Radiation Control.

AS85-1 Overexposure of an Employee

Appendix A (see Example 1 of "For all Licensees") of this report notes that exposure of the whole body of any individual to 25 rems or more of radiation can be considered an abnormal occurrence.

Date and Place - Between June 1, 1984, and June 4, 1984, an individual employed by Gulf Nuclear, Inc. in Webster, Texas, received an overexposure while disassembling a radiographic exposure device.

Nature and Probable Consequences - Prior to the date of the incident, three radiographic devices (cameras) had been taken to the licensee to be repaired. Two devices contained sources. One device with a source was immediately returned to the owner and the other two devices were kept because they were

damaged and could not be repaired. At this time the two devices were wipe tested. The device containing the source was set aside to have the source removed at a later date. The source tag was removed, however, so that it was not readily apparent that the device contained a source.

On Friday afternoon, June 1, 1984, the employee disassembled the two radiographic exposure devices in the shop to salvage the reusable parts. All parts that could be used were placed in a plastic bag and the rest were disposed in the trash.

On Monday, June 4, 1984, the employee was again working at the same bench used to disassemble the device. In the early afternoon, another employee entered the shop with a low range survey instrument. This instrument went off scale as soon as he entered the shop. Because there was not supposed to be radioactive material in the shop, the employee felt the instrument was not working; therefore, he obtained a second low range instrument. This instrument also went off scale. The employee then obtained a higher range survey instrument. At this time, he warned the other individuals in the shop that there was a source in the room. The employee determined the approximate location of the source, and all employees withdrew to the opposite side of the shop. The radiation safety officer was notified.

The radiation safety officer performed a more complete survey and determined that the source was located in a small plastic tray on the workbench used to disassemble the cameras. The source was retrieved using a six-foot handling tool and placed in a shield. A source changer was obtained and the source was then transferred to the source changer. After placing the source in a hotcell, it was determined to be a 24 curie iridium-192 source that had been in one of the cameras. Two individuals involved in the source recovery received exposures of 3.5 rems and 3.9 rems, respectively.

The licensee provides both weekly and monthly personnel monitoring using thermoluminescent dosimeters (TLDs). A review of the dosimetry for this time period revealed that the employee who disassembled the exposure devices received 29.2 rems whole body exposure during this incident. Exposure reports for other employees who were in the vicinity of the source during the incident period did not indicate any excessive exposures.

Interviews of employees were conducted and statements taken. Information concerning the sequence of events leading to the cameras being positioned on the workbench is consistent throughout the statements. However, one employee stated that after the source was discovered, he had questioned the employee who received the 29.2 rems exposure and was told that the camera had the source in it at the time the camera was dismantled. The employee who dismantled the camera was not asked about this discussion, but denied during interviews that the source was in the camera.

A physical examination and laboratory findings from medical tests performed on the technician showed no detectable symptoms of radiation exposure. State Agency TLD's used to determine the fence line radiation levels at a facility next door were evaluated and showed little or no elevation of radiation levels above the normal dose rates.

Cause or Causes - The apparent cause of the overexposure was that the source tag, indicating a source in the camera, was removed before the source was removed, and the employee assumed there was no source in the device. A secondary cause appears to be a lack of training that would provide the employee the knowledge to realize a source was present and take appropriate action. It also appears that, at the time of the incident, management was not active to the point of providing sufficient supervision over handling procedures.

Actions Taken to Prevent Recurrence

Licensee - The licensee has circulated a memo to laboratory personnel stating that a camera containing a source is not to be taken to the shop area without direct supervision of shop managers or the radiation safety officer. In addition, area monitors have been installed in the shop and set to alarm at 1.2 mR/hr.

Agency - The Agency cited the licensee for allowing the overexposures to occur. It was determined that the licensee's reporting of the incident and subsequent actions, including proposed corrective measures, were adequate if implemented. The Agency is currently in litigation with the licensee because of continued violations.

This incident is closed for the purposes of this report.

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AS85-2 Radiation Hand Burn to an Assistant Radiographer

Appendix A (see Example 1 of "For All Licensees") of this report notes that exposure of the feet, ankles, hands, or forearms of any individual to 375 rems or more of radiation can be considered an abnormal occurrence.

Date and Place - On August 24, 1984, the State Agency was notified by Baytown Industrial X-Ray of Houston, Texas, that they had interviewed a radiographer who had a suspicious looking wound on his right hand. On August 27, 1984, the radiographer called the Agency and indicated that the wound had been diagnosed as a radiation burn.

Nature and Probable Consequences - The individual was interviewed by an Agency investigator on August 29, 1984, and was told that the incident occurred while the individual was working as an assistant radiographer for QA Special Services of Houston, Texas.

On March 12, 1984, he went to his family physician because of a persistent blister on his right hand. The wound is located beneath the thumb joint on the palm. The physician suspected an insect bite and prescribed antibiotics. After this treatment failed, he was referred to a dermatologist in April 1984. The dermatologist took cultures over a period of time until the middle of August. After his last visit, he interviewed for a job with the industrial radiography company (Baytown Industrial X-Ray) that made the initial report to the Agency.

The individual told Agency investigators that approximately two weeks prior to his first visit to his family physician, he was working a night shift as an

assistant radiographer for QA Special Services at a refinery. He was radiographing a 4"-8" pipe and the radiographer was developing the film. During the course of radiography operations he approached the camera, after cranking the source in, and noticed his survey meter indicated a reading of approximately 235 mR/hr. He returned to the crank-out, brought it up to the camera and removed the source guide tube to see if the source was retracted to the safe position.

There was no evidence of the source outside the camera, but he still could not lock the camera. At this point he jammed his palm against the exit port of the camera to jar it and turned the crank. Apparently this secured the source and he was able to lock the camera. He didn't report any exposure readings during this operation. He wore his personnel monitor at his collar and didn't recall his pocket dosimeter reading. The radiographer was not in the vicinity during this operation. The assistant did not report the incident to the radiographer nor to the radiation safety officer at the company. He did question company officials about radiation burns after he began seeing his doctor and they told him it appeared to be an insect bite.

A review of the individual's records at the company's office indicated an exposure of about 500 mR for the quarter in which the incident was supposed to have occurred. He could not supply definite information about the date of the incident, or the activity of the source. Training records were limited to a form indicating date of employment, date of birth, and social security number. Also in that file was a test that had not been graded. The individual stated that he had been given the test to take home and complete. He kept it for about two weeks before turning it in. He stated that he had not received any formal training and had no radiography experience before going to work for the company.

Calculations were made by the Agency using a worst case scenario which assumed the source was 100 curies of iridium-192, and that the individual had touched the source for one second while jamming his palm against the exit port of the camera. Using these assumptions, the individual could have received 2000 rems to the palm when pushing it against the camera.

Cause or Causes - The direct cause of the incident was the failure to retract the source to its fully shielded position, but no evaluation of the equipment could be made since the incident was not reported at the time of occurrence. The root cause of the incident appears to be poor training of employees by QA Special Services.

Actions Taken to Prevent Recurrence

Licensee (QA Special Services) - The licensee has not reported the findings of its investigation to the Agency nor any corrective actions. In statements made during interviews, company management indicated they felt nothing could be done because of the failure of the assistant radiographer to report the incident.

Agency - The Agency is currently preparing an action to suspend the company's license due to this and other incidents. By Agency rules, they will be given the opportunity to request a hearing to show cause why the license should not be suspended.

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

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AS85-3 Overexposure of an Assistant Radiographer

Appendix A (see Example 1 of "For All Licensees") of this report notes that exposure of the feet, ankles, hands, or forearms of any individual to 375 rems or more of radiation can be considered an abnormal occurrence.

Date and Place - Magnaflux Industrial Radiography Company of Houston, Texas, reported to the Agency that on November 19, 1984, an assistant radiographer received an overexposure from a radioactive source. It was later estimated that the employee had received about 1320 rems (beta and gamma) to his right hand.

Nature and Probable Consequences - The assistant radiographer was taking radiographs (using a 45-curie iridium-192 source) of castings in the shooting bay at the Magnaflux facility. Each radiograph required an exposure of about 31.5 minutes.

During one of these exposures, the assistant left the area to finish developing some films in the darkroom. When he came out of the darkroom he met another crew of radiographers who asked if he was still shooting a film. He responded that he was, but when they checked the survey meter it read zero. They concluded that while the assistant was in the darkroom, someone had cranked the source in to its shielded position. Another radiographer and the assistant proceeded into the vault, which had been left unlocked, and again checked the survey meter. The meter indicated only scatter radiation from the adjacent vault where exposures were being made with cobalt-60.

The assistant decided to shoot another film to replace the one he was shooting when he went to the darkroom. Assuming that someone had returned the source to its shielded position, he began to set up a new film. (In fact, however, the source was still in the source guide tube rather than being in the shielded position.) The assistant positioned the new film about 32" from the source tube; then he lined the tube up with the casting. During the entire setup he spent about six minutes in close proximity to the source. While he was measuring the source-to-film distance, his hand came near or touched the source tube tip. The radiographer in the next vault came over to see if he was making an exposure, because his survey meter indicated high readings. The assistant radiographer checked his meter which still read zero.

The radiographer checked the camera and found that the source was still in the guide tube. He cranked the source back into the camera and the radiation safety officer was contacted. A physical examination and laboratory findings from medical tests on the assistant radiographer showed no detectable symptoms of high radiation exposure.

Radiation dosimetry indicated a whole body exposure of 9.9 rems. The Agency performed time/motion studies to estimate the exposures received by the assistant radiographer. The results of these studies were: 5.5 rems - whole body;

9.3 rems - head; 1320 rems (beta and gamma) - right hand; and 22 rems - left hand.

Causes or Causes - The overexposure occurred for several reasons. First, the survey meter used by the assistant radiographer was found to have a crack in the anode which caused the Geiger-Mueller tube to short out. The survey meter would function properly until it was put into a radiation field of 300-400 mR/hr. The readings would then become erratic and at times would fall to zero. In addition to this, someone had disabled the area monitor in the vault. Another contributing factor was that the assistant radiographer left the source unattended and, upon returning, assumed the source had been secured by someone else.

Actions Taken to Prevent Recurrence

Licensee - The licensee has instructed all affected employees in radiation safety techniques with emphasis placed on surveying techniques and use of the radiation monitoring system. In addition, the monitoring systems have been integrated into the licensee's routine calibration-certification checks required before using the exposure rooms.

Agency - The Agency issued a Notice of Violation to the licensee for failure to perform adequate surveys of the area; failure to equip the shooting bay with a control device which energized with a conspicuous visual or audible alarm to alert an individual entering the area of the presence of high radiation fields; and failure to maintain direct surveillance of the operation to protect against unauthorized entry.

This incident is closed for the purposes of this report.

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AS85-4 Lost Well Logging Source

Appendix A (see Example 5 of "For All Licensees") of this report notes that any loss of licensed material in such quantities and under such circumstances that substantial hazard may result to persons in unrestricted areas can be considered an abnormal occurrence).

In addition, since the evidence suggests that the source was stolen, Example 6 of "For All Licensees" may be applicable (i.e., a substantiated case of actual or attempted theft or diversion of licensed material can be considered an abnormal occurrence).

Date and Place - On February 13, 1985, Schlumberger Well Service of Houston, Texas, discovered that a 1.5 curie cesium-137 source was missing from its shield. The source was to be used by a crew from the licensee's Graham, Texas facility.

Nature and Probable Consequences - On February 10, 1985, the source was used to log a well in Throckmorton County. After completion of the log at about 8:30 p.m., the source was removed from the logging tool by the engineer and placed in its shield. The shield was transported back to the facility and placed in downhole storage.

On February 13, 1985, the shield was taken out of storage and transported to a well in Jack County, Texas. The shield was opened about 6:30 a.m. and the source was discovered missing. The licensee immediately started interviewing employees and surveying for the source. The Agency was notified.

On February 14, 1985, Agency investigators met with licensee representatives. In addition, all individuals that had worked at the Throckmorton County well site were contacted and informed of the loss. They were also given a description of the source and told a reward was being offered. Both well sites were surveyed along with the routes to and from each well site. The facility and the local landfill were also surveyed.

Surveying, and in some cases, resurveying sites, facilities, and routes failed to locate the source. Radio and television newscasts and notices in area newspapers described the source and possible associated radiation hazards and offered a reward for return of the source. The capsule was engraved with the following:

Reward. Call-Collect
Schlumberger
Houston, Texas
Danger, Radioactive
Do Not Handle
Notify Civil Authorities

It was felt by the Agency and the licensee that it was unlikely the source fell off the truck. The Agency issued a press release on February 15, 1985, describing the source and explaining the associated hazards.

On April 12, 1985, the licensee reported that the source had been found in a cow pasture approximately 120' north of a farm-to-market road 3 miles from the town of Graham, Texas. The serial number verified that this was the missing source. Since the source was not found near any of the routes taken by the licensee's trucks and was too far from the road to account for accidental loss, the licensee reported that the source had been stolen. The licensee removed the source from the pressure vessel and gave the empty vessel to local authorities for use in their investigation.

Cause or Causes - The cause is presumed to be due to theft of the source. It appears that the source was removed from the licensee's facility and thrown into the pasture where it was discovered.

Actions Taken to Prevent Recurrence

Licensee - The licensee is considering giving polygraph tests to all employees and is studying the feasibility of changing all company locks and restricting access of keys.

Agency - The Agency is reviewing the circumstances surrounding the loss of the source to determine what action is to be taken.

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

REFERENCES

1. Letter from Roger D. Walker, Director, Division of Reactor Projects, NRC Region II, to O.W. Dixon, Jr., Vice President, Nuclear Operations, South Carolina Electric and Gas Company, forwarding a Notice of Violation and Inspection Report No. 50-395/85-12, April 3, 1985.*

2. Letter from James M. Taylor, Director, NRC Office of Inspection and Enforcement, to John C. Haynes Company, forwarding an Order (effective immediately), License No. 34-13774-01, April 5, 1985.*

3. Letter from James M. Taylor, Director, NRC Office of Inspection and Enforcement, to John C. Haynes Company, forwarding an Order (effective immediately), License No. 34-13774-01, May 10, 1985.*

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* Available in NRC Public Document Room, 1717 H Street, NW, Washington, DC 20555 for inspection and copying (for a fee).

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 rems or more of radiation; exposure of the skin of the whole body of any individual to 150 rems or more of radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rems 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 (10 CFR § 20.403(b)).

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 1,000 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 which is judged to be significant relative to normally expected performance and which 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), which 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 which 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 which seriously compromised the ability of a confinement system to perform its designated function.

APPENDIX B

UPDATE OF PREVIOUSLY REPORTED ABNORMAL OCCURRENCES

During the January through March, 1985 period, the NRC, NRC licensees, Agreement States, Agreement States Licensees, and other involved parties, such as reactor vendors and architects and engineers, continued with the implementation of actions necessary to prevent recurrence of previously reported abnormal occurrences. The referenced Congressional abnormal occurrence reports below provide the initial and any updating information on the abnormal occurrences discussed. Those occurrences not now considered closed will be discussed in subsequent reports in the series.

NUCLEAR POWER PLANTS

79-3 Nuclear Accident at Three Mile Island

This abnormal occurrence was originally reported in NUREG-0090, Vol. 2, No. 1, "Report to Congress on Abnormal Occurrences: January-March 1979," and updated in each subsequent report in this series, i.e., NUREG-0090, Vol. 2, No. 2 through Vol. 7, No. 4. It is further updated as follows:

Reactor Building Entries

During the first calendar quarter of 1985, 52 entries were made into containment. There have been a total of 574 entries since the March 28, 1979 accident. Activities included inspections of the reactor building polar crane, plenum removal preparation activities, the refurbishment of the polar crane auxiliary hook, and continued installation of the Defueling Water Cleanup System.

Reactor Building Polar Crane (RBPC)

During the fourth quarter of 1984, the licensee reported to the NRC that one of the RBPC's redundant brake systems had been found inoperable. Corrective measures were taken by GPU Nuclear and on January 3, 1985, NRC staff members inspected the crane to insure that all open items had been corrected. The crane was then approved for limited service (up to 5 tons) and later approved for full use (170 tons maximum).

TMI-2 Workers Receive Higher Than Expected Skin Exposures

On January 14, 1985, three workers received higher than expected skin and whole body doses while working in the highly contaminated seal injection valve room, located in the auxiliary building basement. General area dose rates taken in October 1984 indicated up to 30 R/hr and contact readings at "hot spots" were as high as 100 R/hr.

Self-reading dosimeters indicated near 900 mrem, higher than expected for the job. TLDs (thermoluminescent dosimeters) recorded highs of 640 mrem whole body and 2924 mrem skin. No regulatory limits were exceeded. Surveys performed during the job show general area beta up to 230 rad/hr, presumably from primary-coolant-contaminated-boron crystals on the floor.

Inspection of Lower Reactor Pressure Vessel Area

On Wednesday, February 20, 1985, GPU Nuclear was able to guide a small television camera and light to the lower reactor vessel head and examine a small region below the core support structure. The television pictures revealed rubble which had the appearance of a gravel pile with some of the pieces being "fist" size and several inches across. The size of the gravel pieces were compared to the diameter of the light fixture and appear to be nominally three to four inches long and about half as wide. Further examinations on February 21, 1985, revealed similar type material located at the periphery of one of the six inch diameter flow holes in the lower diffuser plate of the core support assembly. These examinations support the concept that some molten material was generated in the core area and resolidified and collected in the lower plenum area. The composition of the rubble pile cannot be determined from video inspection on this material. The licensee has also begun preliminary planning to remove a sample for laboratory analysis of material content. The rubble appears to be about 30 inches deep (10-20 tons) in the lower reactor vessel head area. These early examinations also indicated that, in the limited areas examined, the core thermal shields, lower flow distributor, instrumented incore guide tubes, and reactor vessel walls were not visibly degraded and appear to be in excellent condition.

In a separate effort, EG&G, Inc., under contract to DOE, has an ongoing program to examine a limited number of debris particles previously removed from the reactor in 1984. Results from these examinations indicate that temperatures of at least 5100°F were reached in some areas of the core during the 1979 accident. Uranium dioxide fuel melts at 5100°F.

Liner Shipments

Two shipments of spent resins were sent from the TMI site to Richland, Washington, during this reporting period.

EPICOR-II/Submerged Demineralizer System (SDS) Processing

The EPICOR-II System processed approximately 77,300 gallons of water during the first quarter of 1984. The SDS processed approximately 168,230 gallons of water during the same time period.

TMI-2 Advisory Panel Meetings

On January 10, 1985, the Advisory Panel for the Decontamination of Three Mile Island, Unit 2 (Panel) met in Harrisburg, PA. Discussions included how to properly keep the Panel informed of activities in a timely fashion and presentations by the licensee on site activities.

At the February 14, 1985, Panel meeting, updating material was presented by the NRC on current investigations and enforcement actions.

On March 7, 1985, members of the Panel met with the NRC Commissioners in Washington, DC. The Panel informed the Commission that they were satisfied with licensee and NRC staff actions related to approval of the polar crane up to the current load rating of 170 tons. The Panel also discussed with the Commission its proposed scope of activities over the next six months. The proposed agenda

was favorably received by the Commission. The Commission was also informed of the Panel's desire to consider the results of epidemiological studies associated with radiation released during the TMI-2 accident. In response, the Commission requested that the Panel prepare a proposal setting forth the scope of inquiry and criteria to be followed by the Panel in examining such studies.

There was also considerable discussion on the current NRC staff practice of providing the Panel only information that is publicly available. The Commission agreed to review the current practice and inform the Panel of the result of that review.

Further reports will be made as appropriate.

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83-5 Large Diameter Pipe Cracking in Boiling Water Reactors (BWRs)

This abnormal occurrence was originally reported in NUREG-0090, Vol. 6, No. 3, "Report to Congress on Abnormal Occurrences: July-September 1983," and updated in subsequent reports in this series, i.e., NUREG-0090, Vol. 6, No. 4, and Vol. 7, No. 2. In the latter report, the incident was closed out. However, it is being reopened to report additional concerns involving BWR pipe cracking which have not been reported previously in these quarterly reports to Congress.

Background

Since the issuance of Generic letter 84-11, dated April 19, 1984 (Ref. B-1), three areas of concern have surfaced: (1) inspection of welds in stainless steel pipe at several boiling water reactors (e.g., Monticello, Browns Ferry Unit 3) has revealed cracking in jet pump instrument line nozzles. The NRC staff considers these nozzles as part of the piping system and therefore, a jet pump instrument line nozzle inspection is required at the next scheduled plant outage; (2) axial cracks were found in the recirculation piping safe end to reactor vessel nozzle welds during weld inspections (Pilgrim Station). The axial cracks were the subject of Inspection and Enforcement Information Notice No. 84-41, "IGSCC in BWR Plants," dated June 1, 1984 (Ref. B-2); and (3) circumferential and axial cracking of Type 316L, low carbon stainless steel jet pump inlet riser safe ends, especially in the safe end to the thermal sleeve weld area (Peach Bottom Unit 2) were the subject of Inspection and Enforcement Information Notice No. 84-89, "Stress Corrosion Cracking in Nonsensitized 316 Stainless Steel," dated December 7, 1984 (Ref. B-3).

Discussion

All boiling water power reactor facilities holding an operating license or construction permit have been informed by the referenced Generic Letter/Information Notices of the above three areas of concern. The cracked recirculation piping (item 2 above) has been or is being replaced in some affected facilities. Other facilities having less extensive cracking are taking other mitigation measures. The other two areas of concern will be addressed in the licensees' responses to the reinspection requirements of Generic Letter 84-11, or in the forthcoming implementation of the NRC staff position in NUREG-0313, Revision 2, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping" (Ref. B-4).

As stated in NUREG-0090, Vol. 7, No. 2, the NRC has established a multiplant action (MPA) item to track the BWR pipe crack issue. This MPA item is designated B-84, "Inspection of BWR Stainless Steel Piping." Since the MPA item will be tracked through NUREG-0748, "Operating Reactors Licensing Actions Summary," (Ref. B-5), which is published monthly, it will no longer be reported routinely in the NUREG-0090 report series.

Therefore, unless new significant information becomes available, this incident is considered closed for the purposes of this report.

APPENDIX C

OTHER EVENTS OF INTEREST

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

1.0 Numerous Errors in Technical Specifications Submitted by a Licensee

From December 1980 to August 1984, Mississippi Power and Light Company (MP&L) forwarded a number of submittals to the NRC related to the development of the technical specifications for Grand Gulf Nuclear Station, Unit 1. Over 400 errors were discovered in the technical specifications. Grand Gulf Unit 1 utilizes a boiling water reactor and is located in Claiborne County, Mississippi. The licensee was issued a low power (5%) license for Grand Gulf Unit 1 on June 16, 1982; at the time, the NRC was unaware that the licensee's technical specifications contained numerous errors regarding various plant-specific design features.

Subsequent to issuance of the low power license, the NRC became aware that the licensee's submittals contained numerous errors regarding plant-specific design features. Based on a review of the licensee's submittals from December 1980 to August 1984, the NRC concluded that the submittals contained five alleged material false statements, as summarized below.

(1) On December 15, 1980, the licensee submitted a markup of the Standard Technical Specifications for General Electric Boiling Water Reactors (Ref. C-1) which the licensee stated reflected plant-specific design features. This statement was false because the technical specifications did not reflect plant-specific design features described in the licensee's final safety analysis report. This statement was material in that had the NRC known of the errors in the technical specifications, it would not have issued the low power operating license without requiring changes to the technical specifications.

(2) A markup of the technical specifications submitted on June 26, 1981, contained the same errors. Additional submittals and changes transmitted in letters dated December 31, 1981; January 12, February 25, March 23, April 5, 6, 7, and 30, May 26, June 1, 9 (two letters), and 10, 1982, did not correct the errors. Each of these submittals was a separate opportunity for the licensee to discover and correct the false submittal of December 15, 1980. The failure to do so constitutes a material false statement by omission. The statement was false because the licensee failed to correct the initial false submittal and to ensure that the technical specifications ultimately issued with the license reflected plant-specific design features. The statement was material because the NRC would not have issued the license had it been aware of the erroneous technical specifications.

(3) On June 14, 1983, the licensee provided additional proposed changes to the technical specifications which were "intended, in general, to enhance clarity or provide consistency with the plant design and operations." In two instances, the bases for the proposed changes were false. The statements were

material since an NRC reviewer might have made the requested changes if the errors had not been recognized.

(4) On June 23, 1984, the licensee provided additional proposed changes to the technical specifications, which as stated in (3) above, were "intended, in general, to enhance clarity or provide consistency with the plant design and operation." In one instance, the basis for a proposed change was false. The statement was material since an NRC reviewer might have made the requested change if the error had not been recognized.

(5) On August 5, 1984, the licensee certified in a letter that the technical specifications submitted to the NRC were accurate up to that time. However, the statement was false as reflected in an August 14, 1984, letter requesting additional changes to correct an error in the August 5, 1984, submittal. The statement was material since the NRC might have issued a license with erroneous technical specifications, had the licensee not subsequently corrected the error.

Numerous inspections involving these matters were conducted by the NRC and also several management meetings and Enforcement Conferences were held with the licensee. Written commitments were made by the licensee as a result of these meetings and inspection reports.

On March 21, 1985, the NRC forwarded to the licensee a Notice of Violation and Proposed Imposition of Civil Penalties in the amount of $125,000 (Ref. C-2). As stated in the forwarding letter, the primary responsibility for ensuring that the license contains appropriate technical specifications clearly rests with the licensee. The licensee's failure to fulfill its obligation to thoroughly know and understand the technical specifications which are a part of its license cannot be excused. The alleged material false statements listed in the Notice are indicative of a failure to exercise responsibility to ensure the accuracy and completeness of each and every submittal of information made or required to be made as part of the licensing process.

For the five alleged material false statements, the NRC considered proposing a civil penalty of $250,000 for these violations. However, in recognition of the fact that the informality of the NRC's process for review of technical specifications contributed to the problem, the proposed penalty was mitigated by 50%.

The NRC will closely monitor the licensee's corrective actions. Failure to carry them out satisfactorily could lead to further enforcement actions.

This event received considerable attention by Congress, the media and the public.

2. Failure of Tendon Anchor Heads in Containment Post-Tensioning System

On January 28, 1985, when Farley Unit 2 was shut down for refueling, inspection of the Unit 2 reactor containment building disclosed that a tendon anchor head had failed. Farley Unit 2 is operated by Alabama Power Company and is located in Houston County, Alabama. The plant utilizes a Westinghouse-designed pressurized water reactor which is housed in a post-tensioned concrete containment building.

The purpose of the tendons is to provide reinforcement to the concrete containment building by application of a compressive stress (i.e., post-tensioning force) to the concrete. When internal pressures are applied to the post-tensioned concrete, they are offset by the previously applied compressive stress. Failure of the tendon anchor head releases the post-tensioning force in the tendon.

The problem was discovered by a licensee employee who was conducting a pre-integrated leak rate test (an Appendix J, 10 CFR §50 requirement) walkdown of the exterior of the Unit 2 containment building. The employee noticed that a grease can (cap) covering the top of a vertical tendon was deformed. Inspection of the lower grease can on the same tendon disclosed that the lower grease can also was damaged. Removal of the lower grease can disclosed that the field anchor head had broken into seven pieces. In addition, numerous broken wires from the 170-wire tendon were found. Inspection of another tendon disclosed that the field anchor head on this tendon was cracked and separated into two pieces. The anchor heads and the tendons were supplied by INRYCO Inc., a subsidiary of the Inland Steel Company. Review of the tendon fabrication and installation records disclosed that the field anchor heads from both of these tendons had the same fabrication lot control number (i.e., lot control number HV).

Further review of the installation records disclosed that 47 other Unit 2 tendons had field anchor heads from lot control number HV. There were no anchor heads from lot control number HV installed in the Unit 1 containment. Based on manufacturing records, INRYCO concluded that there are no other anchor heads from lot control number HV installed at any other post-tensioned nuclear facility. In order to determine the cause of this problem, the utility implemented an extensive inspection and testing program. The inspection and testing program included visual inspection and replacement of the remaining 47 HV anchor heads, inspection of 55 randomly selected anchor heads from the non-HV lots, and performance of laboratory testing on the two failed and four other HV anchor heads.

The laboratory testing included chemical and physical properties, scanning, electron microscopy, as well as load testing. The testing was conducted at the Inland Steel Laboratory and at Battelle National Laboratory. Based on preliminary test results, available from both laboratories on February 24, 1985, the utility concluded that the failed anchor heads were not related to a specific lot control number. The primary failure mechanism was identified as hydrogen stress cracking, the cause of which was attributed to the presence of moisture around the anchor heads.

As a result, the licensee modified and expanded the inspection program to inspect all 130 vertical tendon anchor heads and all below-ground horizontal tendon anchor heads. Additionally, magnetic particle tests (MPT) were performed on the 24 HV lot anchor heads that had been removed from tendons. Eight of the 24 were found to have cracks when subjected to MPT. During the expanded visual inspection program, a third field anchor from a vertical tendon was found to be broken into five pieces. This anchor head was from lot control number HP, a different lot control number than the two previously identified failed anchor heads.

At a meeting held at the NRC offices in Bethesda, Maryland, on March 1, 1985, the licensee outlined a detailed program to resolve the tendon anchor head failures on Unit 2 and committed to perform an inspection of tendon anchor heads installed in the Unit 1 containment building.

An NRC Region II inspector, with extensive experience in tendon installation and tendon inservice inspection activities, performed detailed inspections of the utility's repair program and the activities to identify the cause of the problem. No violations or deviations were identified. In addition, test specimens were obtained by the NRC from two failed anchor heads (one each from HV and HP), and two non-failed HV anchor heads, for independent confirmatory laboratory testing. This testing was conducted at the Brookhaven National Laboratory (BNL) of Long Island, New York. The testing program was developed by NRC and BNL personnel. Based on the results of the testing, which were completed in early April 1985, BNL concluded that the tendon anchor head failures were caused by hydrogen stress cracking, which agreed with the results of the testing performed for the utility at Inland Steel and Battelle Labs.

The NRC issued Inspection and Enforcement Information Notice No. 85-10 on February 6, 1985, to all nuclear power reactor licensees to inform them of this event (Ref. C-3). The Notice also informed licensees of previous anchor head failures which occurred during construction of the Bellefonte and Byron facilities.

On March 8, 1985, the NRC issued Supplement 1 to Information Notice No. 85-10 to all nuclear power reactor licensees (Ref. C-4). This supplement updated information provided to the licensees on February 6, 1985, by identifying the cause of the tendon anchor head failures, presenting results of inspections performed by Alabama Power Company through March 1, 1985, and advising the licensees that the presence of moisture or free water during tendon surveillance activities should be considered as evidence of an abnormality and further action may be required.

The NRC has established a task force for a long-term program to identify and address the potential generic implications of the Farley Unit 2 event.

This event is not considered reportable as an abnormal occurrence since the problem did not involve a major reduction in the degree of protection of the public health or safety. The integrity of a post-tensioned concrete containment structure is based on a highly redundant system of several hundred tendons. Bechtel Corporation (the containment structural designer) verified that containment integrity is maintained with as many as eight vertical tendons detensioned for the 40-year design life. More safety margin exists earlier in containment lifetime.

3. Recent Emergency Diesel Generator Failures

During the past several months. there have been a number of engine failures of emergency diesel generators (EDGs), involving various reactor plants and makes of EDGs (see Table 1).

Because the various problems have occurred in engines that are far from the end of their normal design lives, there is some feeling both in the industry and the NRC that testing requirements may have aggravated certain weaknesses and led to premature failures. In order to avoid potential failures, several options have been suggested, including (1) licensees' adoption of NRC's (Generic Letter 84-15; see Ref. C-5) and manufacturers' recommendations on testing procedures to minimize stress and wear; (2) improved preventive maintenance, more frequent inspections, and improved operating practices by licensees; and (3) NRC

Table 1 Recent emergency diesel generator failures

Plant	Licensee	Plant Location	Reactor Type*	EDG Manufacturer	Event Date(s)
Fermi Unit 2	Detroit Edison Company	Monroe County, MI	GE	Fairbanks-Morse	1/10/85
McGuire Unit 2	Duke Power Company	Mecklenburg County, NC	W	Nordberg	1/31/85
North Anna Unit 1	Virginia Electric & Power Company	Louisa County, VA	W	Fairbanks-Morse	2/2/85, 2/4/85
North Anna Unit 2	Virginia Electric & Power Company	Louisa County, VA	W	Fairbanks-Morse	12/9/84, 1/13/85, 3/15/85
Susquehanna Unit 1	Pennsylvania Power & Light Company	Luzerne County, PA	GE	Cooper-Bessemer	7/82 to 4/85 (40 events)
Washington Nuclear Plant Unit 2	Washington Public Power Supply Co.	Benton County, WA	GE	Stewart-Stevenson (2); Morrison-Knudson (1)	1/31/85
Zion Units 1 and 2	Commonwealth Edison Company	Lake County, IL	W	Cooper-Bessemer	11/84 to 2/85 (Several events)

*GE = General Electric-designed boiling water reactor.
W = Westinghouse-designed pressurized water reactor.

reevaluation of reliability requirements and testing procedures and criteria (e.g., modify NRC Regulatory Guide 1.108, see Ref. C-6). To pursue these issues and to seek solutions to the problems, the NRC is consulting with manufacturers, the industry and interested parties.

The various recent problems are discussed below.

At Fermi Unit 2 on January 10, 1985, the licensee reported the trip of one of the four EDGs following low lube oil and high crankcase pressure alarms. Disassembly and inspection of the engine revealed damage to upper crankline connecting rod bearings, main bearings, connecting rods, pistons, and crankshaft. A number of parts were replaced. Inspection of the other Fermi EDGs was conducted. One other EDG engine showed some upper bearings which were damaged and all of these were replaced. The other two EDGs showed some wear but no repairs were necessary. The licensee has attributed the failures to inadequate prelubrication during fast starts, and is considering actions which include use of manual prelube prior to planned starts and loading EDGs more slowly during testing. Changes to the proposed technical specifications are necessary to implement these actions.

At McGuire Unit 2, on January 31, 1985, an EDG tripped on low lube oil pressure during an Engineered Safety Feature test. Upon restart, the engine experienced vibration and was manually tripped. Subsequent inspection revealed brass flakes on lube oil screens and in the crankcase. Four of eleven main bearings were damaged. In addition, the skirt of one piston and the crankshaft were both scored, requiring replacement. All main and connecting rod bearings have been replaced as a precaution. Further analyses are being done by the licensee. It appears that an initial misalignment of the lower crankcase bed during installation contributed to the damage.

At North Anna Unit 1, on February 2, and again on February 4, 1985, the jacket water tank for one of the diesel generator engines was found to be empty. On the second occasion, inspection revealed jacket water in several cylinders and in the engine lube oil, severe scoring of the number 3 cylinder liner and upper piston, seizure of the number 3 upper piston, and three failed upper main bearings. The apparent cause of the engine failure was a failure of a jacket water seal, which resulted in degraded lubrication to the number 3 cylinder and bearing damage. There may be a similarity between this failure and the North Anna Unit 2 engine failures, described below.

North Anna Unit 2 shut down from 100% power on December 9, 1984, due to engine failures on both diesel generators. One engine had water leaking from a cylinder liner. The other engine had shattered rings on one piston. On January 13, 1985, one EDG suffered another engine failure, and excessive wear was found on the rings of one of the pistons. On March 15, 1985, one EDG suffered another engine failure and tripped on high crankcase pressure. This failure was possibly due to water leakage from two cylinder liners. Several parts were replaced, as well as the liners. The licensee believes that the frequent and harsh test starts and rapid loading rate required by the technical specifications are a significant contributor to the EDG failures, and has proposed changes to reduce the severity and number of tests. The NRC is evaluating the proposed changes.

At Susquehanna Unit 1 subsequent to issuance of the operating license on July 17, 1982, there have been in excess of 40 EDG "failures," eight of which were considered to be "valid failures" according to Regulatory Guide 1.108. The most significant failures were associated with: (1) trips of EDGs due to spurious operation of the high connecting rod bearing temperature detector; (2) trips and sluggish operation due to cold emergency service water effect on governor oil; (3) sluggish operation of an air operated valve in the starting circuit due to moisture in the air; and (4) trips due to excessive turbocharger thrust bearing wear, possibly due to lack of turbocharger prelube. The licensee is evaluating corrective actions.

At Washington Nuclear Plant Unit 2, on January 31, 1985, the EDGs did not reach the required voltage to allow automatic closure of their output breakers during an actual scram and subsequent loss of offsite power event. The voltage adjust potentiometers for both EDGs were found to have been mistakenly left adjusted to the low voltage limit, which rendered the EDGs unavailable to support low pressure coolant injection systems. Both high pressure coolant injection systems were available and restored reactor water level, which had dropped to level 2 (-50"). Both EDGs were available, pending operator action to raise the voltages. The licensee has implemented design and procedural changes to preclude the possibility of a recurrence.

At Zion Units 1 and 2, between November 1984 and February 1985, there were a number of events involving the EDGs. The events of particular interest are: (1) on November 17, 1984, an EDG failed to start when an air start valve was seized and would not function; (2) on January 15, 1985, an EDG tripped from full power on high bearing temperature, due to a faulty relief valve in the lube oil line, causing lube oil to be diverted from the bearings; (3) on January 1, 1985, during an EDG operability test, a leak in the fuel oil supply line sprayed oil on the engine, which was then shutdown for cleaning and replacement of the supply line; and (4) on February 15, 1985, an EDG was declared inoperable due to a lube oil leak. The staff is currently reviewing the licensee's proposals for improving diesel generator reliability at Zion.

Diesel generator reliability is an important safety issue and needs to be improved. However, the recent series of EDG problems does not indicate the existence of a new generic problem of major safety concern. A common cause for the failures has not been identified. The actual safety consequences of the events were minimal. For these reasons, the events are not considered reportable as an abnormal occurrence.

Some of the events described above were included in Inspection and Enforcement Information Notice No. 85-32 (Ref. C-7), which was forwarded on April 22, 1985, to all power reactor facilities holding an operating license or a construction permit.

REFERENCES
FOR APPENDICES

B-1 Generic letter 84-11, "Inspections of BWR Stainless Steel Piping," from Darrell G. Eisenhut, Director, Division of Licensing, NRC office of Nuclear Reactor Regulation, to all licensees of operating reactors, applicants for operating license, and holders of construction permits for boiling water reactors, April 19, 1984.*

B-2 U.S. Nuclear Regulatory Commission, Inspection and Enforcement Information Notice No.84-41, "IGSCC in BWR Plants," June 1, 1984.*

B-3 U.S. Nuclear Regulatory Commission, Inspection and Enforcement Information Notice No. 84.-89, "Stress Corrosion Cracking in Nonsensitized 316 Stainless Steel," December 7, 1984.*

B-4 U.S. Nuclear Regulatory Commission, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," USNRC Report NUREG-0313, Revision 2. (The report is under preparation.)

B-5 U.S. Nuclear Regulatory Commission, "Operating Reactors Licensing Actions Summary (Orange Book)," USNRC Report series NUREG-0748, published monthly.**

C-1 U.S. Nuclear Regulatory Commission, "Standard Technical Specifications for General Electric Boiling Water Reactors," USNRC Report NUREG-0123, Revision 2 issued August,1979.**

C-2 Letter from James M. Taylor, Director, NRC Office of Inspection and Enforcement, to William Cavanaugh, III, President, Mississippi Power and Light Company, forwarding a Notice of Violation and Proposed Imposition of Civil Penalties, March 21, 1985.*

C-3 U.S. Nuclear Regulatory Commission, Inspection and Enforcement Information Notice No. 85-10. "Post-Tensioned Containment Tendon Anchor Head Failure," February 6, 1985.*

C-4 U.S. Nuclear Regulatory Commission, Inspection and Enforcement Information Notice No. 85-10, Supplement 1, "Post-Tensioned Containment Tendon Anchor Head Failure," March 8, 1985.*

C-5 Generic Letter 84-15, "Proposed Staff Actions to Improve and Maintain Diesel Generator Reliability," from Darrell G. Eisenhut, Director, Division of Licensing, NRC Office of Nuclear Reactor Regulation, to all licensees of operating reactors, applicants for an operating license, and holders of construction permits, July 2, 1984.*

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*Available in NRC Public Document Room, 1717 H Street, NW, Washington, DC 20555, for inspection and copying (for a fee).

**Available in NRC Public Document Room, 1717 H Street, NW, Washington, DC 20555, for inspection. Available for purchase from the GPO Sales Program, Superintendent of Documents, U.S. Government Printing Office, Post Office Box 37082, Washington, DC 20013-7982.

C-6 U.S. Nuclear Regulatory Commission, Regulatory Guide 1.108, "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants," Revsion 1 issued August 1977.*

C-7 U.S. Nuclear Regulatory Commission, Inspection and Enforcement Information Notice No. 85-32, "Recent Engine Failures of Emergency Diesel Generators," April 22, 1985.*

*U.S. GOVERNMENT PRINTING OFFICE:1985-461-721:20259

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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 January 1 to March 31, 1985. During the report period, there was one abnormal occurrence at the nuclear power plants licensed to operate; the event involved a premature criticality during reactor startup. There were three abnormal occurrences at the other NRC licensees. Two events involved diagnostic medical misadministrations and the other event involved unlawful possession of radioactive material. There were four abnormal occurrences reported by an Agreement State (Texas). Three events involved radiation overexposures; the other event involved a well logging source which was apparently stolen, but later was recovered. The report also contains information updating some previously reported abnormal occurrences.

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