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MASTER

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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 October 1 to December 31, 1988.

For this reporting period, there were no abnormal occurrences at nuclear power plants licensed to operate. There was one abnormal occurrence under other NRC-issued licenses involving a medical therapy misadministration. Three other abnormal occurrences were reported by Agreement States. The State of New York reported an event involving multiple medical therapy misadministrations. The State of Maryland reported two events, both occurring at the same hospital. One involved a single medical therapy misadministration and the second involved multiple medical therapy misadministrations.

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 that the Commission determines is significant from the standpoint of public health or safety.

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

The NRC has determined that only those events, including those submitted by the Agreement States, described in this report meet the criteria for abnormal occurrence reporting. This report covers the period from October 1 to December 31, 1988.

Information reported on each event includes date and place, nature and probable consequences, cause or causes, and actions taken to prevent recurrence.

## THE REGULATORY SYSTEM

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

In licensing and regulating nuclear power plants, the NRC follows the philosophy that the health and safety of the public are best assured through the establishment of multiple levels of protection. These multiple levels can be achieved and maintained through regulations specifying requirements that 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.

## REPORTABLE OCCURRENCES

Actual operating experience is an essential input to the regulatory process for assuring that licensed activities are conducted safely. Licensees are required to report certain incidents or events to the NRC. This reporting helps to identify deficiencies early and to 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 systems, which include not only the type and quality of reports required to be submitted, but also the methods used to analyze the data. In order to more effectively collect, collate, store, retrieve, and evaluate operational data, the information is maintained in computer-based data files.

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

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

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

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

AGREEMENT STATES

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

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

In early 1977, the Commission determined that abnormal occurrences happening at facilities of Agreement State licensees should be included in the quarterly reports to Congress. The abnormal occurrence criteria included in Appendix A

are applied uniformly to events at NRC and Agreement State licensee facilities. Procedures have been developed and implemented, and abnormal occurrences reported by the Agreement States to the NRC are included in these quarterly reports to Congress.

## FOREIGN INFORMATION

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

# REPORT TO CONGRESS ON ABNORMAL OCCURRENCES
# OCTOBER-DECEMBER 1988

## NUCLEAR POWER PLANTS

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

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## FUEL CYCLE FACILITIES

(Other Than Nuclear Power Plants)

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

## OTHER NRC LICENSEES

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

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

88-14 Medical Therapy Misadministration

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

Date and Place - November 17, 1988; Wilkes-Barre General Hospital; Wilkes-Barre, Pennsylvania.

Nature and Probable Consequences - On November 18, 1988, the licensee notified NRC Region I by telephone that a therapeutic misadministration had occurred involving a patient receiving treatment for an endo-bronchial tumor.

A radiotherapy physician had prescribed a therapeutic dose of 750 rads to the right bronchus at a distance of 0.5 centimeters from an iridium-192 source in a remote afterloading brachytherapy device. However the staff radiotherapy physicist mistakenly developed a treatment plan that delivered 750 rads at 1.0 centimeter from the source. This resulted in a dose of 1800 rads at 0.5 centimeters from the source, rather than the prescribed 750 rads.

The licensee stated that the dose received by the endo-bronchial tumor is within standard treatment protocols for that type of tumor and that no adverse effects are anticipated as a result of the misadministration.

However, the event was of concern because of the large magnitude of the error. NRC Region I conducted a special inspection at the licensee on November 29, 1988, to review the circumstances associated with the event and the corrective actions planned by the licensee to prevent recurrence. In addition, NRC Region I requested an NRC medical consultant to review the event.

Cause or Causes - The cause was attributed to human error. The licensee's staff radiotherapy physicist used the wrong table of the manual used to develop a treatment plan.

Actions Taken to Prevent Recurrence

Licensee - Corrective actions include independent verifications of treatment calculations (one by a dosimetrist and one by a radiotherapist), providing additional training on the therapy equipment, and providing an additional chart for determining maximum treatment times for each treatment plan.

NRC - On December 16, 1988, NRC Region I sent a Confirmatory Action Letter to the licensee confirming the licensee's corrective action plans (Ref. 1). The NRC's consultant confirmed the licensee's statement that the dose received was within standard treatment protocols and that no adverse effects on the patient were anticipated. The report for the November 29, 1988 NRC inspection was issued on February 8, 1989 (Ref. 2). NRC Region I has scheduled a management meeting with the licensee to review the licensee's corrective actions.

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

* * * * * * * *

## AGREEMENT STATE LICENSEES

Procedures have been developed for the Agreement States to screen unscheduled incidents or events using the same criteria as the NRC (see Appendix A) and report the events to the NRC for inclusion in the quarterly reports to Congress. For this report, the Agreement States reported the following abnormal occurrences to the NRC:

### AS88-4 Multiple Medical Therapy Misadministrations

Appendix A (see the general criterion) of this report notes that an event involving a moderate or more severe impact on public health or safety can be considered an abnormal occurrence.

Date and Place - Nineteen patients between January 1988 and August 1988; Rochester General Hospital; Monroe County, New York.

Nature and Probable Consequences - On August 23, 1988, the New York State Department of Health, Bureau of Environmental Radiation Protection (State Agency), was notified of a series of cobalt teletherapy misadministrations at the hospital. The hospital was using a computer program in treatment planning for cobalt teletherapy patients. The procedure in use by the physics staff was to enter fractional wedge factors into a utility file in the computer, which then used the

factors to normalize isodose curves to the values they would have in an "open" plan (without wedges). The wedge factors were applied in a subsequent manual calculation to arrive at the correct treatment time.

It appears that in April 1988, someone altered the data in the wedge file so that the computer now applied the wedge factors. These factors were applied again in the subsequent treatment time calculations resulting in substantial errors in the treatment times calculated for wedged fields. The licensee believes the data was changed when a software upgrade was loaded, and originally believed that loading the software altered the wedge factors. The software manufacturer, however, asserted that this was impossible and that it would have required deliberate action to access and change the data.

Fourteen patients received doses that exceeded the prescribed total doses by greater than 10 percent. In addition, five patients received fractional doses that exceeded the prescribed dose per fraction by greater than fifty percent, although their treatments were terminated before the total error exceeded 10 percent. The largest total overdose was 81 percent, and the largest fractional overdose was 119 percent.

On August 25, 1988, a consultant physicist retained by the State Agency visited the hospital to assess the extent of the problem. He found two additional problems: (1) output calibrations performed by a previous assistant physicist omitted two necessary correction factors, which fortunately cancelled each other numerically, and (2) incorrect data on the physical dimensions and composition of one wedge had been entered into the computer in January 1988. The senior physicist had measured the wedge transmission with a dosimeter and was aware that his measured factor differed substantially from the factor calculated by the computer using the input on physical dimensions and composition. However, he did not attempt to resolve the discrepancy and used the measured factor to calculate treatment times.

During the period January to April 1988, use of the incorrect data entered in the wedge file in January resulted in dose distribution patterns that differed from those seen and approved by the prescribing physician. After the wedge file data was changed in April, the incorrect data actually helped to reduce the percent of error by "splitting the difference."

All patients were notified of the errors and an outside radiation oncologist was brought in to evaluate any possible impact on the affected patients and make recommendations.

Cause or Causes - The person who is alleged to have made the changes in the wedge data files had advanced degrees and work experience in applied physics. However, he had no training and experience in medical physics prior to his employment at the Rochester General Hospital, beginning in August 1987, under the supervision of an experienced medical physicist. Although in January 1988, the supervising physicist had decided that the individual was competent to work independently, it appears that he did not understand the significance of the changes he apparently made and should have been more closely supervised.

The supervising physicist had also failed to observe the errors in calibration reports by a previous assistant physicist and had not acted to resolve a discrepancy between a computer generated wedge factor and the measured factor.

No one made any quality assurance tests after the software upgrade was loaded, or routinely ran test plans to check the operation of the treatment planning system.

The causes of this series of misadministrations appear to have been lack of supervision, inadequate quality assurance, and an inadequate program to identify and eliminate errors.

Actions Taken to Prevent Recurrence

Licensee - The licensee proposed a corrective action plan which included recruitment of a second certified medical physicist. The State Agency has asked the licensee to provide a better description of the supervisory responsibilities of the senior physicist and of actions to ensure a specified level of accuracy in dose delivery.

State Agency - The Agency has taken enforcement action against the licensee and has amended all teletherapy licenses to require quality assurance, reporting of misadministrations, and a medical physicist with specified qualifications for each license. Code amendments are in preparation.

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

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AS88-5 Medical Therapy Misadministration

Appendix A (see the general criterion) of this report notes that an event involving a moderate or more severe impact on public health or safety can be considered an abnormal occurrence.

Date and Place - Discovered on August 29, 1988; Sacred Heart Hospital; Cumberland, Maryland.

Nature and Probable Consequences - On September 2, 1988, Maryland's Center for Radiological Health (State Agency) was notified by the licensee that an 81 year old patient had received a therapeutic dose of 1400 rads to a part of the body which was not scheduled for radiation therapy.

The patient was scheduled to receive radiation therapy exposures for a total of 3,000 rads to the right maxillary sinus from a cobalt-60 teletherapy machine. The total exposure was to be administered in increments over a period of time. Two ports of the teletherapy device unit were used during these treatments; however, one port was improperly aligned toward the base of the brain, rather than toward the right maxillary sinus. Seven incremental exposures between August 8 and August 26, 1988, were administered before the oncologist discovered the error on August 29, 1988, and halted the treatments. As a result, the base of the brain received a total of 1,400 rads. The oncologist stated that the misadministration did not cause any medical side effects. On later dates, the patient received additional exposures to the right maxillary sinus to conclude the 3,000 rads prescribed dose.

Cause or Causes - The oncologist improperly aligned the teletherapy unit's lateral port to the patient's skull.

Actions Taken to Prevent Recurrence

Licensee - In the report to the State Agency, the oncologist stated that she would exercise increased vigilance and alertness in performing her work.

State Agency - During the subsequent investigation at the hospital, the State Agency's investigator and the oncologist discussed additional methods to prevent recurrence, such as conducting the resimulation of the port areas earlier than two weeks into a patient's treatment program and establishing a film method for using the cobalt-60 source in producing a patient image to determine port locations.

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

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AS88-6 Multiple Medical Therapy Misadministrations

Appendix A (see the general criterion) of this report notes that an event involving a moderate or more severe impact on public health or safety can be considered an abnormal occurrence.

Date and Place - Thirty-three patients between September 1987 and October 1988; Sacred Heart Hospital; Cumberland, Maryland.

Nature and Probable Consequences - On October 27, 1988, Maryland's Center for Radiological Health (State Agency) was notified by the hospital's Vice President that over the past 13 months, 33 patients undergoing brain cancer treatments had received therapeutic radiation exposures from a cobalt-60 teletherapy machine that exceeded 10% of the prescribed dose in each case.

All 33 patients had been diagnosed as terminally ill prior to the initiation of their treatments. The hospital's consulting physicist later determined that each patient had received a radiation exposure that was 75% greater than the prescribed dose. At the time of the notification to the State Agency, 20 patients had died, either during the course of their treatment or after the conclusion of treatment. The Vice President believed that none of the deaths were attributable to the excessive radiation doses.

The hospital's therapy staff had observed severe skin erythemas on several patients during the thirteen month span and expressed their concerns to the hospital oncologist, who determined the erythemas to be normal during treatment. Finally, after a skin erythema was again observed on a patient undergoing treatment, the hospital physicist was notified. The physicist determined that a computer program file used for the treatment of brain cancer and identified for use "with trimmer bars" was not updated in March 1987 when the therapy department replaced a depleted cobalt-60 source. Other program files had been updated to reflect the current cobalt-60 source, but the aforementioned file had not been updated because, as the oncologist stated to the consulting physicist during the March 1987 source calibration, "trimmer bars" were not used to treat patients requiring whole brain irradiation. However, in September 1987, the oncologist initiated brain treatments using the "trimmer bar" computer file with the data reflecting the prior source, thereby causing the actual doses to be 75% greater than the prescribed doses.

Once the file was identified, it was removed and stored under lock and key. The physicist reviewed all computer files for their accuracy and proper identification and measured the output of the cobalt-60 source. No changes were needed in the remaining files. The hospital suspended the oncologist pending the investigation and removed this individual as radiation safety officer and as Chairman of the Medical Isotopes Committee.

The hospital retained the services of an oncologist from the University of Virginia Medical Center to perform an independent review of the patient records to determine if the radiation doses contributed to and enhanced patient deaths.

In addition, the State Agency retained the services of a medical physicist representing Radiation Physics Associates of Louisville, Kentucky, and an oncologist from the Johns Hopkins Medical Institutions of Baltimore, Maryland. Investigation activities by these doctors included measuring the radiation output of the cobalt-60 unit, reviewing the computer program files, and reviewing the medical charts of those patients who incurred misadministrations.

Cause or Causes - The error which resulted in the misadministrations was due to the hospital oncologist's use of a computer program file that was not updated to reflect the current cobalt-60 source information. Also, the oncologist failed to perform manual calculations to cross check the computer chart calculations that would have identified this problem earlier.

Actions Taken To Prevent Recurrence

Licensee - The hospital oncologist who was responsible for the misadministrations has resigned. During the time of this investigation the hospital has hired two interim oncologists. According to the hospital administrator, the hospital is actively pursuing the hiring of a full-time oncologist. Also, the hospital's consulting physicist has made weekly visits to the hospital to ensure that the therapy program's operations are smooth, efficient, and safe for both the hospital's patients and the therapy staff.

State Agency - The Agency is waiting for all written reports to be sent from those individuals hired to conduct independent evaluations of this incident. After all reports are reviewed and evaluated, the Agency will then decide upon and proceed with the proper compliance action against the licensee.

NRC - On December 2, 1988, the NRC issued Information Notice No. 88-93 ("Teletherapy Events") to all NRC medical licensees to emphasize the importance of the correct use of computerized treatment planning (Ref. 3). The Notice described the above event, as well as therapy misadministrations due to errors in computerized treatment planning that occurred at hospitals in the Agreement State of New York. The latter events were described in Agreement State abnormal occurrence No. AS87-5 in NUREG-0090, Vol. 10, No. 3 ("Report to Congress on Abnormal Occurrences: July-September 1987").

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

## REFERENCES


1. Confirmatory Action Letter No. 88-28 from William V. Johnston, Acting Director, Division of Radiation Safety and Safeguards, NRC Region I, to Nate Boring, Vice President, Wilkes-Barre General Hospital, Docket No. 30-10942, December 16, 1988.*

2. Letter from Stewart D. Ebneter, Director, Division of Radiation Safety and Safeguards, NRC Region I, to Nate Boring, Vice President, Wilkes-Barre General Hospital, forwarding Inspection Report No. 30-10942/88-1 and Notice of Violation, Docket No. 30-10942, February 8, 1989.*

3. U.S. Nuclear Regulatory Commission, NRC Information Notice No. 88-93, "Teletherapy Events," December 2, 1988.*


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

## APPENDIX A

## ABNORMAL OCCURRENCE CRITERIA

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

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

1. Moderate exposure to, or release of, radioactive material licensed by or otherwise regulated by the Commission;

2. Major degradation of essential safety-related equipment; or

3. Major deficiencies in design, construction, use of, or management controls for licensed facilities or material.

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

For All Licensees

1. Exposure of the whole body of any individual to 25 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 that is judged to be significant relative to normally expected performance and that is judged to be caused by theft or diversion or by substantial breakdown of the accountability system.

8. Any substantial breakdown of physical security or material control (i.e., access control, containment, or accountability systems) that significantly weakened the protection against theft, diversion, or sabotage.

9. An accidental criticality [10 CFR §70.52(a)].

10. A major deficiency in design, construction, or operation having safety implications requiring immediate remedial action.

11. Serious deficiency in management or procedural controls in major areas.

12. Series of events (where individual events are not of major importance), recurring incidents, and incidents with implications for similar facilities (generic incidents) 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 that result in loss of plant capability to perform essential safety functions such that a potential release of radioactivity in excess of 10 CFR Part 100 guidelines could result from a postulated transient or accident (e.g., loss of emergency core cooling system, loss of control rod system).

For Fuel Cycle Licensees

1. A safety limit of license technical specifications is exceeded and a plant shutdown is required [10 CFR §50.36(c)].

2. A major condition not specifically considered in the safety analysis report or technical specifications that requires immediate remedial action.

3. An event that seriously compromised the ability of a confinement system to perform its designated function.

## APPENDIX B

## UPDATE OF PREVIOUSLY REPORTED ABNORMAL OCCURRENCES

During the October through December 1988 period, NRC licensees, Agreement States, Agreement State licensees, and other involved parties, such as reactor vendors and architect-engineering firms, continued with the implementation of actions necessary to prevent recurrence of previously reported abnormal occurrences. The referenced Congressional abnormal occurrence reports below provide the initial and any subsequent updating information on the abnormal occurrences discussed. The updating provided generally covers events that took place during the report period; some updating, however, is more current as indicated by the associated event dates. Open items will be discussed in subsequent reports in the series.

### 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 (NUREG-0090, Vol. 2, No. 2 through Vol. 11, No. 3). It is planned to continue these updates until defueling activities at the site are completed. The update of activities for this report period is as follows:

##### Reactor Vessel and Ex-Vessel Defueling Operations

During the October through December 1988 period, approximately 5,000 pounds of fuel and debris were removed from the reactor vessel. As of the end of 1988, the total mass loaded into canisters is approximately 208,000 pounds (69 percent) out of a total of approximately 300,000 pounds of core debris and other materials. The total mass to be removed includes the mass of the core; structural and absorber materials; mass added by oxidation of core and structural material; and portions of the baffle plates, formers, and other components that will become co-mingled with core debris during cutting operations. The original core area has been defueled; principal remaining areas are the Lower Core Support Assembly (LCSA), lower head, and radially outside the core baffle plates.

During the period, LCSA disassembly and defueling operations continued, using the core drilling rig and a plasma arc cutting torch. The LCSA consists of five layers or sections. The three uppermost sections of the LCSA [i.e., the lower grid rib section (LGRS), the flow distributor plate (FDP), and the grid forging] have been sectioned and removed from the reactor vessel and placed underwater in a modified core flood tank for shielding. Work on defueling and sectioning of the guide tube support plate is in progress. Work on the flow distributor will be performed later.

##### Decontamination and Dose Reduction Activities

Since early December 1988, the licensee focused its efforts on the completion of defueling and the support of that activity. Decontamination (other than reactor building) and system flushing activities were suspended, except for limited efforts to maintain access to activate systems and components.

Efforts to remove the resins from the makeup and purification demineralizers were largely successful. These resins contain high levels of activity because they were in service at the time of the 1979 accident. Preliminary results indicate that greater than 80 percent of the resins have been removed. The remaining block of agglomerated fused resin beads has resisted removal efforts. The removal effort has been suspended.

## Fuel Cask Shipments

During the period, one additional shipment containing 6,000 pounds of core debris was made from TMI-2 to the Idaho National Engineering Laboratory (INEL). As of December 31, 1988, the total amount shipped was 197,000 pounds (68 percent of the total amount of core debris). The licensee replaced the gaskets on shipping cask lids in December 1988, to assure that they will function under accident conditions at temperatures as low as minus 40 degrees Fahrenheit. The new gaskets are made of a different type of neoprene rubber.

## Post-Defueling Monitored Storage

As mentioned in previous reports, on April 27, 1988, the NRC staff issued Draft Supplement 3 to the Programmatic Environmental Impact Statement (PEIS) related to the decontamination and disposal of radioactive waste resulting from the March 29, 1979, accident at TMI-2 (Ref. B-1). This Supplement evaluates the impacts of the licensee's proposal to place the facility in a state of Post-Defueling Monitored Storage (PDMS) until Unit 1 is ready for decommissioning.

As discussed further below, the NRC staff received final comments on the draft Supplement from the Advisory Panel for the Decontamination of TMI-2 in October 1988. The NRC staff is evaluating the comments and preparing the final Supplement 3 to the PEIS.

## Proposal to Dispose of Accident-Generated Water

The public hearing on evaporation of accident-generated water (AGW) at Three Mile Island Unit 2 by the NRC Atomic Safety and Licensing Board Panel (ASLBP) concluded on November 15, 1988. Contentions being litigated were the analysis of the "no action alternative," characterization of the AGW, evaluations of potential release of microorganisms, and the health effects of tritium. On February 2, 1989, the ASLBP issued an initial decision deciding in favor of the applicant in all relevant matters and concluded that the requested amendment authorizing the disposal of the water should be issued. This issue is currently pending Commission review.

## TMI-2 Advisory Panel Meetings

The Advisory Panel for the Decontamination of Three Mile Island Unit 2 (Panel) met with the NRC Commissioners on October 25, 1988. The Panel recommended that the licensee not be allowed to proceed with PDMS at the current time. Their opposition to the PDMS proposal was due to uncertainties in length of the storage period, and the future funding necessary to complete cleanup or decommission the facility. Also, the Panel expressed concern that the proposal had poorly defined endpoints and would not significantly reduce worker exposure due to long term storage.

The Panel will continue to follow issues related to fuel removal, PDMS, and the evaporation of AGW.

Future reports will be made as appropriate.

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85-14 Management Deficiencies at Tennessee Valley Authority

This abnormal occurrence was originally reported in NUREG-0090, Vol. 8, No. 3, "Report to Congress on Abnormal Occurrences: July-September 1985," and updated in subsequent reports in this series (Vol. 9, No. 1; Vol. 9, No. 2; Vol. 9, No. 3; Vol. 10, No. 2; Vol. 10, No. 4; Vol. 11, No. 1; Vol. 11, No. 2; and Vol. 11, No. 3). It is further updated for this report period as follows:

Overview of Sequoyah Issues

Since the shutdown of both Sequoyah units in August 1985, the Tennessee Valley Authority (TVA) and the NRC have worked to resolve the issues to be addressed before the restart of Sequoyah. On the basis of the NRC staff review of the TVA program to resolve these issues and corrective actions taken by TVA, the NRC authorized TVA to restart both units. TVA was authorized to restart Unit 2 on March 30, 1988, and achieved criticality on May 13, 1988; TVA was authorized to restart Unit 1 on November 5, 1988, and achieved criticality on November 6, 1988.

Sequoyah Unit 1 Restart

TVA completed the required portions of its corrective action program necessary for Sequoyah Unit 1 restart in October 1988; based on TVA's certification and on the results of its own restart readiness review, the NRC staff approved the restart of Unit 1 on November 5, 1988. During the heatup process, prior to reaching criticality, TVA identified several maintenance items that would require corrective actions in the near term. These items included leaks in both the primary and secondary safety valves, leakage through the reactor vessel inner O-ring seal, a defect in the voltage control system for one emergency diesel generator, and leaks in several non-safety steam and cooling systems. TVA expected that similar deficiencies would be identified during the ascent to rated power and elected to repair these deficiencies during the same maintenance outage. Consequently, TVA requested, and the NRC staff granted, permission for a limited period of power operation before these deficiencies were corrected. TVA committed to begin its outage within three weeks of the start of power operation (by December 1, 1988).

Criticality was achieved on November 6, 1988, and power ascension and operation continued uneventfully until November 18, 1988. At that time a fault occurred in the plant main generator resulting in the tripping of the turbine which, in turn, tripped the reactor. The post-trip review identified the cause of the generator fault as a short in one of the stator coils; the short required the removal and repair of the coil. TVA elected to start the maintenance outage to complete the repair of the generator and the additional items discussed earlier. TVA completed this work and resumed power operations on December 27, 1988.

TVA Management and Personnel

As noted in the previous report (i.e., NUREG-0090, Vol. 11, No. 3), TVA had planned to replace Steven A. White as Senior Vice President, Nuclear, with Oliver D. Kingsley, Jr. on November 1, 1988. Since Sequoyah Unit 1 was in the midst of its approach to initial criticality, TVA elected to delay the replacement of Mr. White until after power ascension and testing were completed. The transfer of responsibility became effective on November 22, 1988, shortly after the reactor trip at Unit 1 described above.

Future reports will be made as appropriate.

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## OTHER NRC LICENSEES

### 87-13 Significant Breakdown in Management and Procedural Controls at an Industrial Radiography Licensee.

This abnormal occurrence was originally reported in NUREG-0090, Vol. 10, No. 2, "Report to Congress on Abnormal Occurrences: April-June 1987" and updated in Vol. 11, No. 2. It is further updated, and closed out, as follows:

United States (U.S.) Testing has satisfactorily completed 95% of their improvement action items and should achieve 100% in the first quarter of 1989.

The licensee's Chief Executive Officer, President, and Vice President are personally involved in radiation safety management and provide the oversight needed to coordinate the licensee's wide ranging radiation safety program.

Recent inspections at U.S. Testing's Modesto, California, and Hoboken, New Jersey, offices indicate that strong upper and middle management have organized a unified radiation safety program and eliminated the confusion that had been pervasive in the licensee's organization at all levels.

Additional NRC enforcement action is pending until the NRC Office of Investigation report is released.

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

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### 88-5 Breakdown in Management Controls at Georgia Institute of Technology Research Facility

The abnormal occurrence was originally reported in NUREG-0090, Vol. 11, No. 1, "Report to Congress on Abnormal Occurrences: January-March 1988." It is updated, and closed out, as follows:

As discussed in the previous report, on January 20, 1988, the NRC issued an Order Modifying License (Ref. B-2) to the Georgia Institute of Technology (Georgia Tech) because of management and program deficiencies at their research reactor (GTRR). The immediately effective Order required the licensee to suspend

irradiation experiments at the facility until requirements of the Order were satisfied and the NRC approved the resumption of irradiation experiments. The licensee voluntarily shut down the GTRR on February 15, 1988. On March 17, 1988, the NRC issued to the licensee a Confirmatory Order Modifying License (effective immediately) confirming the licensee's commitments made at an enforcement conference on February 23, 1988 (Ref. B-3).

An NRC team inspection was conducted from August 29 to September 9, 1988, and from November 7-10, 1988, in order to address the licensee's commitments to the two NRC Orders. The inspection also examined subjects which are usually addressed in routine operations and health physics inspections of research reactors. The initial results of this special inspection concluded that there were numerous examples of inadequate or absent procedures for the conduct of routine operations and surveillance. However, by the close of the inspection, adequate procedures and practices were in place, and the facility staff had received training in the new procedures. The inspection findings substantiated that appropriate actions had been taken to correct the major deficiencies that led to the issuance of the two Orders. The inspection findings also indicated that certain other activities, although of lesser safety significance, appeared to violate NRC requirements. The licensee was issued a Notice of Violation concerning these activities, details of which are discussed in the inspection report forwarded to the licensee on December 29, 1988 (Ref. B-4). By the end of the inspection, all corrective actions for these violations had been completed; therefore, no response to the inspection report was required from the licensee.

In a letter to Georgia Tech dated November 15, 1988, NRC Region II stated that based on the previously mentioned inspections and the corrective actions taken by the licensee, the NRC had determined that the reactor could be restarted and that irradiation experiments could be resumed (Ref. B-5).

Also on November 15, 1988, the NRC issued a Notice of Violation and Proposed Imposition of Civil Penalty for the GTRR management and program deficiencies from 1987 (Ref. B-6). The civil penalty was escalated 100% to $5,000 because of prior poor performance and failure to take prompt corrective action on the management control problems. The licensee paid the civil penalty on December 20, 1988.

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

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## APPENDIX C

## OTHER EVENTS OF INTEREST

The following items are described because they may possibly be perceived by the public to be of public health 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. Pressurizer Surge Line Thermal Stratification at Trojan

Portland General Electric Company, the licensee for the Trojan plant, has observed unexpected movement of the pressurizer surge line at every refueling outage since 1982, when monitoring of the line movements began. The monitoring program was implemented after removal of a thermal sleeve that was found to have cracked attachment welds. Trojan is a Westinghouse-designed pressurized water reactor (PWR) located in Columbia County, Oregon.

In April 1988, during the latest refueling outage, the licensee found that in addition to unexpected gap closures in the pipe whip restraints, the piping actually contacted two restraints. Although the licensee had repeatedly adjusted shims and gap sizes based on analysis of various postulated conditions, the problem had not been resolved. The most recent investigation by the licensee confirmed that the movement of piping was caused by thermal stratification in the line. This phenomenon was not considered in the original piping design.

Unexpected piping movements are highly undesirable because of potentially high piping stress that may exceed design limits for fatigue and stresses. The problem can be more acute when the piping expansion is restricted, such as through contact with pipe whip restraints. Plastic deformation can result, which can lead to high local stresses, low cycle fatigue, and functional impairment of the line. Analysis performed by the Trojan licensee indicated that thermal stratification occurs in the pressurizer surge line during heatup, cooldown, and steady-state operations of the plant.

During a typical plant heatup, water in the pressurizer is heated to about 440°F; a steam bubble is then formed in the pressurizer. Although the exact phenomenon is not thoroughly understood, as the hot water flows (at a very low flow rate) from the pressurizer through the surge line to the hot-leg piping, the hot water rides on a layer of cooler water, causing the upper part of the pipe to be heated to a higher temperature than the lower part. The differential temperature could be as high as 300°F based on expected conditions during typical plant operations. Under this condition, differential thermal expansion of the pipe metal can cause the pipe to deflect significantly.

For the specific configuration of the pressurizer surge line in the Trojan plant, the line deflected downward and when the surge line contacted two pipe whip restraints, it underwent plastic deformation; this resulted in permanent deformation of the pipe.

The significance of unexpected high piping stresses is that the piping may crack, particularly if the weakened piping is subjected to additional stresses induced by a seismic event, water hammer, or some other cause. Concerns related to high piping stresses for various plants have been described in NRC Bulletin No. 79-13,

Revision 2, "Cracking in Feedwater System Piping" (Ref. C-1) and in NRC Bulletin No. 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems" (Ref. C-2). The event described in the latter Bulletin was also reported as abnormal occurrence No. 88-3 ("Cracked Pipe Weld in Safety Injection System at Farley Unit 2") in NUREG-0090, Vol. 11, No. 1 ("Report to Congress on Abnormal Occurrences: January-March 1988").

The Trojan event demonstrates that thermal stratification in the pressurizer surge line causes unexpected piping movement and potential plastic deformation. The licensing basis according to 10 CFR §50.55a for all PWRs requires that the licensees meet the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Sections III and XI and to reconcile the pipe stresses and fatigue evaluation when any significant differences are observed between measured data and the analytical results for the hypothesized conditions. Staff evaluation indicates that the thermal stratification phenomenon could occur in all PWR surge lines and may invalidate the analyses supporting the integrity of the surge line. The staff's concerns include unexpected bending and thermal striping (rapid oscillation of the thermal boundary interface along the piping inside surface) as they affect the overall integrity of the surge line for its design life (e.g., the increase of fatigue).

On October 7, 1988, the NRC issued Information Notice No. 88-80 ("Unexpected Piping Movement Attributed to Thermal Stratification") to all holders of operating licenses or construction permits for PWRs to inform them of the Trojan event (Ref. C-3).

On December 20, 1988, the NRC issued Bulletin No. 88-11 ("Pressurizer Surge Line Thermal Stratification") to the same recipients (Ref. C-4) to: (1) request that U.S. applicants or licensees of PWRs establish and implement a program to confirm pressurizer surge line integrity in view of the occurrence of thermal stratification; and, (2) require them to inform the NRC of the actions taken to resolve this issue. The Bulletin outlines detailed actions to be taken by the U.S. licensees to examine the piping vulnerable to thermal stratification and resultant deformation, to determine safety significance of pipe movement and deformation, and to take steps to eliminate these concerns.

Although not requested by the Bulletin, recipients were encouraged to work collectively to address the technical concerns associated with this issue, as well as to share pressurizer surge line data and operational experience. In addition, they were encouraged to review piping in other systems which may experience thermal stratification and thermal striping, especially in light of the previously mentioned Bulletin Nos. 79-13 and 88-08. The NRC intends to review operational experience to determine if further generic communications are required.

The actual impact of the event on safety was small; therefore, it is below the threshold for abnormal occurrence reporting. However, the event is of concern because of the potential failure of systems designed to contain radioactive material due to an unexpected cause and because of the potential generic implications.

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## 2. Radioactive Contamination of Plant Equipment and Waste

On August 25, 1988, lead waste shipped by truck from ALCO Pacific, Inc., of Gardena, California, was rejected at the Casmalia Toxic Waste site because of radiation levels of up to 1.4 millirem/hour at the surface of the waste. The truck with the contaminated waste returned to ALCO Pacific. Meanwhile, a representative of Casmalia Toxic Waste notified Environmental Radiation Management (ERM) of the California Department of Health Services of the event. ERM notified the Los Angeles field office of the event and requested that the Los Angeles County Health Department be notified.

ALCO Pacific, a non-licensee, operates a lead reprocessing facility. Lead waste products, received from various states as well as local companies in the Los Angeles area, are reprocessed by incineration. An ERM Health Physicist went to the facility and confirmed radiation levels above background in the returned waste shipment. Radiation levels in the work and public areas did not exceed background levels. The Los Angeles County Health Department had samples of the waste analyzed, and the analyses indicated levels between 3 and E-3 microcuries of Cs-137.

ALCO Pacific was advised by ERM to obtain the services of a knowledgeable firm to decontaminate and remove the radioactive waste, and to cease operations until the magnitude of the problem had been identified and any hazards eliminated. ALCO Pacific complied and hired AWC, Inc. of Las Vegas, Nevada, for assessment and cleanup. A representative of AWC, Inc. responded on September 19, 1988 and made a complete survey of the facility. In addition to the waste, radiation levels of 100 microrems/hour were detected in the facility's baghouse. The recycled lead product, however, did not have measurable levels of radiation above background.

The AWC, Inc. representative was able to trace the cause of the radioactivity to a Cs-137 source inadvertently left in a shipment of source holders and shields from J. L. Shepherd Associates of San Fernando, California. AWC, Inc. packaged the contaminated waste and decontaminated the baghouse. Fifty-two drums of waste from the baghouse contained significant levels of cadmium and lead as well as Cs-137. This waste is being stored at ALCO Pacific awaiting final disposal as mixed waste. The remaining waste was shipped in approximately 500 drums to the Beatty (Nevada) Low Level Waste Site.

Decontamination was complete, the furnace reignited, and operations resumed on September 28, 1988. ALCO Pacific has requested State assistance in disposing of or storing the 52 drums of mixed waste.

In order to help prevent recurrence of similar events, ALCO Pacific purchased a radiation meter to survey incoming shipments. The California Department of Occupational Safety (DOSH) investigated the operations of J. L. Shepherd Associates and found failures to maintain accurate and clear records. A notice of violation was issued and authorization for removal of sealed sources from source holders has been temporarily suspended by DOSH, pending satisfactory completion of corrective actions. J. L. Shepherd Associates is contesting the investigation findings.

The effect on public health or safety, including plant workers, was minimal for this event. However, had the source been of a much higher activity, the

consequences could have been significant, not only to public health or safety, but also in regard to the costs associated with decontamination of the facility. The most significant aspect of this event is that a licensee had lost control of licensed material.

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3. Breakdown of Management Controls at a Nuclear Pharmacy's Facilities

On October 12, 1988, the NRC issued an Order Modifying Licenses (effective immediately) to two nuclear pharmacies (located in Blue Ash, Ohio, and Columbus, Ohio) operated by Syncor International Corporation of Chatsworth, California (Ref. C-5). The Order required additional quality assurance measures at the facilities as a result of improperly labeled radiopharmaceuticals being distributed by the Blue Ash facility and inadequate quality control measures at both facilities. The Order also required Syncor to assess corporate oversight at a sampling of various Syncor facilities. Syncor International operates many facilities which distribute radiopharmaceuticals to medical institutions for diagnostic and therapeutic medical procedures.

In April and May 1988, NRC Region III was notified of several misadministrations of diagnostic radiopharmaceuticals occurring at hospitals serviced by the Syncor operation at Blue Ash. Syncor had distributed 17 patient doses of one radiopharmaceutical incorrectly labeled as another. This mislabeling resulted in 14 diagnostic misadministrations at seven hospitals. In August 1988, NRC Region III interviewed a sample of customers of the Blue Ash facility and identified numerous other occurrences of improperly tagged or labeled radiopharmaceuticals being provided to these customers. (Tagging is the chemical combination of a radioactive material and other materials which determine the behavior of the radiopharmaceutical in the body. Different tagging substances are used for various diagnostic procedures. Labeling is the identification of the radiopharmaceutical on its container.) Each of these improperly tagged or labeled doses resulted in diagnostic misadministrations or in unnecessary organ and whole body doses during the diagnostic procedures.

On July 13, 1988, NRC Region III issued a Confirmatory Action Letter to the Blue Ash facility documenting the licensee's agreement to implement improvements to its quality assurance/quality control program and to properly report misadministrations (Ref. C-6).

On September 2, 1988, NRC Region III issued a second Confirmatory Action Letter to the Blue Ash facility documenting the licensee's agreement to provide an independent verification by two individuals that radiopharmaceuticals have been properly tested and labeled before distribution (Ref. C-7).

As a result of the Blue Ash findings, NRC Region III conducted inspections at a sampling of other Syncor facilities, including the Columbus, Ohio, facility. The Columbus inspection on September 8-9, 1988, determined that testing equipment for radiopharmaceuticals had been out of service September 5-7, 1988, and that required tests had not been performed.

On September 9, 1988, NRC Region III issued a Confirmatory Action Letter to the Columbus facility documenting the licensee's agreement to institute additional management quality assurance audits to make certain that all tests and assays are performed properly (Ref. C-8).

The October 12, 1988, Order modified the licenses of the two facilities to include the commitments of the two Confirmatory Action Letters.

The Order notes that in addition to the problems at the two Syncor facilities in Ohio, labeling and radiation protection violations were identified at a Syncor facility in Allentown, Pennsylvania. The latter violations resulted in 14 diagnostic misadministrations and the radiation overexposure of a worker.

Because of the problems found at the three facilities, the Order directs Syncor to prepare a corporate plan for assessing its activities to assure that it meets regulatory requirements and that the distribution of improperly tagged or labeled radiopharmaceuticals is eliminated. The review included the two Ohio facilities as well as at least half of the other Syncor facilities licensed by the NRC. On January 19, 1989, Syncor presented the findings of its assessment to the NRC. The results indicated that Syncor does have some problems at isolated facilities. A corporate management program has been instituted to correct the problems identified.

The doses to the patients due to the mislabeling incidents at the Blue Ash and Allentown facilities are considered below the abnormal occurrence reporting threshold for medical diagnostic misadministrations. However, the item is of concern because of several problems previously identified at various Syncor facilities. For example, Appendix C, Item 3 of NUREG-0090, Vol. 10, No. 3 ("Report to Congress on Abnormal Occurrences: July-September 1987") described a single mislabeling error at Syncor's Pittsburgh, Pennsylvania, facility which resulted in 33 mislabeled doses leading to 26 diagnostic misadministrations.

In addition, Appendix C, Item 3 of NUREG-0090, Vol. 11, No. 3 ("Report to Congress on Abnormal Occurrences: July-September 1988") described the previously mentioned Allentown violations. The latter violations led to a more aggressive NRC enforcement policy in regard to medical diagnostic misadministrations. The NRC also issued Information Notice No. 88-53 on July 28, 1988, to all manufacturers and distributors of radiopharmaceuticals for human use, nuclear pharmacies, and medical licensees to heighten their sensitivity to the NRC's concern regarding labeling errors (Ref. C-9). The Notice informed the recipients of the mislabeling incidents at Syncor's Allentown facility and described the modification in severity classification of violations which have led to diagnostic misadministrations.

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4. Deficient 125 VDC Distribution System at Nine Mile Point Unit 1

On November 18, 1988, Niagara Mohawk Power Corporation (the licensee) reported to the NRC that the 125 VDC system for Nine Mile Point Unit 1 did not meet its design basis. The plant was shut down in December 1987 for refueling, and the reactor was defueled. During this shutdown, the licensee made modifications to the 125 VDC power system and performed studies for possible modifications to other portions of the 125 VDC system. A subsequent review of these potential modifications revealed the design deficiency. Nine Mile Point Unit 1 is a General Electric-designed boiling water reactor located in Oswego County, New York.

Each of the two batteries associated with its 125 VDC system is supplied and charged by a battery charging motor generator (MG) set. The battery charging MG set consists of a 600 VAC motor, a 600 VAC generator, and a 600 VAC/125 VDC motor generator. With AC power available from its normal source (power board 16 or 17), the 600 VAC motor provides rotational motion while the AC generator provides power to emergency lighting, and the MG provides power to the 125 VDC power board. On a loss of 600 VAC, the MG utilizes power from the battery to provide rotational force while the AC generator continues to supply 600 VAC to the emergency lighting. Additionally, the battery continues to supply other DC loads, including breaker control power at various power boards and locations in the plant.

The design basis problem occurs when battery voltage decreases to less than 125 VDC. The plant's technical specifications (TSs) state that the minimum voltage to consider a battery operable is 106 VDC. However, studies show that with less than 114 VDC present at the battery terminals, the actual voltage supplied at the different power boards will be approximately 90 VDC due to line losses. This may not be sufficient to allow breaker operation at the power boards.

On a loss of off-site power, the battery charging MG sets will lose their normal AC power source and will swap over to operation on the battery. When the emergency diesel generators (EDGs) start to pick up loads, the battery chargers are sequenced to normally swap back to their AC source (power boards 16 and 17) after approximately two minutes; however, if the battery voltage is less than 114 VDC (well above the TS minimum operability limit) insufficient control power potentially exists for the battery chargers to swap back to the AC source. In this case, the MG sets continue to run off the batteries, thus running them down even further. There is no indication in the control room to alert the operators to the fact that swapover to the AC source has not occurred. The battery voltage will drop low enough to cause EDG protective relays, which are DC powered and most of which deenergize to actuate, to trip the EDGs. This would produce total loss of AC power.

The potential for a degraded voltage condition had existed prior to the system modifications made during the refueling outage. The cause was attributed to an original design deficiency involving cable sizing.

The licensee which was also the system designer, is unaware of any testing done to establish the adequacy of the original design and has not found documentation of the original design basis. The licensee is currently preparing a design basis in support of the actions necessary to correct this problem.

On February 16, 1989, the NRC issued Information Notice No. 89-16 ("Excessive Voltage Drop in DC Systems") to all holders of operating licenses or construction permits for nuclear power reactors to inform them of the event (Ref. C-10).

The actual impact on safety was small, and therefore the event is below the threshold for abnormal occurrence reporting. However, the event is of concern because of the potential for failure of systems designed to mitigate accident consequences due to an unexpected cause.

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## REFERENCES (FOR APPENDICES)


B-1 U.S. Nuclear Regulatory Commission, "Programmatic Environmental Impact Statement (PEIS) Related to Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979 accident at Three Mile Island Nuclear Station, Unit 2, Draft Supplement 3 Dealing with Post-Defueling Monitored Storage and Subsequent Cleanup," NUREG-0683, Supplement No. 3, April 1988.*

B-2 Letter from James M. Taylor, NRC Deputy Executive Director for Regional Operations, to Georgia Institute of Technology, forwarding an Order Modifying License, Effective Immediately, Docket No. 50-160, January 20, 1988.*

B-3 Letter from James M. Taylor, NRC Deputy Executive Director for Regional Operations, to Dr. J. P. Crecine, President, Georgia Institute of Technology, forwarding a Confirmatory Order Modifying License, Effective Immediately, Docket No. 50-160, March 17, 1988.*

B-4 Letter from Malcolm L. Ernst, Acting Administrator, NRC Region II, to Dr. J. P. Crecine, President, Georgia Institute of Technology, forwarding NRC Inspection Report No. 50-160/88-02, Docket No. 50-160, December 29, 1988.*

B-5 Letter from Malcolm L. Ernst, Acting Administrator, NRC Region II, to Dr. J. P. Crecine, President, Georgia Institute of Technology, Docket No. 50-160, November 15, 1988.*

B-6 Letter from Malcolm L. Ernst, Acting Administrator, NRC Region II, to Dr. J. P. Crecine, President, Georgia Institute of Technology, forwarding a Notice of Violation, and Proposed Imposition of Civil Penalty, Docket No. 50-160, November 15, 1988.*

C-1 U.S. Nuclear Regulatory Commission, IE Bulletin No. 79-13, Revision 2, "Cracking in Feedwater System Piping," October 16, 1979.*

C-2 U.S. Nuclear Regulatory Commission, NRC Bulletin No. 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems," June 12, 1988.*

C-3 U.S. Nuclear Regulatory Commission, NRC Information Notice No. 88-80, "Unexpected Piping Movement Attributed to Thermal Stratification," October 7, 1988.*

C-4 U.S. Nuclear Regulatory Commission, NRC Bulletin No. 88-11, "Pressurizer Surge Line Thermal Stratification," December 20, 1988.*

C-5 Letter from James M. Taylor, NRC Deputy Executive Director for Regional Operations, to Monte Fu, Chairman of the Board, Syncor International Corporation, forwarding an Order Modifying Licenses (Effective Immediately), License Nos. 34-18309-01MD and 34-18484-01MD, October 12, 1988.*


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

C-6 Confirmatory Action Letter from A. Bert Davis, Administrator, NRC Region III, to Michelle Loos, R. Ph., Pharmacy Manager, Syncor Corporation, License No. 34-18309-01MD, July 13, 1988.*

C-7 Confirmatory Action Letter from A. Bert Davis, Administrator, NRC Region III, to Monte Fu, Chairman of the Board, Syncor International Corporation, License No. 34-18309-01MD, September 2, 1988.*

C-8 Confirmatory Action Letter from A. Bert Davis, Administrator, NRC Region III, to Monte Fu, Chairman of the Board, Syncor International Corporation, License No. 34-18484-01MD, September 9, 1988.*

C-9 U.S. Nuclear Regulatory Commission, NRC Information Notice No. 88-53, "Licensee Violations of NRC Regulations, Which Led to Medical Diagnostic Misadministrations," July 28, 1988.*

C-10 U.S. Nuclear Regulatory Commission, NRC Information Notice No. 89-16, "Excessive Voltage Drop in DC Systems," February 16, 1989.*

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

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Same as 7., above

11a. TYPE OF REPORT

Quarterly

b. PERIOD COVERED (Inclusive dates)

October - December 1988

12. SUPPLEMENTARY NOTES

13. ABSTRACT (200 words or less)

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health and safety and requires a Quarterly report of such events to be made to Congress. This report covers the period October 1 to December 31, 1988. For this reporting period, there were no abnormal occurrences at nuclear power plants licensed to operate. There was one abnormal occurrence under other NRC-issued licenses, involving a medical therapy misadministration. There were three abnormal occurrences reported by Agreement States. The State of New York reported an event involving multiple medical therapy misadministrations. The State of Maryland reported two events, both occurring at the same hospital. One involved a single medical therapy misadministration and the second involved multiple medical therapy misadministrations. The report also contains information updating some previously reported abnormal occurrences.

14. DOCUMENT ANALYSIS - a. KEYWORDS/DESCRIPTORS

Medical Therapy Misadministrations; Thermal Stratification; Unexpected Pipe Movement; Radioactive Contamination at Lead Reprocessing Facility; Breakdown of Management Controls at Nuclear Pharmacy Facilities; Improperly Tagged or Labeled Radiopharmaceuticals; Deficient 125VDC Distribution System.

b. IDENTIFIERS/OPEN-ENDED TERMS

15. AVAILABILITY STATEMENT

Unlimited

16. SECURITY CLASSIFICATION

(This page)
Unclassified

(This report)
Unclassified

17. NUMBER OF PAGES

18. PRICE