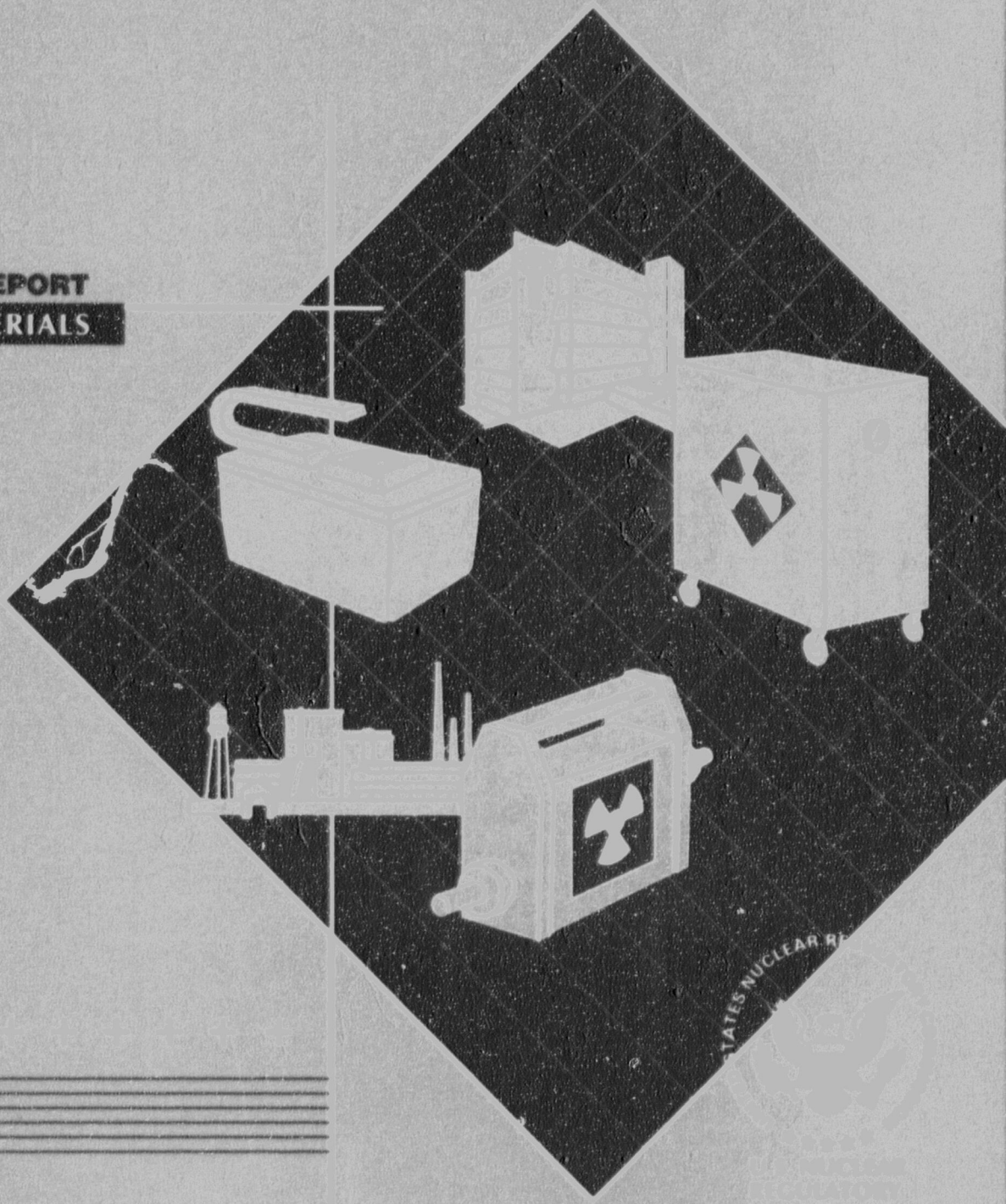
OFFICE FOR

NUREG-1272
VOL. 11, NO. 2

ANALYSIS and EVALUATION of OPERATIONAL DATA

1997 ANNUAL REPORT

NUCLEAR MATERIALS



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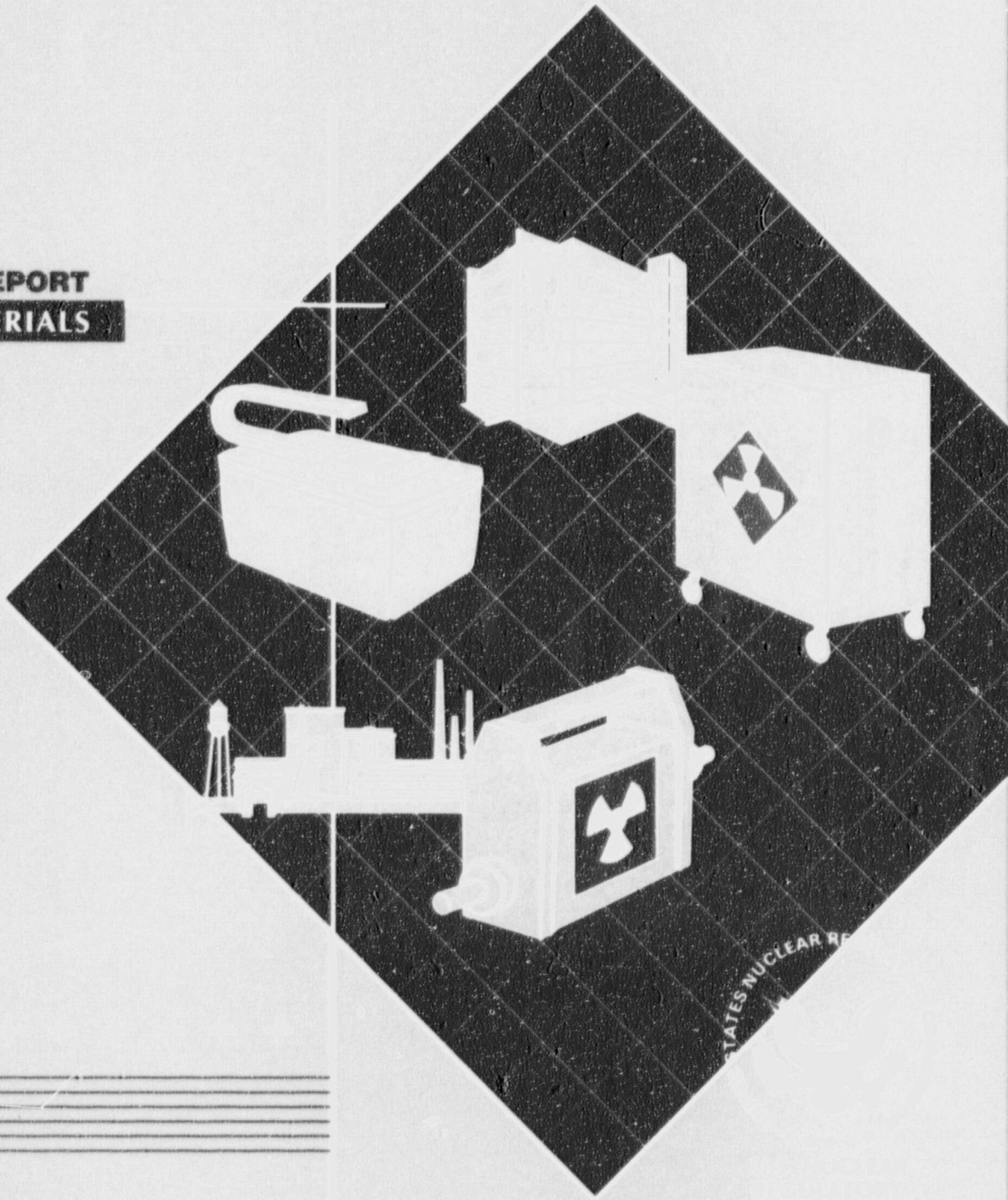

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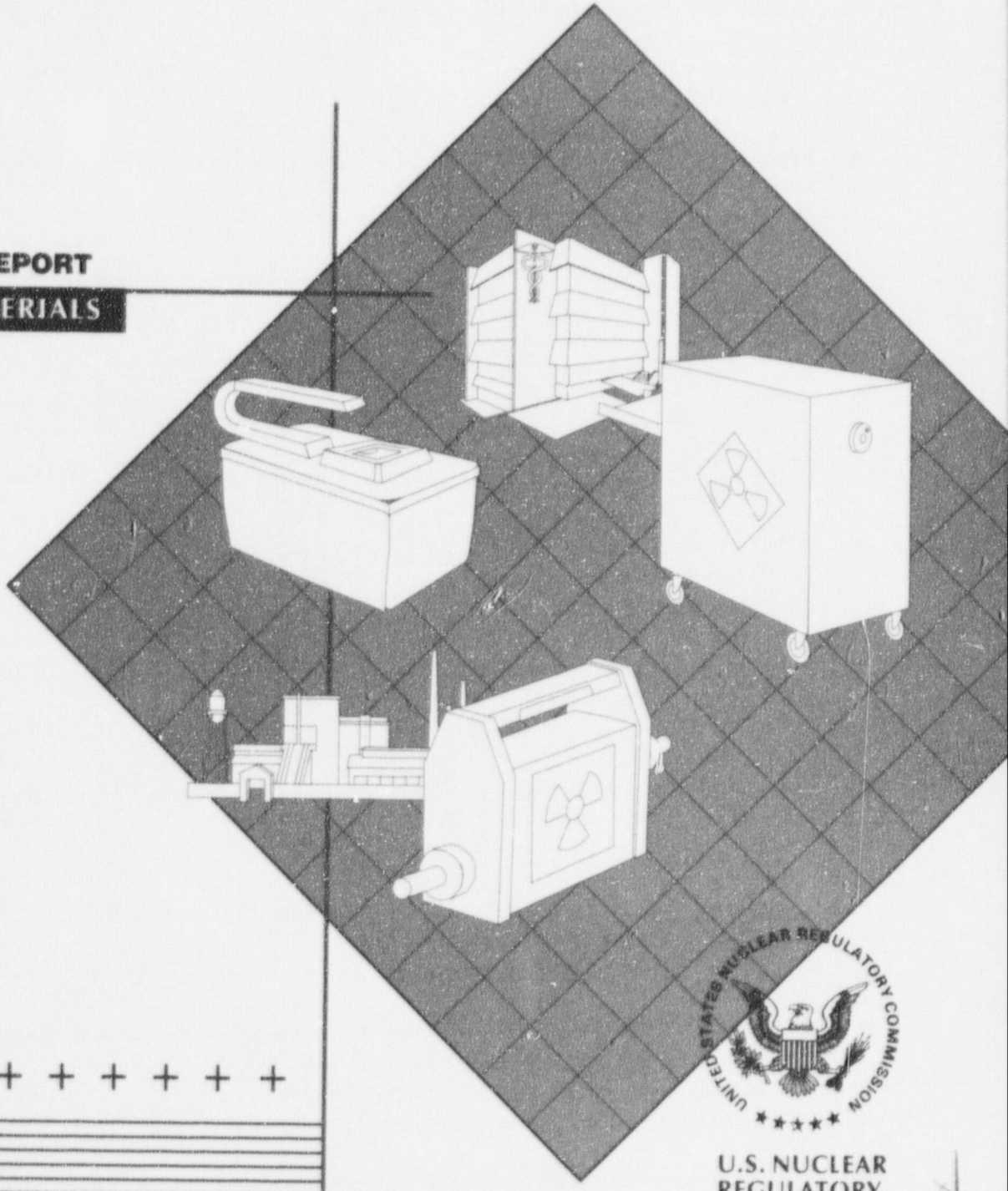

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NOVEMBER 1998

Previous Reports in Series

The following semiannual or annual reports have been prepared by the Office for Analysis and Evaluation of Operational Data (AEOD).

- *Semiannual Report, January - June 1984*, AEOD/S405, September 1984
- *Semiannual Report, July - December 1984*, AEOD/S502, April 1985
- *Annual Report 1985*, AEOD/S601, April 1986
- *Report to the U.S. Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data 1986*, NUREG-1272, AEOD/S701, May 1987
- *Report to the U.S. Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data 1987*, NUREG-1272, AEOD/S804
  Vol. 2, No. 1, Power Reactors, October 1988
  Vol. 2, No. 2, Nonreactors, October 1988
- *Office for Analysis and Evaluation of Operational Data 1988 Annual Report*, NUREG-1272
  Vol. 3, No. 1, Power Reactors, June 1989
  Vol. 3, No. 2, Nonreactors, June 1989
- *Office for Analysis and Evaluation of Operational Data 1989 Annual Report*, NUREG-1272
  Vol. 4, No. 1, Power Reactors, July 1990
  Vol. 4, No. 2, Nonreactors, July 1990
- *Office for Analysis and Evaluation of Operational Data 1990 Annual Report*, NUREG-1272
  Vol. 5, No. 1, Power Reactors, July 1991
  Vol. 5, No. 2, Nonreactors, July 1991
- *Office for Analysis and Evaluation of Operational Data 1991 Annual Report*, NUREG-1272
  Vol. 6, No. 1, Power Reactors, July 1992,
  Vol. 6, No. 2, Nonreactors, August 1992
- *Office for Analysis and Evaluation of Operational Data 1992 Annual Report*, NUREG-1272
  Vol. 7, No. 1, Power Reactors, July 1993
  Vol. 7, No. 2, Nonreactors, October 1993
- *Office for Analysis and Evaluation of Operational Data 1993 Annual Report*, NUREG-1272
  Vol. 8, No. 1, Power Reactors, November 1994
  Vol. 8, No. 2, Nuclear Materials, May 1995
- *Office for Analysis and Evaluation of Operational Data 1994-FY95 Annual Report*, NUREG-1272
  Vol. 9, No. 1, Power Reactors, July 1996
  Vol. 9, No. 2, Nuclear Materials, September 1996
  Vol. 9, No. 3, Technical Training, September 1996
- *Office for Analysis and Evaluation of Operational Data 1996 Annual Report*, NUREG-1272
  Vol. 10, No. 1, Power Reactors, December 1997
  Vol. 10, No. 2, Nuclear Materials, December 1997
  Vol. 10, No. 3, Technical Training, December 1997

ABSTRACT

The United States (U.S.) Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD) has published reports of its activities since 1984. The first report covered January through June of 1984, and the second report covered July through December of 1984. After those first two semiannual reports, AEOD published annual reports of its activities from 1985 through 1993. Beginning with the report for 1986, AEOD Annual Reports have been published as NUREG-1272. Beginning with the report for 1987, NUREG-1272 has been published in two parts, No. 1 covering power reactors and No. 2 covering nonreactors (changed to "nuclear materials" with the 1993 report). AEOD changed its annual report from a calendar year (CY) to a fiscal year (FY) report, and added part 3 covering technical training, beginning with the combined Annual Report for CY 1994 and FY 1995, NUREG-1272, Vol. 9.

In this annual report, NUREG-1272, Vol. 11, the staff describes activities conducted during FY 1997. The report is published in three parts. In NUREG-1272, Vol. 11, No. 2, covering nuclear materials, the staff presents a review of the events and concerns associated with the use of licensed material in applications other than power reactors. In NUREG-1272, Vol. 11, No. 1, covering power reactors, the staff presents an overview of the operating experience of the nuclear power industry from the NRC perspective. In NUREG-1272, Volume 11, No. 3, covering technical training, the staff presents the activities of the Technical Training Center in support of the NRC's mission. Throughout these reports, whenever information is presented for a calendar year, it is so designated. Fiscal year information is designated by the four digits of the fiscal year.

CONTENTS

Appendices

Tables

ABBREVIATIONS

A

ACMUI	Advisory Committee on Medical Uses of Isotopes
AEOD	Analysis and Evaluation of Operational Data (NRC Office for)
AO	abnormal occurrence
ARG	Accident Review Group

B

Bq	becquerel
BRC	Bureau of Radiation Control (State of Texas)

C

CAL	Confirmatory Action Letter (NRC)
cGy	centigray
CFR	Code of Federal Regulations
Ci	curie
cm	centimeter
Co	cobalt
CRGR	Committee to Review Generic Requirements (NRC)
cSv	centisievert
CY	calendar year

D

DNA	deoxyribonucleic acid

E

EDO	Executive Director for Operations (NRC)

F

FCSS	Fuel Cycle Safety and Safeguards (NMSS Division of)
FR	*Federal Register*
FRERP	Federal Radiological Emergency Response Plan
FRP	Federal Response Plan

G

gBq	gigabecquerel
GDP	gaseous diffusion plant
GE	General Electric Company
GL	Generic Letter (NRC)
Gy	gray

H

HDR	high-dose-rate

I

I	iodine
IDNS	Illinois Department of Nuclear Safety
IDOT	Illinois Department of Transportation
IIP	Incident Investigation Program
IIT	Incident Investigation Team
IN	Information Notice
in	inches
ISA	integrated safety analysis

M

MBq	megabecquerel
mCi	millicuries
MC	Manual Chapter (NRC)
MD	Management Directive (NRC)
MDI	Many Diversified Interests, Inc.
MIT	Massachusetts Institute of Technology
ml	milliliter
mm	millimeter
mrem	millirem
mSv	millisievert

N

NaI	sodium iodide
NIST	National Institute of Standards and Technology
NMED	Nuclear Material Events Database
NMSS	Nuclear Material Safety and Safeguards (NRC Office of)
NRC	U.S. Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation (NRC Office of)

O

OGC	Office of the General Counsel (NRC)
ORISE	Oak ridge Institute for Science and Education
OSP	Office of State Programs (NRC)

P

P&GD	policy and guidance directive

Q

QMP	quality management program

R

RCM	Response Coordination Manual
REM	radiation equivalent man
RES	Nuclear Regulatory Research (NRC Office of)
RI	Region I (NRC)
RII	Region II (NRC)
RIII	Region III (NRC)
RIV	Region IV (NRC)
RPC	Radiation Protection Committee (MIT)
RPO	Radiation Protection Officer (MIT)
RSO	radiation safety officer
RTM	Response Technical Manual

S

SF&CG	standard format and content guidance
SNM	special nuclear material
Sr	strontium-90
SRP	Standard Review Plan
Sv	sievert

T

TDH	Texas Department of Health
TEDE	total effective dose equivalent
TRTR	Test, Research, and Training Reactors

U

U.S.	United States
USEC	United States Enrichment Corporation

EXECUTIVE SUMMARY

General

The Office for Analysis and Evaluation of Operational Data (AEOD) was created in 1979 to provide a strong, independent capability to analyze and evaluate operational safety data associated with activities licensed by the United States (U.S.) Nuclear Regulatory Commission (NRC). AEOD is also responsible for the NRC's Incident Response, Incident Investigation, Diagnostic Evaluation, and Technical Training Programs. In addition AEOD provides administrative and technical support to the NRC's Committee to Review Generic Requirements. AEOD also obtains industry feedback on these activities.

The AEOD programs constitute the essential independent review and assessment of power reactor and nuclear materials safety performance, and complement the reviews of operating events performed by the regions, the Office of Nuclear Reactor Regulation, and the Office of Nuclear Material Safety and Safeguards. AEOD performs a quality verification function that ensures feedback of important operational safety lessons. AEOD findings and recommendations continue to be addressed through generic correspondence, in the resolution of generic issues, and in initiatives taken by industry.

AEOD has published annual reports of its activities since 1985. AEOD changed its annual report from a calendar year (CY) to a fiscal year (FY) report beginning with the combined Annual Report for CY 1994 and FY 1995, NUREG-1272, Vol. 9. In this report, NUREG-1272, Vol. 11, No. 2, the staff presents a review of the events and concerns during FY 1997 associated with the use of licensed materials in applications other than power reactors. Throughout this report, whenever information is presented for a calendar year, it is so designated. Fiscal year information is designated by the four digits of the fiscal year.

Operating Experience Feedback

NRC and Agreement State nuclear materials licensees are required by Title 10 of the *Code of Federal Regulations*, comparable Agreement State regulations, or license conditions, to submit reports of events that meet established criteria. The following types of nuclear materials events are reportable:

- medical misadministrations of radiation or radiopharmaceuticals to patients
- radiation overexposures
- loss of control of licensed material
- problems with equipment that uses licensed material or is otherwise associated with the use of licensed material
- releases of material or contamination
- leaking radioactive sources
- problems during the transportation of licensed material
- problems occurring at fuel cycle facilities
- problems occurring in nonpower reactors

AEOD collects, reviews, and assigns codes to information about nuclear materials events reported by NRC licensees and Agreement States. In 1993 AEOD developed a new database, the Nuclear Material Events Database (NMED), that was designed to allow multiple events in a single report to be appropriately recorded. For example, a report may describe a loss of control of licensed material and an overexposure. In such a case, both events would be recorded in the NMED and both would be identified by the same report number. An interim, standalone version of the NMED was distributed to the Agreement States in October 1994. Installation of the NMED within NRC headquarters was completed in June 1996, and the NMED was distributed to Agreement States in September 1996.

Approximately 7,000 NRC licensees and 15,000 Agreement State licensees submit reports of events. NRC licensees submit reports directly to the NRC regional or headquarters offices. Agreement State licensees submit reports to the States, which in turn voluntarily transmit summary reports to the NRC under an informal information sharing agreement. In 1997 there were 593 events involving radiological material licensed to nuclear materials licensees and nonpower reactors that were required to be reported under NRC or equivalent Agreement State regulations. Two of those events were reported to Congress as abnormal occurrences (AOs). (There were five events reported to Congress as AOs in 1997, however only two of them occurred in the time period covered by this report.)

There were 27 reportable medical misadministrations that occurred in 1997, including 1 that was reported to Congress as an AO. In 26 of these events, there were little or no adverse effects on the patients' health and no follow-up medical care was required. In the remaining case, the patient, who had been prescribed a diagnostic dose for a thyroid scan and uptake procedure, received in error a whole-body dose for a cancer evaluation. This larger dose may induce hypothyroidism, which will require the patient to take thyroid hormone for the rest of his life. The main factors contributing to these misadministrations were (1) inattention to detail (dose calibrator set improperly, afterloader/applicator placed in the wrong position), (2) communications problems (not understanding the referring physician's request, incorrect data used in dose planning), and (3) errors in calculation of the treatment plan. Corrective actions reported by licensees included creating a new procedure, modifying an existing procedure, retraining, and improving the quality management plan.

Eight events in 1997 caused eight people, including one member of the public, to receive radiation in excess of the exposure limit. The non-occupational overexposure resulted from a technician entering the room of a brachytherapy patient (Ir-192 implant) and drawing a blood sample from the patient. The dose received by the technician was calculated to be 0.117 centisievert (cSv) (117 mrem). Four whole-body occupational overexposures ranged from 5.77 cSv (5.77 rem) to 16 cSv (16 rem). Three of these were accumulated over a 3-month monitoring period as a result of radiography activities; the fourth one came from using a portable moisture density gauge, an activity that only rarely produces reports of overexposures. There were also two overexposures to the hands of people handling radiopharmaceuticals, and a skin dose of 482 cSv (482 rem) to an individual's thumb that became contaminated with a beta-emitting isotope while working in a radiopharmaceutical facility. The skin dose was reported to Congress as an AO.

There were 558 other nuclear materials events, including loss of control of licensed material, leaking sources, release of material, transportation events, equipment problems, fuel cycle facility problems, and problems at test, research, and training reactors. None of these events were reported to Congress as AOs.

Other AEOD Activities

In its final "Policy Statement on Adequacy and Compatibility of Agreement State Programs," the staff proposed that Agreement State event reporting be required as an element of compatibility. The Commission approved the policy statement on September 3, 1997; now, Integrated Material Performance Evaluation Program (IMPEP) teams review event reporting for adequacy during IMPEP evaluations. This promotes standardized material event reporting between Agreement State and NRC licensees.

The Commission asked the staff to determine if the AO criteria need to be modified for fuel cycle facilities to explicitly include those facilities that are not licensed by the NRC but that are otherwise regulated by the NRC, such as the gaseous diffusion plants. The staff determined that revised criteria were needed for the gaseous diffusion plants. These criteria were developed and became effective in 1997.

Incident Response

Nuclear materials licensees reported two alerts in 1997. The NRC did not enter the monitoring mode for either of these events. There were no nuclear materials events reported at the Site Area Emergency level in 1997.

Incident Investigation Program

No nuclear materials events in 1997 were judged to have a level of safety significance sufficiently high to warrant either an Incident Investigation Team investigation or an Augmented Inspection Team inspection.

1 INTRODUCTION

The United States (U.S.) Nuclear Regulatory Commission (NRC) licenses the use of reactor-produced isotopes, the milling of uranium, and the subsequent processing of natural uranium, enriched uranium, and other special nuclear material (SNM). In 1997 the NRC directly regulated licensees in 20 States, the District of Columbia, and the U.S. territories. The remaining 30 States, known as Agreement States, have entered into agreements with the NRC under Section 274 of the Atomic Energy Act, as amended, whereby the NRC relinquishes and the States assume regulatory authority over the use of byproduct materials, source materials, and other SNM in quantities too small to sustain a chain reaction.

The NRC's Office for Analysis and Evaluation of Operational Data (AEOD) was created in 1979 to provide a strong, independent capability to analyze operational data. AEOD implements this role for nuclear materials applications by collecting and maintaining nuclear materials event data in the Nuclear Material Events Database, analyzing and evaluating these operating experience data, providing feedback on lessons learned and, as appropriate, recommending actions to reduce the probability that operational events will recur or will lead to more serious events.

AEOD is also responsible for the NRC's Incident Response, Incident Investigation, Diagnostic Evaluation, and Technical Training Programs. The Incident Response Program provides a coordinated NRC emergency response to ongoing events through the NRC Operations Center. The Incident Investigation Program offers a structured NRC investigative response to significant operational events according to their safety significance. The Diagnostic Evaluation Program independently assesses licensee performance at selected reactor facilities. The Technical Training Program provides initial and continuing technical training for NRC staff and contractors. In addition, AEOD supplies administrative and technical support to the NRC's Committee to Review Generic Requirements.

AEOD also obtains industry feedback on these activities.

The AEOD programs, taken as a whole, constitute the essential independent review and assessment of nuclear materials safety performance, and complement the reviews of operating events performed by the regions and the Office of Nuclear Material Safety and Safeguards. AEOD performs a quality verification function that ensures feedback of important operational safety lessons. AEOD findings and recommendations continue to be addressed through generic correspondence, in the resolution of generic issues, and in initiatives taken by industry.

AEOD consists of three divisions organized as follows: the Incident Response Division, comprising the Response Operations Section, the Response Coordination Section, and the Operations Officer Section; the Safety Programs Division, comprising the Reactor Analysis Branch and the Reliability and Risk Assessment Branch; and the Technical Training Division, comprising the Reactor Technology Training Branch, the Specialized Technical Training Branch, and the Technical Training Support Branch.

AEOD changed its annual report from a calendar year (CY) to a fiscal year (FY) report beginning with the combined Annual Report for CY 1994 and FY 1995, NUREG-1272, Volume 9. In this report, NUREG-1272, Vol. 11, No. 2, covering nuclear materials, the staff presents a review of the events and concerns during 1997 associated with the use of licensed materials in applications other than power reactors. Throughout this report, whenever information is presented for a calendar year, it is so designated. Fiscal year information is designated by the four digits of the fiscal year. The report also contains the following appendices:

- Appendix A summarizes the 1997 nuclear materials events by event type
- Appendix B summarizes the 1997 nuclear materials abnormal occurrences

- Appendix C lists nuclear materials reports and videotapes issued by AEOD from CY 1981 through 1997
- Appendix D presents the Status of Recommendations in AEOD nuclear materials studies
- Appendix E presents the status of staff actions resulting from the findings of NRC Incident Investigation Teams for nuclear materials events

In the report on power reactors, NUREG-1272, Vol. 11, No. 1, the staff presents an overview of the 1997 operating experience of the nuclear power industry from the NRC perspective. In NUREG-1272, Volume 11, No. 3, covering technical training, the staff presents the activities of the Technical Training Center in support of the NRC's mission.

2 OPERATING EXPERIENCE FEEDBACK

The primary concern with the use of radioactive materials is the potential for overexposure, which can cause cancer or, in severe cases, death. Extremity or localized skin exposures from radioactively hot particles are a lesser health concern but are still important to the NRC in assessing the effectiveness of byproduct materials control.

One measure of the effectiveness of a licensee's control of regulated materials is the collective dose received by all employees who work with, or may be present in the vicinity of, nuclear materials. Licensees are required to provide appropriate monitoring equipment to, and to require the use of such equipment by, each person who is likely to receive a dose in any calendar quarter exceeding 25 percent of the allowable limits specified in Part 20 of Title 10 of the *Code of Federal Regulations* (10 CFR). Licensees are also required to monitor and control activities that can lead to exposing their employees or the general public to radiation.

2.1 Nuclear Material Events Database

NRC and Agreement State nuclear materials licensees are required by 10 CFR, comparable Agreement State regulations, and license conditions, to submit reports on any of the following events:

- a medical misadministration of radiation or radiopharmaceuticals to a patient
- a radiation overexposure
- a loss of control of licensed material
- a problem with equipment that uses licensed material or is otherwise associated with the use of licensed material
- a release of material or contamination
- a leaking radioactive source
- a problem during the transportation of licensed material
- a problem in a fuel cycle facility
- a problem in a nonpower reactor

AEOD collects, reviews, and codes information about nuclear materials events. Approximately 7,000 NRC licensees and about 15,000 Agreement State licensees submit reports of events that are required to be reported. Licensees also voluntarily submit reports of events that are not required to be reported. Voluntary reports are not considered when evaluating operating experience and are therefore not included in this annual report. NRC licensees submit reports directly to the NRC regional or headquarters offices. Agreement State licensees submit reports to the States, which then transmit summary reports to the NRC under an information-sharing agreement. Non-licensees also report events involving radioactive material to the NRC and to Agreement States. Those events that involve radioactive material licensed under the Atomic Energy Act are included in this report. In addition, the NRC obtains reports of events from other sources, such as NRC inspection reports, and, occasionally, from non-licensees, including members of the public. The NRC in turn reports to Congress any unscheduled incidents or events that it determines to be significant from the standpoint of public health and safety. Such events are designated as abnormal occurrences (AOs).

From CY 1981 through CY 1992 AEOD coded nuclear materials event data and maintained them in two databases, one containing records of medical misadministration events and the other containing records of other reported nuclear materials events. In 1993 AEOD developed a new database, the Nuclear Material Events Database (NMED), that was designed to allow multiple events in a single report to be appropriately recorded. For example, a report may describe both a loss of control of licensed material and an overexposure. In such a case, both events would be recorded in the NMED and both would be identified by the same report number. In developing the database structure, AEOD received substantial input from the NRC

Headquarters Offices of Nuclear Materials Safety and Safeguards, State Programs, and Nuclear Regulatory Research; the regional offices; and the Agreement States. Most of this information occurred during AEOD-sponsored workshops held in November 1993 and May 1994. An interim, stand alone version of the NMED was distributed to the Agreement States in October 1994. Installation of the NMED within NRC headquarters was completed in June 1996. A new NMED data entry, search, and report program was fully operational in the third quarter of CY 1996 and was distributed to Agreement States in September 1996.

The NMED contains about 14,000 detailed records of reported events, including voluntary reports, as well as information for identifying associated reports, such as inspection reports. NRC data since CY 1981 are available, as well as Agreement State data from CY 1991. The NMED contains records of material events for all categories of materials licensees, including nonpower reactors. Radiation overexposure events since 1993 for commercial power reactors are also maintained in the NMED.

In 1997 there were 593 events involving radiological material licensed to nuclear materials licensees and nonpower reactors that were required to be reported to the NRC. Two of these events were reported to Congress as AOs. (There are five events in the 1997 *Report to Congress on Abnormal Occurrences*, NUREG-0090, Vol. 20, however only two of them occurred during the time period covered by this report.) Table 2.1 shows the number of reportable events in 1997 by type submitted both to the NRC and to Agreement States as of the date of preparation of this report.

Table 2.1 Nuclear Materials Reportable Events Submitted to the NRC and to Agreement States in 1997 by Event Type

Type of Event	Number
Misadministrations	27
Radiation overexposures	8
Loss of control of licensed material	248
Leaking sources	15
Release of material	38
Transportation	53
Equipment problems	145
Fuel cycle facility problems	55
Test, research, and training reactors	4
Total	593

Note: Not all Agreement State reports had been received at the time this table was prepared.

2.2 Medical Misadministrations

The NRC and Agreement States regulate certain aspects of reactor-produced radionuclides used in nuclear medicine and therapeutic radiology in accordance with 10 CFR Part 35, "Medical Use of Byproduct Material." The major concerns with the use of radioactive materials in medical applications arise from either a licensee's failure to effectively control licensed material or from other human errors, such as dispensing a radiopharmaceutical that does not comply with the written directive. This can result in a patient receiving an unintended or excessive dose or a dose to the wrong treatment site. Occasionally a radiopharmaceutical is administered to the wrong patient. Excessive exposures to monitored employees and uncontrolled exposures to the general public are also a concern in the medical use of radioactive materials. However, such incidents are relatively rare, considering the hundreds of thousands of procedures performed each year.

The Misadministration Rule, which became effective on November 10, 1980, required NRC medical licensees to report medical misadministrations to the NRC. This rule was revised in 1987 to require Agreement States to have reporting requirements for medical misadministrations that are compatible with the NRC reporting requirements. Licensees in Agreement States would then report misadministrations to the appropriate regulatory agency in their state. Agreement State agencies had 3 years to promulgate such rules. Therefore, Agreement State licensees were required to report medical misadministration events by 1991. The Agreement States report these events to NRC. Reporting of events data involving Atomic Energy Act (AEA) material, including medical misadministrations, is a compatibility requirement for Agreement States.

The Quality Management Program and Misadministration Rule, which became effective in 1992, requires a quality management program and contains revised definitions of, and reporting requirements for, medical misadministrations. As part of this rule, the misadministration definitions were changed to apply to the following six types of procedures:

- administration of diagnostic radiopharmaceuticals, including less than 1.11 megabecquerels (MBq) (30 microcuries [μCi]) NaI-125 or NaI-131
- diagnostic administrations of NaI-125 or NaI-131 radiopharmaceuticals in quantities greater than 1.11 MBq (30 μCi)
- administration of therapeutic radiopharmaceuticals (other than NaI-125 or NaI-131)
- gamma stereotactic radiosurgery
- teletherapy
- brachytherapy

The criteria for misadministrations vary and include such errors as treatment of the wrong organ or patient, use of the wrong radiopharmaceutical, administration of a dose that differs from the prescribed dose, or an incorrect administration route or treatment mode. The specific definitions are in 10 CFR Part 35.

The term "diagnostic misadministration," as used in NRC regulations, refers to the misadministration of radioisotopes in such nuclear medicine studies as renal, bone, and liver scans. "Therapeutic misadministration" refers to the misadministration of radiation in the treatment of patients using Co-60 (the external use of radiation from a single Co-60 source for therapeutic treatment), gamma stereotactic radiosurgery (the external use of radiation from about 200 small Co-60 sources for therapeutic treatment), brachytherapy (the insertion or implantation of sealed sources containing radioactive material for therapeutic treatment), or radiopharmaceutical therapy (the ingestion or injection of radioactive materials for therapeutic treatment).

The potential or actual effect of a therapeutic misadministration generally differs from that of a diagnostic misadministration. Therapeutic misadministrations are associated with procedures in which large doses of radiation are administered to patients to achieve a therapeutic effect; diagnostic misadministrations are associated with clinical or investigative procedures requiring comparatively small doses of radiation. However, some misadministrations involving the use of NaI-125 or NaI-131 for diagnostic purposes may deliver unintended doses in the therapeutic range to the patient's thyroid. Not all therapeutic overdoses result in significant radiation-induced clinical effects to patients. Some patients receive a dose of radiation that is less than that prescribed. In these cases, if the error is found in time, the total prescribed dose can still be achieved.

In 1997 the NRC and Agreement States regulated approximately 7,000 licensees in 50 states, the District of Columbia, and the U.S. territories that use radionuclides in radiation therapy and nuclear medicine applications. These facilities submitted reports of 27 misadministrations that occurred in 1997. These events are listed in Appendix A-1 to this report. Table 2.2 lists the reported medical misadministrations by type of procedure. Sodium iodide and brachytherapy misadministrations together account for about 70 percent of the reported misadministrations. One of the sodium iodide misadministrations was reported to Congress as an AO (AS 97-4; see Section 3.2 of this volume.) The remainder of the reported misadministrations were about evenly distributed between diagnostic radiopharmaceuticals, therapeutic radiopharmaceuticals, and teletherapy. There was also one reported gamma stereotactic radiosurgery misadministration. Within the scope of review of the data for this report, no significance can be ascribed to the relative number of reported misadministrations, other than to observe that the more frequently administered procedures show a relatively higher number of reported misadministrations.

The causes of the reported misadministrations were reviewed and separated into three categories: human errors related to inattention to detail, communication problems, and treatment planning errors. About one half of the causes reported for the misadministrations were related to inattention to detail: dose calibrator set improperly, afterloader/applicator placed in the wrong location, and failure

Table 2.2 Reportable Medical Misadministrations Submitted to the NRC and to Agreement States in 1997

Procedure	Number
Diagnostic radiopharmaceutical	2
Sodium iodide	10
Therapeutic radiopharmaceutical	2
Gamma stereotactic radiosurgery	1
Teletherapy	3
Brachytherapy	9
Total	27

of the technologist to verify that the entire dose was administered. The causes reported for about 25 percent of the misadministrations were about equally distributed between communications problems (referring physician's request misunderstood) and treatment planning errors (incorrect data used in therapy dose planning). Causes were not reported for the remaining 25 percent of the misadministrations. The cause for one misadministration was attributed to an equipment problem - a lightning strike made a teletherapy machine inoperable. Among the corrective actions reported by licensees were creating a new procedure, modifying an existing procedure, retraining, and improving the quality management plan.

2.3 Radiation Overexposures

The occupational dose limits for radiation workers are defined, in 10 CFR 20.1201, "Occupational dose limits for adults," to be equivalent to a whole-body dose of 5 centisieverts (cSv) (5 rem) per year. The dose limit for non-radiation workers (members of the public) is 0.1 cSv (100 millirem [mrem]) per year, in accordance with 10 CFR 20.1301, "Dose limits for individual members of the public." In addition, the occupational dose limits for minors are defined, in 10 CFR 20.1207, "Occupational dose limits for minors," to be 10 percent of the annual limits for adult workers. (Medical misadministrations resulting in doses to patients exceeding planned treatments are not categorized as overexposures. Only doses to patients not intended to be treated are included in this section.)

There were 8 events in 1997 that resulted in 8 people, including one member of the public, receiving radiation doses in excess of regulatory limits. (See Table 2.3.) Additional information on these events is listed in Table A-2 of Appendix A to this report. The non-occupational overexposure resulted from a technician entering the room of a brachytherapy patient (Ir-192 implant) and drawing a blood sample from the patient. The calculated dose received by the technician was 0.117 cSv (117 mrem). Industrial radiography accounted for about 40 percent of the occupational overexposures of all types and 75 percent of the whole-body occupational overexposures. The whole-body overexposures ranged from 5.3 cSv (5.3 rem) to 16 cSv (16 rem) and were due to radiographers accumulating the dose over the quarterly monitoring period rather than to specifically identified events.

One occupational overexposure was a whole-body dose to the user of a portable moisture density gauge. These gauges typically contain an 8 to 10 millicurie (mCi) Cs-137 source and a 40 mCi Am-241/Be neutron source used in a way that minimizes exposure to the user. Significant whole-body exposures from using portable moisture density gauges are rarely reported.

Two of the occupational overexposures were radiation doses to the hands of two individuals handling radiopharmaceuticals: the dose to one

Table 2.3 Reportable Radiation Overexposures Submitted to the NRC and to Agreement States in 1997

Type of Licensee	Number of Reports	Number of Individuals
Medical/ Academic	1	1
Research/ Commercial	4	4
Industrial Radiography	3	3
Totals	8	8

person's hand was 131 cSv (131 rem) and the dose to the other individual's hand was 52 cSv (52 rem). The remaining occupational overexposure was a 609 cSv (609 rem) skin dose to an area of a person's thumb that became contaminated with a beta-emitting isotope while working in a radiopharmaceutical facility. This event was reported as AO 97-2.

2.4 Loss of Control of Licensed Material

Loss of control of licensed material occurs when licensed material is not under the direct physical or administrative control of a nuclear materials licensee. This can be due to actual loss, administrative loss, unauthorized abandonment or disposal, or theft. Discovery of licensed material in the public domain is also considered a loss-of-control event even if the licensee failed to recognize the loss. The primary safety concern is that, while the material is out of the licensee's control, it may adversely affect public health and safety, whether or not it is later recovered.

Part 20 of 10 CFR contains the reporting requirements for all loss-of-control events except for well-logging sources that have been declared irretrievable. Well-logging sources may be abandoned (left in place) in accordance with the requirements of 10 CFR 39.77 and guidelines approved by the NRC and the Agreement States.

Licensed material can generally be lost in one of the following six ways:

- missing from inventory (gauging measuring devices, calibration sources)
- stolen (most often portable moisture density gauges)
- abandoned by licensee
- inadvertently sent to commercial landfills (mostly medical waste)
- inadvertently shipped to metal scrap yards (usually contaminated metal or industrial measuring gauges)
- well-logging sources that are abandoned downhole (usually Cs-137 and Am-241)

There were 248 loss of control of material events in 1997 that were reported to the NRC. Table 2.4 shows the distribution of reported events by loss category. Table A-3 in Appendix A to this report gives information on who reported the event, the radionuclide, and the activity lost. The radionuclide activities in these events ranged from undetermined trace amounts of NaI-131 in municipal waste to approximately 3.9 terrabecquerel (108 Ci) of Ir-192 contained in a radiography exposure device.

Of the categories of reports of lost material summarized in Table 2.4, "Lost by licensees" is three times as great as the next highest category, "Stolen licensed material." Events in the "Lost by licensees" category can generally be characterized as a loss of material from inventory, in that the material is usually discovered lost during an inventory of the devices that contain the material or when there is a need to use the device or the material. In most cases it is not known how the material was lost. Examples of losses in this category are lost industrial gauges (Cs-137), static eliminators (Po-210), gas chromatographs (Ni-63), and self-luminous devices (H-3). About one half of the devices and material are eventually found, usually within the licensee's facility. The majority of material lost in this category were low activity sources in a shielded configuration. On the other hand, about 20 percent of the events were lost industrial gauges containing

Table 2.4 Loss of Control of Licensed Material Reportable Events Submitted to the NRC and to Agreement States in 1997

Type of Loss	Number
Lost by licensees	136
Stolen licensed material	42
Abandoned licensed material	2
Material found at landfills/incinerators	21
Material found at scrap yards	18
Abandoned well logging sources	29
Total	248

100 mCi to 2 curie (Ci) Cs-137 sources. In addition, about 2 percent of the reported events were lost radiography sources; in two cases the radiography devices were temporarily lost during shipment and in one case the radiography device fell off of the licensee's vehicle. All of the devices were recovered intact. Other events were stolen radiography devices; in two cases the devices were lost when the vehicle containing the devices was stolen. All of the devices were recovered intact. No overexposures were reported to have occurred from lost or stolen sources in this category.

Portable moisture density gauges, which contain an 8 to 10 mCi Cs-137 source on a retractable rod and an internal 40 mCi Am-241 source, are the most commonly stolen licensed devices. They are used in highway and other construction projects involving soil compaction and paving. They are thought to be targeted for theft because they are valuable and portable. The NMED lists approximately 25 to 30 thefts of moisture density gauges each year. Some of the stolen gauges were left unsecured, but the typical report is of a properly stored and locked gauge being stolen from a locked and seemingly secure facility. AEOD has undertaken a study to identify the causes of the thefts of licensed material (including portable moisture density gauges), the recovery rate for stolen gauges, and the relative risk to public health and safety.

Of the 248 reports of lost material received by the NRC in 1997, 18 were reports of material found at scrap-metal facilities and 21 were reports of material found at sanitary landfills. This is about twice the number of events reported for these categories for this period as were reported for the previous year. We are unable, within the scope of this review, to determine whether the higher numbers for this year reflect a higher rate of occurrence or a higher rate of reporting. Another database containing records of reports of radioactive material found at scrap-metal facilities is one maintained by James Yusko of the Commonwealth of Pennsylvania, Department of Environmental Protection. A review of the data in the Yusko database for 1997 found 46 reports of material found at scrap-metal facilities, 18 of which involved non-Atomic Energy Act (AEA) material. In another 26 reports the isotope was not identified. The remaining two reports involved AEA material. Six of the events, including the two involving AEA material, were also reported to the NRC and were in the NMED. An AEOD study on lost material events undertaken under contract with the Idaho National Engineering and Environmental Laboratory that is scheduled to be published in 1998 will provide a quantitative assessment in this area and include an assessment of data on lost sources, including data maintained in the Yusko database.

The causes of the reported lost material events generally involved inadequate accounting procedures, failure to follow procedures, and ineffective security measures. Radiation monitors installed at commercial landfills and scrap-metal yards can reduce the amount of licensed material entering such facilities. Among the corrective actions that were reported were retraining personnel on procedures for handling and oversight of licensed material, developing new procedures for using devices containing licensed material, and improving how licensed material is labeled and handled.

2.5 Leaking Sources

Sealed sources are constructed of licensed radioactive material welded in a metal capsule or encapsulated within a sealant such as metallic foil or a ceramic. Periodic leak tests from every 3 months to every 3 years are required, depending upon the source construction and the method of encapsulation. Test results of more than 185 Bq (0.005 μCi) of removable contamination is considered evidence of leakage. Detecting leaking sources early is essential to preventing significant facility contamination, personnel contamination, and personnel exposures. Sources that are ruptured because of a physical impact or that are ground up in a recycling facility are not counted as leaking sources. Events of this nature are captured in other event categories.

In 1997 15 events involving 15 leaking sources were reported to the NRC. These events are listed in Table A-4 of Appendix A to this report. Of the 15 leaking sources, 33 percent involved Ni-63 in electron-capture detectors contained in gas chromatographs. These sources are covered with a thin film and are prone to minor leakage with normal use. Another 20 percent of the leaking sources contained Cs-137 used in gauges and a calibration source. The remainder of the reports involved sources of Sr-90, Fe-55,

Cm-244, and Cl-36. There were no reported personnel exposures resulting from the leaking sources. There was a report of facility contamination as a result of a leaking Sr-90 source.

All licensees took prompt corrective action by removing the leaking sources from service. Most licensees returned the leaking sources to the equipment manufacturer to have the source replaced. Several licensees disposed of the sources.

2.6 Release of Material

Among those events categorized as "release of licensed material" are spills and gaseous or effluent releases, during which licensed material is either released to the environment (air or water) or causes personnel or facility contamination exceeding regulatory limits. Such events are required to be reported to the NRC or to Agreement States by 10 CFR 20.2202 and 20.2203 or comparable Agreement State regulations. Certain contamination events that occur at facilities are also included in this category and are required to be reported to the NRC or to Agreement States by 10 CFR 30.50, 40.60, 50.72, 50.73 and 70.50 or comparable Agreement State regulations.

There were 38 events in 1997 involving the release of licensed material that were reported to the NRC; they are listed in Table A-5 of Appendix A to this report. The 38 events involved release of material or contamination of personnel or facilities, or both.

Two of the events involved uranium hexafluoride (UF_6) releases to air reported by a production facility and a gaseous diffusion plant. The releases were caused by equipment problems and were below regulatory limits and confined to plant sites.

Of the remaining 36 events, about 31 percent involved personnel contamination, including the contamination of a member of the public who handled a damaged tritium exit sign. This person did receive an uptake, but it was below the regulatory limit for tritium. One contamination event involved a radiopharmaceutical worker who contaminated his thumb by working with defective gloves. As a result, the worker received a skin dose of about 609 cSv (609 rem). This event is also listed in Table A-2 of Appendix A to this report and is discussed in Sections 2.3 and 3.2.

The other personnel contamination events did not involve exposures or uptakes that exceeded regulatory limits. These events were minor contamination events affecting radiopharmacy workers (Tc-99m), research laboratory workers (P-32), and military personnel (H-3) using self-luminous devices. Thirty-five percent of the events involved low levels of contamination of limited areas of floors and work spaces with H-3, I-131, P-32, Tc-99m. Another 20 percent of the events involved military personnel handling damaged self-luminous devices.

In about one-half of all events, there was a release of material or contamination at either a medical or academic facility or a military installation. About 20 percent of the events occurred at radiopharmacies. The remainder of the events either (1) occurred at fuel facilities or other facilities licensed to handle byproduct material, or (2) involved a common carrier. Few of the reports indicated what corrective actions were taken to prevent similar events. Of the corrective actions that were reported, the principal ones were additional training, new equipment purchases, and design changes made to existing equipment.

2.7 Transportation Events

Transportation events involve shipments of packages that have removable radioactive surface contamination or radiation levels that exceed NRC limits. Licensed material shipments that are in accidents or that are damaged during shipment are also counted as transportation events. Transportation events are reported to the NRC or to the Agreement States as required by 10 CFR Part 71 and 10 CFR 20.1906 or comparable Agreement State regulations.

In 1997 53 transportation events were reported to the NRC; they are listed in Table A-6 of Appendix A to this report. Contaminated shipments/packages and vehicle accidents each accounted for about 36 percent of the reported events. Most of the contaminated packages were being shipped between radiopharmacies and hospitals. One exception was an event with a contaminated Sealand ISO container shipped from Spain.

Most of the vehicles involved in accidents were transporting radiopharmaceuticals to and from

hospitals or portable moisture density gauges to and from construction sites. Three exceptions were two train accidents and a flatbed trailer accident. In one train accident, a car carrying 12 Mo-99/Tc99m generators derailed; in the other, a train carrying a contaminated turbine rotor hit a bridge. The flatbed trailer accident involved a shipment of four 2.5 ton solid UF_6 cylinders. In none of the vehicle or train accidents was shielding lost or radioactive material lost.

In about 20 percent of the reported transportation events, the packages being shipped either exceeded regulatory limits or they were damaged in shipment. No personnel exposures were reported to have resulted from the shipment of packages that exceeded regulatory limits. On the other hand, several areas of one facility were contaminated by one of the damaged packages.

The remainder of the events concerned packages that were lost from a transport vehicle or high radiation levels in the cab of a transport vehicle. No radiation exposures or releases of material exceeding regulatory limits resulted from these events.

2.8 Equipment Problems

There were 145 equipment problems reported to the NRC in 1997; they are listed in Table A-7 of Appendix A to this report and are summarized in Table 2.5.

Twenty-six percent of the 145 reported equipment problems involved industrial gauges; about one-half of them were moisture density gauges, most of which sustained damage from vehicles at construction sites. One event, which concerned a "hard to extend" source rod, may have contributed to a 52 cSv (52 rem) exposure to the operator's hand. Equipment problems with gauges other than moisture density gauges occurred due defective parts, fire, or mechanical impact.

About 37 percent of the reported equipment problems occurred at fuel facility plants, most of which were gaseous diffusion plants. These events typically involved plant systems associated with the maintenance of proper criticality controls. An analysis of these events is not within the scope of this report.

Twelve percent of the equipment problems involved industrial radiography equipment. About half of the reported problems were associated with the drive cable connector for radiography cameras. In 1998 the NRC will issue a NUREG and an information notice to discuss and highlight these problems. About 3 percent of the reported equipment problems involved radiotherapy equipment, teletherapy units, and high-dose-rate brachytherapy units. Two reports on teletherapy units were caused by, in one case, a loose wire connection and, in the other case, a burned relay that caused problems extending and retracting the source. Two reports on HDR brachytherapy units described, in one case, a machine malfunction due to a technician bumping the table containing the device and, in the other case, a faulty limit switch which caused an unintended extension of the source. No medical misadministrations were reported to have occurred because of these events.

Among the remaining equipment problems were a leaking Sr-90 source due to damage to the source, and damaged H-3 devices used in military sighting and targeting systems that resulted in low levels of contamination to several people and work areas.

Table 2.5 Reportable Equipment Problems Submitted to the NRC and to Agreement States in 1997

Type of Equipment	Number
Industrial gauges	38
Industrial radiography devices	17
Fuel processing	54
Irradiators	8
Medical equipment	3
Radioluminescent devices	2
Teletherapy units	2
High-dose-rate units	2
Gamma knives	1
Sealed sources	10
Well logging equipment	1
Exhaust hoods	1
Non-Power reactors	1
Other	5
Total	145

2.9 Fuel Cycle Facility Events

Fuel cycle facility events include criticality, loss of a control that is required to prevent criticality, or a release involving any of the non-radioactive chemicals that are used in the fabrication of uranium reactor fuel. The criteria for reporting fuel cycle facility events are found in 10 CFR Part 50, 10 CFR Part 70, and NRC Bulletin 91-01.

The NRC regulates all commercial fuel cycle facilities where uranium ore is processed and reactor fuel is fabricated. The nine major fuel cycle facilities are one UF_6 production facility and eight uranium fuel fabrication facilities. In addition, two gaseous diffusion uranium enrichment plants, owned by the Department of Energy but leased to and operated by the U.S. Enrichment Corporation, came under NRC regulatory oversight in early 1997.

There were 55 reported fuel cycle facility events that occurred in 1997. Seventy-five percent of the reports were submitted by gaseous diffusion plants (GDPs). Forty five percent of all of the reported events involved the loss or degradation of criticality controls; the majority of them exceeded the administrative limits of fissionable material in a given area as defined by a license condition or a criticality safety analysis. No personnel exposures or offsite releases that exceeded regulatory limits resulted from the reported fuel cycle events.

2.10 Test, Research, and Training Reactors

The NRC regulates all reactor facilities, including power reactors and test, research, and training reactors (TRTRs). NUREG-1272, Vol. 11, No. 1, covers power reactors and presents an overview of the operating experience of the nuclear power industry from the NRC perspective. The operating experience of TRTRs is described here. The NRC regulates the TRTR facilities in accordance with 10 CFR Part 50.

There are 58 TRTR facilities currently licensed by the NRC - 45 with operating licenses, 8 with possession-only licenses, and 5 with dismantling orders. The TRTR facilities are owned and operated by universities, the Federal Government, and commercial companies.

Four TRTR events were reported in 1997. Three were related to equipment problems and one was related to human error - someone forgot to remove an alarm bypass key from the emergency control panel. There were no adverse effects on public health and safety as a result of the reported events.

2.11 Annual Radiation Exposure Data

According to the National Council on Radiation Protection and Measurements, the average total effective dose equivalent (TEDE) to a person in the United States is approximately 0.36 cSv (360 mrem) per year, mostly from natural sources of radiation. The average person in the United States receives a TEDE of about 0.05 cSv (50 mrem) per year from medical applications. The entire fuel cycle, including operation of reactors, contributes less than 0.001 cSv (1 mrem) per year. All other human-controlled sources of radiation combined add up to a TEDE of approximately 0.006 cSv (6 mrem) per year.

The NRC regulates both reactor and nonreactor applications of nuclear materials. All NRC licensees are required to monitor employee exposure to radiation and radioactive materials at levels sufficient to demonstrate compliance with the occupational dose limits specified in 10 CFR Part 20. Radiation exposures from the operation of power reactors is discussed in NUREG-1272, Vol. 11, No. 1; it is also compared to radiation exposures from nuclear materials applications in that report.

Personnel exposure data from CY 1990 through CY 1996 (the latest year for which data are available) are given in Tables 2.6 through 2.10 for the following five categories of materials licensees: (1) industrial radiography, (2) manufacturing and distribution, (3) low-level waste disposal, (4) independent spent fuel storage, and (5) fuel fabrication and processing. Exposure data for Agreement State licensees are not in these tables because the Agreement States are not required to supply this information to the NRC. Because licensees submit revisions, late reports, or retractions, data are

Table 2.6 Annual Exposure Data for NRC Industrial Radiography Licensees CY 1990 to CY 1996

Year	No. of Licensees	No. of Monitored Individuals	No. of Workers With Measurable TEDE	Collective TEDE Person-cSv (rem)	Average Individual TEDE-cSv (rem)	Average Measurable TEDE per Worker-cSv (rem)
1990	258	6523	4458	2120	0.33	0.48
1991	248	6820	4649	2160	0.32	0.46
1992	246	6703	4265	1864	0.28	0.44
1993	176	4721	3007	1596	0.34	0.53
1994	139	3230	2351	1415	0.44	0.60
1995	139	3530	2465	1338	0.38	0.54
1996	139	3631	2537	1385	0.38	0.55

Table 2.7 Annual Exposure Data for NRC Manufacturing and Distribution Licensees CY 1990 to CY 1996

Year	No. of Licensees	No. of Monitored Individuals	No. of Workers With Measurable TEDE	Collective TEDE Person-cSv (rem)	Average Individual TEDE-cSv (rem)	Average Measurable TEDE per Worker-cSv (rem)
1990	58	4203	2279	693	0.16	0.30
1991	59	4930	1952	722	0.15	0.37
1992	67	5210	2250	784	0.15	0.35
1993	58	4913	2254	680	0.14	0.30
1994	44	2941	1251	580	0.20	0.46
1995	36	2666	1222	595	0.22	0.49
1996	36	2628	1239	556	0.21	0.45

Table 2.8 Annual Exposure Data for NRC Low-level Waste Disposal Licensees CY 1990 to CY 1996

Year	No. of Licensees	No. of Monitored Individuals	No. of Workers With Measurable TEDE	Collective TEDE Person-cSv (rem)	Average Individual TEDE-cSv (rem)	Average Measurable TEDE per Worker-cSv (rem)
1990	2	784	115	26	0.03	0.23
1991	2	905	147	39	0.04	0.27
1992	2	467	82	37	0.08	0.45
1993	2	432	76	21	0.05	0.27
1994	2	202	83	22	0.11	0.27
1995	2	212	56	8	0.04	0.15
1996	2	165	67	8	0.04	0.12

Table 2.9 Annual Exposure Data for NRC Independent Spent Fuel Storage Licensees CY 1990 to CY 1996

Year	No. of Licensees	No. of Monitored Individuals	No. of Workers With Measurable TEDE	Collective TEDE Person-cSv (rem)	Average Individual TEDE-cSv (rem)	Average Measurable TEDE per Worker-cSv (rem)
1990	2	56	22	6	0.11	0.27
1991	2	41	24	4	0.10	0.17
1992	2	290	85	11	0.04	0.13
1993	2	135	52	14	0.10	0.26
1994	1	158	89	42	0.27	0.47
1995	1	104	49	51	0.49	1.04
1996	1	97	53	54	0.56	1.06

Table 2.10 Annual Exposure Data for NRC Fuel Fabrication and Processing Licensees CY 1990 to CY 1996

Year	No. of Licensees	No. of Monitored Individuals	No. of Workers With Measurable TEDE	Collective TEDE Person-cSv (rem)	Average Individual TEDE-cSv (rem)	Average Measurable TEDE per Worker-cSv (rem)
1990	11	14,505	3871	422	0.03	0.11
1991	11	11,702	3929	378	0.03	0.10
1992	11	8439	5061	545	0.06	0.11
1993	8	9649	2611	339	0.04	0.13
1994	8	3596	2847	1147	0.32	0.40
1995	8	4106	2959	1217	0.31	0.41
1996	8	4369	3061	878	0.20	0.29

updated as appropriate. This may cause minor changes in the data published from year to year. The data are taken from the Radiation Exposure Information Reporting System funded by the NRC's Office of Nuclear Regulatory Research.

In CY 1996 NRC radiography licensees had the highest collective TEDE. Independent spent fuel storage licensees had the highest average measurable TEDE per worker. Low-level waste disposal licensees and independent spent fuel storage licensees had relatively low collective TEDE.

There has been a decreasing trend in the number of individuals who received a measurable TEDE among most categories of licensees. Over this same period, the average measurable TEDE per worker has increased for most categories of licensees. In all cases, however, the average measurable TEDE per worker is far below the allowable limits of 10 CFR Part 20.

3 ABNORMAL OCCURRENCES

3.1 Abnormal Occurrence Reporting

Section 208 of the Energy Reorganization Act of 1974 (PL 93-438) identifies an abnormal occurrence (AO) as an unscheduled incident or event that the Nuclear Regulatory Commission (NRC) determines to be significant from the standpoint of public health or safety. The NRC identifies an AO using revised criteria that were initially promulgated in an NRC policy statement that was published in the *Federal Register* on February 24, 1977. This policy statement was published before medical licensees were required to report medical misadministrations to the NRC, and few of the examples in the policy statement were applicable to these misadministrations. In 1996 the NRC published revised AO criteria to add criteria for medical misadministrations, and in 1997 the NRC revised the AO criteria to add criteria for gaseous diffusion plants. These revised criteria were used to select events to be included in the 1997 AO report to Congress.

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 States must maintain programs that are adequate to protect public health and safety and are compatible with the Commission's programs for such material. In early 1977 the Commission determined that events that meet the criteria for AOs that occur at facilities licensed by Agreement States should be included in the periodic report to Congress. Procedures have been implemented for the evaluation of nuclear materials events to determine those that should be reported as AOs. AOs reported by the Agreement States to the NRC are included in the periodic report to Congress. The AO criteria are applied uniformly to events that occur at facilities regulated by the NRC or by the Agreement States.

3.2 Abnormal Occurrence Report for 1997

The 1997 AO report (NUREG-0090, Vol. 20) contains five nuclear materials AOs. (Some of these events occurred before 1997 but the information required to determine if they met the AO criteria was not previously available.) One of these AOs occurred at a facility licensed by the NRC and involved an occupational overexposure. Four AOs were submitted by the Agreement States; two of them were overexposures of workers or a member of the public, and two were radiopharmaceutical misadministrations. These AOs are described in Appendix B to this report.

4 OTHER AEOD ACTIVITIES

4.1 Agreement State Operational Experience Data

To establish standards for collecting material event data from Agreement States and to encourage voluntary reporting of material events, a trial program for Agreement State reporting of events began in April 1995. The program was evaluated after approximately 6 months and the results were sent to the Commission in late 1996. In its final "Policy Statement on Adequacy and Compatibility of Agreement State Programs," the staff proposed that Agreement State event reporting be required as an element of compatibility. The Commission approved the policy statement on September 3, 1997; as a result, Integrated Material Performance Evaluation Program (IMPEP) teams review event reporting for adequacy during IMPEP evaluations. This promotes standardized material event reporting between Agreement State and NRC licensees.

4.2 Gaseous Diffusion Plant Abnormal Occurrence Criteria

As explained in Chapter 3 of this volume, AEOD prepares the NRC annual report to Congress on abnormal occurrences (AOs). Also as explained in Chapter 3, revised medical misadministration AO reporting criteria became effective in 1996. When approving the new AO criteria, the Commission directed the staff to implement three new requirements. First, the staff is to file incident information on potential AOs in the NRC's Public Document Room (PDR) as soon as possible after the staff determines that the incident is a potential AO. The staff has established procedures to implement this directive. Second, the staff was to determine if modifications to the AO criteria for fuel cycle facilities are necessary to explicitly cover those facilities that are not licensed by the NRC but that are otherwise regulated by the NRC, such as the gaseous diffusion plants. The staff determined that revised criteria were necessary for the gaseous diffusion plants. These criteria were developed and became effective in 1997. Finally, the staff was directed to report to the Commission on how the NRC will identify unintended medical radiation exposures to an embryo/fetus or a nursing child, describe the staff's experience with voluntary reporting; and address whether, if it does not recommend a mechanism to identify unintended medical radiation exposures to an embryo/fetus or a nursing child, the final AO criteria should be revised to omit reference to these types of incidents. The staff is preparing a *Federal Register* notice requesting public comments on this issue.

In 1997, in keeping with the changes to the AO criteria, AEOD finalized the revision of NRC Management Directive 8.1, "Abnormal Occurrence Reporting Procedure," which contained the new AO reporting criteria, the requirement for publishing an annual AO report on a fiscal-year basis, and the requirement for using the PDRs to quickly let the public learn about potential AOs.

5 INCIDENT RESPONSE

AEOD maintains and implements the NRC's Incident Response Program with the support of other headquarters and regional offices. Within the framework of this program, AEOD receives data and reports for both emergency and non-emergency events from licensees followed by an appropriate NRC response. The response for the more serious emergencies is through an incident response organization that has representatives from several headquarters offices and the responsible regional office. The NRC's response organization also coordinates with other Federal agencies and with State and local governments.

5.1 NRC Operations Center

The NRC Operations Center, in the Two White Flint North building in Rockville, Maryland, is the focal point for NRC communications with its licensees, State agencies, and other Federal agencies about events that occur in the commercial nuclear sector. It is continuously staffed by a Headquarters Operations Officer who is a nuclear systems engineer trained to receive, evaluate, and respond to all types of events. The NRC Operations Center features a state-of-the-art information management system that integrates voice, video, and data subsystems to support the timely and effective flow of information during the NRC's response to an incident.

5.2 Emergency Response

NRC-licensed facilities have a variety of emergency plan requirements. Both production and utilization facilities (power and non-power reactors) are required to maintain plans for responding to emergencies that could affect the health and safety of the public. Facilities or activities that are licensed to possess and utilize byproduct material, source material, or special nuclear material are required to maintain emergency plans for responding to a radiological release only if these licensees possess quantities of nuclear material that exceed the amounts specified in 10 CFR Parts 30, 40, and 70. In addition, all NRC-certified gaseous diffusion plants are required to maintain emergency plans. The emergency response requirements for independent spent fuel storage installations located on the sites of NRC-licensed nuclear power reactors are included in the emergency plans required for these sites. Other facilities or activities that the NRC licenses to possess or utilize nuclear materials are not required by the *Code of Federal Regulations* (CFR) to maintain emergency plans; however, their NRC licenses may require them to do so.

Power and non-power reactor licensees utilize the following four emergency classes, in order of increasing severity:

- **Unusual Event** - a condition involving potential degradation of the level of plant safety that does not represent an immediate threat to public health and safety.
- **Alert** - a condition involving actual or potential substantial degradation of the level of plant safety where any offsite radiological releases are expected to be limited to small fractions of the Environmental Protection Agency protective action guideline exposure levels.
- **Site Area Emergency** - a condition involving actual or likely major failures of one or more plant functions required for protection of the public or involving conditions with potential for a significant offsite radiological release but where a core melt situation is not indicated.
- **General Emergency** - a condition involving actual or imminent substantial core degradation or melting with potential for loss of containment.

Emergencies for nuclear materials licensees are categorized into one of the following two classes, in order of increasing severity:

- **Alert** - for an NRC-licensed nuclear materials facility, this indicates that events may occur, are in progress, or have occurred that could lead to a release of radioactive material but that the

release is not expected to require a response by offsite organizations to protect individuals off site.

- **Site Area Emergency** - for an NRC-licensed nuclear materials facility, this indicates that events may occur, are in progress, or have occurred that could lead to a significant release of radioactive material and that could require a response by offsite organizations to protect individuals off site.

Although not required by the CFR, some nuclear materials licensees may also utilize the Unusual Event emergency class for events with lower safety significance.

In the event of an emergency at an NRC-licensed facility (or one associated with an NRC-licensed activity), the licensee would place an emergency telephone call to the NRC Operations Center, after notifying appropriate State and local agencies and within 1 hour of the event. For Site Area Emergencies and for events for which an NRC response may be appropriate, the regional administrator and an Executive Team member (typically the Director of the Office of Nuclear Material Safety and Safeguards [NMSS]) will discuss the event in a conference call with the licensee.

The NRC's response to an event may range from routine follow-up to a complete activation of both the regional Incident Response Center and the NRC Headquarters Operations Center. The NRC utilizes the following distinct modes for responding to events at its licensed facilities: Normal, Standby, Initial Activation, and Expanded Activation.

For the **Normal Mode**, the lowest level of response, the NRC will not fully staff the NRC Operations Center or the Incident Response Center located in the applicable regional office, but it may take some other action such as sending out a special inspection team or staffing the response centers with a few select experts to monitor the event. The latter is referred to as the Monitoring Phase of the Normal Mode.

Standby Mode, the next level of response, is entered when an event is judged to be sufficiently uncertain or complex that the situation needs to be continuously monitored from the headquarters and regional response centers by teams of experts. At this point, the primary responsibility of the responsible region is to prepare to dispatch a team to the site. During the Standby Mode, the NRC response is led from the NRC Operations Center.

If the event threatens public health and safety, the NRC will enter the **Initial Activation Mode** and will promptly send a team from the regional office to the site to lead the NRC response. Until the Site Team is in place, the NRC response will continue to be led from the NRC Operations Center. Within the NRC Operations Center, teams of specialists will evaluate the status of reactor critical safety functions and will independently evaluate protective actions recommended by the licensee for implementation by State and local authorities. All communications with the media, State and Federal officials, international organizations, Congress, and the White House will also be coordinated from the NRC Operations Center. During this mode, representatives from six other Federal agencies report to the NRC Operations Center to give direct support to the NRC as Lead Federal Agency.

Once the NRC site team arrives on the scene and is prepared to accept the operational authority and responsibility for the Federal response, the NRC enters the **Expanded Activation Mode**. The Director of Site Operations, typically the regional administrator, will report to the licensee's Emergency Operations Facility (or its functional equivalent) near the site. The lead responsibility for assessing reactor safety, protective measures, and liaison activities then shifts from headquarters to the NRC team at the site. The NRC Operations Center will then provide logistical and technical support to the NRC Site Team as necessary.

5.3 NRC Operations Center Data for 1997

In addition to emergency event notifications, the NRC Operations Center receives many notifications of events that do not meet the threshold for emergency classification. These include events required to be reported as well as events voluntarily reported. Actions taken by the Headquarters Operations Officer in response to such notifications range from preparing computer reports and log entries

followed by appropriate notifications, to setting up emergency conference calls between licensee representatives and senior NRC regional and headquarters representatives. For very significant events, conference calls may result in the activation of the agency's Incident Response Plan.

Table 5.1 shows the total number of events reported to the NRC Operations Center during 1997. These notifications were submitted primarily by nuclear power plant licensees. A small subset of these notifications involved events classified by licensees into one of the emergency classes. There was a large increase in the number of events reported to the NRC Operations Center by fuel facilities this year (131 total versus 17 last year). This was mainly attributed to the transfer of regulatory authority over gaseous diffusion plant operations from the Department of Energy to the NRC on March 3, 1997.

Table 5.2 shows the number of each type of emergency event reported annually from CY 1989 through 1997. Table 5.3 lists the emergency events reported by NRC-licensed nuclear materials facilities to the NRC Operations Center during 1997. (No nuclear materials events were reported at the Site Area Emergency level.) The NRC did not enter the Monitoring Phase of the Normal Mode for either of the two Alerts reported by nuclear materials licensees. However, the NRC did enter the Monitoring Phase of the Normal Mode for the following two nuclear materials events:

- Mattingly Testing Service; Billings, Montana; April 4, 1997 - A nuclear radiography camera containing a locked Iridium-192 shielded source was stolen from a locked storage building that was placarded with a radioactive symbol.
- New Jersey Department of Environmental Protection; Cream Ridge, New Jersey; May 10, 1997 - An individual ingested tritium gas or liquid from broken exit sign tritium tubes in Union, New Jersey.

NRC staff members monitored both of these events from their offices and often used NRC Operations Center communications capabilities. Site teams were also dispatched from the regional offices. In addition, the NRC requested an Aerial Measuring System aircraft from the Department of Energy to assist in locating the source material in the stolen Mattingly radiography camera.

Table 5.1 Events Reported to the NRC Operations Center in 1997

Emergency Class	Power Reactor	Fuel Facility	Non-Power Reactor	Hospital	Well Logging/ Transport/ Materials	Other	Total
Non-Emergency	1,458	129	2	54	140	102	1,885
Unusual Event	49	0	0	0	0	0	49
Alert	2	2	0	0	0	0	4
Site Area Emergency	0	0	0	0	0	0	0
General Emergency	0	0	0	0	0	0	0
Totals	**1,509**	**131**	**2**	**54**	**140**	**102**	**1,938**

Table 5.2 Classification of Events Under Licensee Emergency Plans CY 1989 through 1997

Emergency Class	CY 1989	CY 1990	CY 1991	CY 1992	CY 1993	CY 1994	CY 1995	CY 1996	CY 1997
Unusual Event	197	151	170	135	103	97	66	67	49
Alert	13	10	9	20	8	4	8	10	4
Site Area Emergency	0	1	2	1	1	0	0	1	0
General Emergency	0	0	0	0	0	0	0	0	0
Totals	210	162	181	156	112	101	74	78	53

Table 5.3 Alerts Reported by NRC-Licensed Nuclear Materials Facilities in 1997

Plant	Event No.	Date	Description of Event	Duration
Allied-Signal	31461	12/16/96	Onsite release of uranium hexaflouride gas caused by a dust collector shutting down due to a power outage	31 minutes
Babcock and Wilcox	31883	03/04/97	Local evacuation following a spill of uranyl nitrate (≈100 liters) in the low enriched uranium down blending area	4 hours and 22 minutes

5.4 Emergency Exercises

Emergency exercises are held periodically to ensure that NRC, licensee, local, State, and other Federal response organizations remain proficient in dealing with each type of emergency. The NRC's primary role in these exercises is to independently assess licensee actions, assist the licensee when requested, review the protective action recommendations that the licensee makes to State and local authorities, and facilitate communications between the licensee and other response organizations. To prepare for an exercise, the licensee develops a postulated accident scenario that normally goes well beyond the facility's design basis and that results in the release of some radioactivity outside the facility's boundary. NRC responders follow the radiological materials safety and protective measures aspects of the simulated event; communicate with licensee, State, and Federal responders; and make recommendations to an NRC Executive Team in the NRC Operations Center. In 1997 the NRC headquarters and regional offices participated in a full-scale emergency exercise with the Portsmouth Gaseous Diffusion Plant on September 12, 1997. The NRC also conducted a site team exercise with General Electric Wilmington on July 16, 1997. In addition, tabletop exercises were conducted with the Portsmouth and Paducah Gaseous Diffusion Plants on November 7, 1996, and with the Environmental Protection Agency (EPA) on September 30, 1997. The tabletop exercise with Portsmouth/

Paducah was the first exercise conducted in preparation for NRC regulation of the gaseous diffusion plants, which began on March 3, 1997. During the tabletop exercise with the EPA, AEOD assisted NRC Region I in conducting the early phase of a "lost source" exercise at the Philadelphia Electric Company's emergency operations facility in Coatesville, Pennsylvania. This was the first exercise of its kind with the NRC supporting the EPA.

5.5 State Outreach

In 1997 AEOD continued an aggressive State Outreach Program designed to increase and improve the NRC's interaction with States during events and exercises. AEOD briefed State officials on the NRC and Federal emergency response program, the Emergency Response Data System, NRC/State liaison during an emergency, and financial assistance available to responders. AEOD also expanded the program to cover training on NUREG/BR-0230, "Response Coordination Manual" (RCM-96) and the recently updated NUREG/BR-0150, "Response Technical Manual" (RTM-96). Outreach sessions were conducted for respondents from 22 States and numerous licensees: in NRC Region 1 for Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, and Delaware; in NRC Region 2 for North Carolina, South Carolina, and Georgia; in NRC Region 3 for Michigan, Indiana, Wisconsin, and Ohio; and in NRC Region 4 for California, Washington, Oregon, Arizona, and Missouri. Participants represented both the radiation health and emergency services organizations within those States, licensees' counties, and regional Federal organizations. (Although the scenarios in these exercises involved power reactors, the interactive process between the NRC and the State personnel is the same as for emergencies involving nuclear materials licensees.)

5.6 Coordination with Other Federal Agencies

In 1997 AEOD continued to work with other Federal agencies in completing annexes to the Federal Response Plan (FRP), such as the Radiological Incident Annex, which describes how the FRP and the Federal Radiological Emergency Response Plan (FRERP) are integrated. Furthermore, significant work has been done in preparing for nuclear, biological, and chemical terrorist events. As a result of the NRC regulatory oversight of the gaseous diffusion plants, AEOD staff worked with other Federal agencies through the Environmental Protection Agency's (EPA's) National Response Team to ensure that proper coordination takes place among Federal agencies with statutory responsibility to respond to chemical emergencies. As a result of this work, the EPA and the National Oceanic and Atmospheric Administration have been more thoroughly integrated into the NRC response procedures. Additionally, AEOD initiated activities to develop the assessment tools needed for handling emergencies that involve chemical as well as radioactive material releases. In cooperation with other Federal agencies, the role of the principal agencies and their associated responsibilities in responding to chemical as well as radiological emergencies at fuel cycle facilities, such as the EPA and Department of Energy, were better defined.

AEOD participated with other Federal agencies in responding to real emergencies involving lost sources and reported contamination events. These interactions led to improved procedures and understanding among key Federal agencies.

In 1997 AEOD supported the Federal Emergency Management Agency (FEMA) in providing accident assessment training to Federal, State, and local officials on four occasions. In addition, AEOD participated in the design and conduct of an FRERP workshop sponsored by FEMA. As a member of the Federal Radiological Preparedness Coordinating Committee, AEOD participated in meetings to discuss issues relating to State and local governments response. Furthermore, as a member of the training subcommittee, exercise subcommittee, and the protective action guideline subcommittee; AEOD participated in coordinating related activities with other Federal agencies. As a member of the Emergency Support Function Leaders Group, AEOD participated with other Federal agencies in discussing issues relating to Federal coordination and response.

AEOD provided training to other Federal and State representatives on public information, severe

weather response, and emergency dose projection using the RASCAL program. These training sessions took place inhouse as well as at the Harvard School of Public Health.

AEOD also presented the NRC concept of operations at various forums, such as the American Nuclear Society conference, the Conference of Radiation Control Program Directors meeting, the National Emergency Management Agencies conference, Nuclear Energy Institute meetings, and the National Radiological Emergency Preparedness conference.

In addition, AEOD supported EPA in preparing for and co-facilitating an exercise involving a lost radioactive source. This was an important step in identifying the areas of concern by the principal Federal and State agencies.

5.7 Gaseous Diffusion Plant Activities

The Energy Policy Act of 1992 (the Act) amended the Atomic Energy Act of 1954 to establish a new government corporation, the United States Enrichment Corporation (USEC), for the purpose of managing and operating the two uranium enrichment plants owned and previously operated by the Department of Energy (DOE): the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio, and the Paducah Gaseous Diffusion Plant (GDP) in Paducah, Kentucky. The Act further directed the NRC to establish a process under which the NRC will annually certify these two plants for compliance with NRC standards. These standards require site-specific emergency response plans for the GDPs to be reviewed and approved before certification. Regulatory authority over GDP operations was transferred from DOE to the NRC on March 3, 1997.

Since DOE maintains responsibility for certain processes at the two GDPs, the NRC completed a memorandum of understanding with DOE delineating each agency's role in the event of an emergency at a GDP. Agreement was reached on the selection of the Lead Federal Agency when the origin of the emergency was unknown. AEOD also participated in negotiations in which agreement was reached with DOE, USEC, and their contractors on the adoption of an emergency classification scheme that would be consistent with the Commission's policy. In addition, AEOD conducted training for NRC respondents which emphasized the use of response procedures, communications among different organizations, accident assessment tools, and preparation of Executive Team briefings. AEOD developed RASCAL Version 2.2 to ensure that UF_6 releases can be handled by the code. The hydrogen fluoride (HF) and the uranyl fluoride (UO_2F_2) byproducts were modeled in Version 2.2 and the results were provided in a format directly comparable with intervention levels.

6 INCIDENT INVESTIGATION PROGRAM

The Incident Investigation Program (IIP) ensures that NRC investigations of significant events are timely, thorough, well coordinated, and formally administered. The scope of the IIP covers investigations of significant operational events involving reactor and materials activities licensed by the NRC. Within the framework of the IIP, the NRC responds to an operational event according to its safety significance. For an event of extraordinary safety significance, the Commission may establish an Accident Review Group (ARG) led by an individual from outside the NRC and composed of experts from within and outside the NRC. The ARG reports directly to the Commission and is independent of NRC management. For an event of potentially major safety significance, the Executive Director for Operations (EDO) establishes an Incident Investigation Team (IIT) to investigate the event. For an event of less safety significance, the responsible NRC regional administrator may establish an Augmented Inspection Team (AIT) to investigate the event. Both IITs and AITs are assigned to determine the circumstances and causes of an operational event and to assess the safety significance of the event so that appropriate follow-up actions can be taken. The EDO assigns staff actions arising from IITs; regional administrators identify needed actions based on AIT findings; AEOD and other NRC offices, including NMSS, independently review AIT reports to gain additional assurance that potential generic lessons are learned and communicated to the industry. As described in NUREG-1303, "Incident Investigation Manual," AEOD has overall responsibility for administration of the IIP, and NRR is responsible for maintaining the procedures for an AIT response.

6.1 Incident Investigation Team Events

There were no nuclear materials events in 1997 that were judged to have a level of safety significance sufficiently high to warrant an IIT investigation. The status of actions associated with previous IIT findings assigned by the EDO to various NRC offices is documented in Appendix F to this report.

6.2 Augmented Inspection Team Events

There were no nuclear materials events in 1997 that were judged to have a level of safety significance sufficiently high to warrant an AIT investigation.

7 COMMITTEE TO REVIEW GENERIC REQUIREMENTS

The Committee to Review Generic Requirements (CRGR) reviews all generic requirements proposed by the NRC staff that involve one or more classes of power reactors. The CRGR consists of senior managers from various headquarters program offices and, on a rotational basis, from one of the NRC regional offices. The AEOD Director serves as the CRGR Chairman, and the AEOD staff provides support for all of the Committee's activities. The AEOD Director also oversees plant-specific backfit activities of the NRC staff in the headquarters program offices and the regional offices. In this period, one new member from a region was appointed to the CRGR. The membership of the CRGR in 1997 was as follows:

Denwood F. Ross, Director, AEOD (Chairman)

Frank J. Miraglia, Deputy Director, NRR

Malcolm R. Knapp, Deputy Director, NMSS

Joseph A. Murphy, Director, Division of Regulatory Applications, RES

Dennis C. Dambly, Assistant General Counsel for Materials,

Antitrust and Special Proceedings, OGC

James E. Dyer, Deputy Regional Administrator, Region IV

While performing the CRGR review function, a CRGR member expresses an individual professional opinion about each item considered, rather than representing the view of his respective office. The members of the CRGR determine whether proposed new generic requirements have sufficient merit in terms of safety and are justified in terms of cost (where appropriate) before reaching a consensus recommendation about each issue considered. Each independent CRGR recommendation is given to the EDO for consideration.

In 1994 a staff proposal was submitted to the Commission to reduce the scope of the CRGR review and to evaluate various means of reducing the burden on CRGR members. On April 21, 1994, the EDO transmitted SECY-94-109 to the Commission proposing to reduce the basic scope of CRGR review to include only "high impact" and "controversial" generic correspondence and rules before public comment, issues that the staff has difficulty resolving after public comment, emergency and urgent generic correspondence, and significant proposals with highly expedited schedules. A June 15, 1994, staff requirements memorandum (SRM) directed the staff not to reduce the scope of the CRGR Charter but to consider, and to recommend a course of action for, enlarging the scope of CRGR review to include proposed generic requirements in the nuclear materials area. The SRM also directed the staff to look at measures that would reduce the time that individual CRGR members spent on CRGR reviews. The Committee evaluated this option and agreed to address, on a 1-year trial basis, selected nuclear materials issues identified by the NMSS Director or by the EDO. The Committee will assess whether or not the nuclear materials issues that are presented by the staff for CRGR review warrant CRGR attention and, if they do, whether the CRGR review adds significant value. On the basis of that assessment, the Committee will make appropriate recommendations to the EDO regarding continuation of the CRGR review of nuclear materials issues. This assessment will be included in the CRGR meeting minutes during the trial period, and it will also be reported to the EDO in the CRGR Weekly Items of Interest to be reported to the Commission. This aspect of the expanded scope of CRGR review was included in the ongoing CRGR Charter revision process.

On February 9, 1996, in SECY-96-032, the EDO requested Commission approval for this 1 year trial program to include selected nuclear materials issues. The Commission was also informed that the CRGR has considered and adopted measures to reduce the time spent by members on CRGR reviews. When appropriate, based on lack of controversy, low expected impact, or small potential

for error related to the proposed generic actions, the CRGR Chairman may agree to one of three courses of action: (1) defer the CRGR's review pending public comment on the proposal; or (2) agree to a negative consent approach which, in essence, is an abbreviated review; or (3) forgo a second CRGR review, thus reducing the number of dual reviews (i.e., review at both the proposed and final stage). All other staff proposals will be scheduled for regular CRGR review.

On March 22, 1996, the Commission approved Revision 6 to the CRGR Charter, which expanded the scope of CRGR reviews to include, on a 1-year trial basis, selected nuclear materials issues requested by the NMSS Director or the EDO. The Staff Requirements Memorandum, "SECY-97-052 - Committee to Review Generic Requirements (CRGR) - Scope of Review and Periodic Review Activities," dated April 18, 1997, asked the CRGR to continue to review nuclear materials issues for another year, and to also review inspection guidance at the staff's request or at the Committee's self-initiative. Also in response to this SRM, a report containing an annual evaluation of the CRGR's activities and its contributions in achieving the agency's mission (COMSECY-96-028) was submitted to the Commission in August 1997. This report contained an assessment of the value added by the CRGR review of various generic staff proposals, which included the Committee's own self-assessment, assessments by the program offices sponsoring the proposals, and assessments by some of the cognizant staff who had the primary responsibility for the proposals reviewed by the Committee. Also in this report were the highlights of regional backfit training and audits done by the CRGR staff, the feedback received from licensees during the CRGR annual site visit to a nuclear power plant and to a nuclear materials facility, and direct feedback received by the Committee from industry-supported organizations. Another report containing proposals for future CRGR review of nuclear materials issues selected as part of the 1-year continuation of the trial program was also submitted to the Commission.

In 1997 the CRGR members and staff visited the Callaway nuclear power plant in Columbia, Missouri, the Gaseous Diffusion Plant in Paducah, Kentucky, and the Allied Signal Chemicals plant in Illinois. The purpose of the CRGR annual visits to various facilities is to have a candid dialogue with licensees to get their feedback on the NRC's regulatory backfitting activities. In 1997 neither CRGR members nor staff met with the Nuclear Utilities Backfitting and Reform Group.

7.1 CRGR Issues

In 1997 the CRGR held 18 meetings during which it reviewed 30 issues; 29 were related to nuclear power plants only, and 1 issue concerned both nuclear and materials facilities. In addition, the staff briefed the CRGR seven times; one of the briefings was by the Office of Nuclear Material Safety and Safeguards. The issue and the briefing related to nuclear materials are as follows:

- Briefing by the NMSS staff identifying nuclear materials topics for future CRGR review
- Proposed final Revision 3 of Regulatory Guide 5.44, "Perimeter Intrusion Alarm Systems"

7.2 Value Added by the CRGR Review

The CRGR agrees with the general office perception that, in addition to preventing improper backfits, a major role that the CRGR plays is in offering an independent review of various proposed actions. The Committee considered value added by CRGR review and identified various topics reviewed during this assessment period where significant value was added to the incoming staff proposals by the CRGR review. Some of the staff proposals required review at more than one CRGR meeting, involved extensive staff effort to rewrite the proposals, and involved staff effort to address the Committee's comments and recommendations. The value added by the CRGR was reflected in an improved focus on the safety concerns and backfit considerations, as well as in the quality of the product, including scope, content, tone, completeness, and consistency with the Commission's policies, rules, and regulations.

In certain cases, the CRGR believed that the review process would have been more efficient with better

staff preparation for the CRGR review. For some review items, the Committee supported the staff's requests for prompt action by scheduling special CRGR meetings, and, in select cases, also by accepting products still under development or even accepting partial submittal of the review material. In such cases, the Committee's endorsement was conditional on acceptability of the post-CRGR-review changes made to the documents. Although these considerations by the CRGR appear to have helped the staff meet the schedule pressures, the Committee concluded that it was not the most efficient use of its resources, as it necessitated repeat informal review both by the Committee and the CRGR staff.

CRGR review added significant value to one review item related to nuclear materials, as summarized below:

- The NMSS staff presented to the Committee the scope and schedule of various ongoing activities and identified various areas in which future CRGR review may be beneficial. No inspection guidance or procedures related to nuclear materials facilities were identified. The Committee commented on the topics proposed by the staff for which CRGR review could add value. The Committee believed that CRGR review will be most beneficial in certain focused areas. Topics such as backfitting procedures for the gaseous diffusion plants, issues related to spent fuel storage and transportation, and those concerning large fuel cycle facilities could benefit from CRGR review. The Committee noted that there are certain inherent differences in the risks associated with the operation of the power reactors and those related to the operation of nuclear material facilities (e.g., mixed risk from uranium-bearing toxic compounds). The members also noted the inherent differences in the established regulatory framework for the nuclear power reactors and nuclear materials facilities. They recognized the need for establishing some ground rules to ensure consistency and uniformity in the review of nuclear materials topics, if the CRGR were to continue in this role.

APPENDIX A

Nuclear Materials Data by Event Type

Table A-1 Medical Misadministrations

Item No.	Licensee	License Number	Event Date	City	State	Type of Misadministration
960717	Bayonne Hospital	29-12253-01	11/12/96	Bayonne	NJ	Brachytherapy, HDR Remote Afterloader
970665	Bluefield Regional Medical Center	47-19142-01	7/14/97	Bluefield	WV	Brachytherapy, Eye Applicator
970049	Centre Community Hospital	37-13681-01	12/20/96	State College	PA	Brachytherapy, HDR Remote Afterloader
970465	Columbia Hospital	48-02417-01	5/27/97	Milwaukee	WI	Brachytherapy, Manual Afterloader
970035	Fort Sanders Sevier Medical Center	TN-R-78002K98	10/1/96	Sevierville	TN	Diagnostic Radiopharmaceutical
970205	Gunderson Clinic, Ltd.	48-01277-02	3/6/97	La Crosse	WI	Sodium Iodide
970108	Health & Human Services, Dept. Of	19-00296-10	2/18/97	Bethesda	MD	Sodium Iodide
980259	Healthsouth Doctor's Hospital, Inc.	FL-2301-2	3/27/97	Coral Gables	FL	Gamma Stereotactic Radiosurgery
971131	Kaiser Permanente	CO-668-01	8/20/97	Denver	CO	Therapeutic Radiopharmaceutical
980[illegible]	Memorial Medical Center	35-27041-01	5/12/97	Tulsa	OK	Brachytherapy, HDR Remote Afterloader,
970831	Mercy Hospital	21-15638-01	8/13/97	Port Huron	MI	Brachytherapy, Manual Afterloader
970909	Michigan, University Of	21-00215-04	9/15/97	Ann Arbor	MI	Sodium Iodide
970105	Monsour Medical Center	37-14870-01	2/12/97	Jeannette	PA	Sodium Iodide
970805	NR	NR	3/11/97	NR	NY	Brachytherapy, HDR Remote Afterloader,
970402	Overlook Hospital	29-03308-01	5/5/97	Summit	NJ	Sodium Iodide
980176	Parkland Memorial Hospital	NR	7/11/97	Dallas	TX	Sodium Iodide
971130	Saint Anthony Hospital North	CO-00152-01	8/27/97	Denver	CO	Therapeutic Radiopharmaceutical
970390	Theda Clark Regional Memorial Hospital	48-09494-01	12/20/96	Neenah	WI	Sodium Iodide

Table A-1 Medical Misadministrations

Item No.	Licensee	License Number	Event Date	City	State	Type of Misadministration
970155	Tuomey Regional Medical Center	SC-10-0010	12/11/96	Sumter	SC	Sodium Iodide
970972	Tuomey Regional Medical Center	SC-10-0010	9/23/97	Sumter	SC	Brachytherapy, Manual Implant
970221	University of Louisville	KY-202-029-22	10/15/96	Louisville	KY	Brachytherapy, Manual Implant
960837	V.A. Medical Center	36-01395-01	12/18/96	Portland	OR	Sodium Iodide
970429	V.A. Medical Center	31-00786-02	5/9/97	Buffalo	NY	Sodium Iodide
970846	V.A. Medical Center	04-00181-04	8/26/97	Los Angeles	CA	Teletherapy
960169	Washington Hospital	37-10363-01	12/26/96	Washington	PA	Diagnostic Radiopharmaceutical
970358	Western Baptist Hospital	KY-202-079-31	1/6/97	Paducah	KY	Teletherapy
970602	Western Baptist Hospital	KY-202-079-31	5/19/97	Paducah	KY	Teletherapy

Table A-2 Overexposures

Item No.	Licensee	License Number	Event Date	City	State	Type of Exposure	No. Exposed	Dose (Rem)
971045	Columbia Regional Oncology Center	NR	11/6/96	El Paso	TX	Whole Body, Non-Occupational	1	0.117
971058	H & G Inspection Company, Inc.	NR	12/31/96	Houston	TX	Whole Body, Occupational	1	5.8
970696	ICN Pharmaceuticals	CA-1828-30	12/31/96	Irvine	CA	Extremity, Occupational	1	52
970434	Mallinckrodt Medical, Inc.	24-04206-01	5/14/97	Maryland Heights	MO	Skin, Occupational	1	609
960699	Professional Service Industries, Inc.	45-25088-01	11/6/96	Bristol	VA	Whole Body, Occupational	1	16
971054	Syncor International Corporation	NR	12/15/96	Houston	TX	Extremity, Occupational	1	131.4
970320	Texas Industrial	NR	10/1/96	Houston	TX	Whole Body, Occupational	1	5.3
960816	Tulsa Gamma Ray, Inc.	35-17178-01	35388	Tulsa	OK	Whole Body, Occupational	1	8.3

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970655	A. G. Wassenaar	CO-212-01	7/10/97	Denver	CO	Am-Be Cs-137	0.044 0.009
960802	ABB Process Automation, Inc.	34-00255-03	12/2/96	Columbus	OH	Sr-90 Kr-85	0.07 0.25
970101	Air Force, Department of the	42-23539-01A	2/6/97	Brooks AFB	TX	Sr-90	0.001
970428	Air Force, Department of the	42-23539-01A	5/12/97	Brooks AFB	TX	Am-241	<0.001
970444	Air Force, Department of the	42-23539-01A	5/15/97	Brooks AFB	TX	Th-230	NR
971096	Air Force, Department of the	42-23539-01A	7/15/97	Brooks AFB	TX	H-3 H-3	10.4 12
970795	Air Force, Department of the	42-23539-01A	8/7/97	Brooks AFB	TX	Cs-137	0.086
971037	Air Force, Department of the	42-23539-01A	9/8/97	Brooks AFB	TX	H-3 H-3 H-3 H-3 H-3	0.19 0.19 0.19 0.19 0.19
970180	All American Asphalt	CA-5547-33	11/8/96	Corona	CA	Cs-137 Am-Be	0.008 0.04
970919	Allegheny General Hospital	SNM-1484	3/25/97	Pittsburgh	PA	Pu-238	NR
970936	ALP Lighting, Inc.	General License	8/4/97	Pennsauken	NJ	Po-210	0.003
980215	Alpha Testing, Inc.	NR	9/4/97	Dallas	TX	Am-Be Cs-137	0.044 0.011
970656	Ambric Engineering, Inc.	37-20968-01	6/25/97	Philadelphia	PA	Cs-137	0.008
960580	Amersham Corp.	20-12836-01	11/23/96	Burlington	MA	Ir-192	108
960820	Amersham Corp.	20-12836-01	12/10/96	Burlington	MA	Ir-192	64.4
970436	Anheuser Busch, Inc.	General License	5/5/97	St. Louis	MO	Am-241 Am-241	0.1 0.1
980266	Arco Engineering & Testing Consultants	FL-1622-1	8/26/97	Miami	FL	Am-Be Cs-137	0.04 0.008
970015	Ardman & Associates	FL-972-08	1/7/97	West Palm Beach	FL	Cs-137 Am-Be	0.008 0.04
960659	Arizona State University	General	10/26/96	NR	AZ	H-3	20

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
960624	Army, Dept. of the	General	10/15/96	Fort Sill	OK	H-3	25
970093	Army, Dept. of the - Rock Island Arsenal	12-00722-06	10/27/96	Rock Island	IL	H-3	10
970131	Army, Dept. of the - Rock Island Arsenal	12-00722-13	11/1/96	Rock Island	IL	Am-241	<0.001
970085	Army, Dept. of the - Rock Island Arsenal	12-00722-06	11/25/96	Rock Island	IL	H-3	120
970088	Army, Dept. of the - Rock Island Arsenal	12-00722-06	12/6/96	Rock Island	IL	H-3	10
970074	Army, Dept. of the - Rock Island Arsenal	12-00722-06	12/10/96	Rock Island	IL	H-3	120
970083	Army, Dept. of the - Rock Island Arsenal	12-00722-13	2/7/97	Rock Island	IL	Am-241	<0.001
970864	Army, Dept. of the - Rock Island Arsenal	SUC-1380	2/27/97	Rock Island	IL	(dep	NR
970237	Army, Dept. of the - Rock Island Arsenal	12-00722-13	3/13/97	Rock Island	IL	Am-241	<0.001
970668	Army, Dept. of the - Rock Island Arsenal	12-00722-13	3/25/97	Rock Island	IL	Am-241	<0.001
970443	Army, Dept. of the - Rock Island Arsenal	12-00722-14	3/27/97	Rock Island	IL	Ni-63	0.01
970349	Army, Dept. of the - Rock Island Arsenal	12-00722-13	4/22/97	Rock Island	IL	Am-241 Ni-63	<0.001 0.01
970403	Army, Dept. of the - Rock Island Arsenal	12-00722-06	5/2/97	Rock Island	IL	H-3	10
980240	Army, Dept. of the - Rock Island Arsenal	12-00722-13	7/1/97	Rock Island	IL	Am-241	<0.001
970853	Army, Dept. of the - Rock Island Arsenal	12-00722-13	8/28/97	Rock Island	IL	Am-241	<0.001
970911	Army, Dept. of the - Rock Island Arsenal	12-00722-04	9/16/97	Rock Island	IL	Am-241	<0.001
980189	Atser Corp.	NR	7/10/97	Houston	TX	Am-Be Cs-137	0.04 0.008
980262	Auto Shred Recycling	Non-Licensee	6/16/97	Pensacola	FL	Am-241	0
971052	B. J. Industries	NR	12/13/96	Mentone	TX	Cs-137	0.05
960723	B. J. Services Co., U.S.A.	42-19649-01	12/20/96	Houston	TX	Cs-137	0.1

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
960640	Babcock & Wilcox Co.	SNM-0145	10/18/96	Vandergrift	PA	U-He Th-230	NR NR
971034	Baker Hughes Oilfield Operations, Inc.	17-27437-01	8/30/97	Broussard	LA	Cs-137 Am-Be	2 5
970560	Baptist Hospital of Miami	FL-0614-2	10/28/96	Miami	FL	I-131	NR
970030	BASF Corp.	NC-032-0760-1	1/13/97	RTP	NC	Ni-63 Ni-63	0.008 0.008
970794	BFI	Non-Licensee	4/15/97	Clinton	IL	I-131	NR
980377	BFI Little Dixie Landfill	Non-Licensee	2/24/97	Jackson	MS	I-131	NR
980378	BFI Three Rivers Landfill	Non-Licensee	4/4/97	Ecru	MS	I-131	NR
970122	Bhate Engineering	TN-R-A1009-C-00	2/21/97	Millington	TN	Cs-137 Cs-137 Am-Be Am-Be	0.01 0.01 0.04 0.04
970920	Bill Miller, Inc.	35-19048-01	9/17/97	Henryetta	OK	Ir-192	16
970718	Bowser-Morner, Inc.	34-17390-01	7/25/97	Dayton	OH	Cs-137 Am-Be	0.009 0.04
970555	Browning Ferris Industries	Non-Licensee	10/14/96	Miami	FL	I-131	NR
970709	California State University	CA-0319-19	3/12/97	Northridge	CA	Ni-63	0.014
960632	CAT Engineering Consultants	FL-2611-01	10/15/96	Coral Gables	FL	Am-Be Cs-137	0.044 0.009
971053	Chaparral Steel	NR	3/31/97	Midlothian	TX	Fe-55 Fe-55	0.01 0.01
970263	Chem-Nuclear Systems, Inc.	39-23004-01	3/27/97	Columbia	SC	NR	<0.001
980149	Cherrington Scrap Metal, Inc.	Non-Licensee	6/5/97	Oak Hill	OH	Cs-137	0.3
970838	Cincinnati, University Of	34-06903-05	8/22/97	Cincinnati	OH	I-125 I-125 I-125	<0.001 <0.001 <0.001
960832	CIS-US, Inc.	20-20973-01	12/17/96	Bedford	MA	I-131	0.203
971110	Cole Industries License	General	11/1/96	Elizabethtown	KY	Po-210	0.01

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
971079	Consolidated Papers, Inc.	General License	3/1/97	Wisconsin Rapids	WI	Po-210	0
970771	Crown Recycling	Non-Licensee	2/25/97	Riverhead	NY	I-131	<0.001
970717	CSU	CA-1874-36	10/15/96	San Bernadino	CA	Cs-137	NR
970836	CTL Engineering, Inc.	34-18533-01	8/20/97	Columbus	OH	Cs-137 Am-Be	0.009 0.04
971005	Dames & Moore, Inc.	CA-4393-19	3/3/97	Los Angeles	CA	Am-Be Cs-137	0.04 0.008
970852	Defense Distribution Depot	37-30062-01	8/4/97	Chambersburg	PA	H-3	3
960633	Delta Testing & Inspection, Inc.	17-26873-01	10/19/96	New Orleans	LA	Cs-137 Am-Be	0.008 40
970217	Doverspike Brothers Coal Co.	37-28449-01	3/12/97	Punxsutawney	PA	Cs-137	0.2
970882	Dowell Schlumberger, Inc.	42-27055-01	7/10/97	Houston	TX	Cs-137 Am-Be	NR NR
980078	Dowell Schlumberger, Inc.	42-27055-01	9/26/97	Houston	TX	Cs-137 Am-Be	1.7 16
980325	Durham Landfill	Non-Licensee	4/15/97	Durham	NC	Tc-99M	NR
970598	E.I. Dupont Denemours and Co. Inc.	General License	5/30/97	Chamberworks	NJ	Ni-63	0.015
960748	Eastern Well Surveys, Inc.	34-12927-01	12/24/96	Wooster	OH	Am-Be Cs-137	3 2
970225	EBA Engineering, Inc.	MD-07144-01	3/13/97	Baltimore	MD	Cs-137 Am-Be	0.008 0.04
960473	Edgewater Manor Apartments	General License	12/20/96	Edgewater Park	NJ	H-3	140
970158	Environmental Control Technology Co.	21-15470-02	2/28/97	Ann Arbor	MI	Ni-63	0.008
970417	Federal Express	Non-Licensee	12/17/96	NR	NH	I-131	NR
970584	Federal Express	Non-Licensee	2/18/97	Memphis	TN	Xe-133	NR
970394	Federal Express	Non-Licensee	4/30/97	Memphis	TN	Cr-51	0.001
970634	Federal Express	Non-Licensee	6/29/97	NR	CA	Xe-133	0.23

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970482	Florida Hospital Medical Center	FL-0069-7	1/20/97	Altamonte Springs	FL	Cs-137	0.038
970505	Florida State University, Radiation Safety Office	FL-0032-10	5/2/97	Tallahassee	FL	Am-241	<0.001
960718	Framatom/Cogema	NR	11/13/96	NR	VA	U-le	NR
970182	Fremont Medical Center	CA-2518-51	10/25/96	Yuba City	CA	Ir-192	<0.001
970202	General Electric Co.	SNM-1097	3/6/97	Wilmington	NC	U-le	NR
970350	GME Consultants, Inc.	IL-01274-22	4/21/97	Bridgeview	IL	Cs-137 Am-Be	0.009 0.044
970288	GME Engineering	SC-0522	10/7/96	Greenville	SC	Cs-137 Am-Be	NR NR
970765	Goodrich Testing and Engineering	TN-R-19192	8/2/97	NR	TN	Cs-137 Am-Be	0.008 0.04
970691	Goodson and Associates, Inc.	CO-441-04	5/21/97	Lakewood	CO	Cs-137 Am-Be	0.009 0.044
970703	Granada Hills Community Hospital	CA-1463-70	4/4/97	Granada Hills	CA	Tc-99M	<0.001
980178	H&G Inspection, Inc.	NR	7/16/97	Houston	TX	Ir-192	60
980191	Halliburton	LA-2353-L01	9/24/97	Houston	TX	Am-Be Cs-137	18.5 1.5
970238	Halliburton Co.	42-01068-07	11/25/96	Houston	TX	Am-241 Cs-137	18.5 1.5
970239	Halliburton Co.	42-01068-07	11/29/96	Houston	TX	Cs-137 Am-Be	1.5 18.5
970165	Halliburton Co.	NR	3/3/97	Houston	TX	Cs-137 Am-Be	1.5 8
980109	Halliburton Co.	NR	3/7/97	Houston	TX	Am-Be Cs-137	18.5 1.5
970850	Halliburton Co.	42-01068-07	5/11/97	Houston	TX	Cs-137 Am-Be	NR NR
970855	Halliburton Co.	42-01068-07	5/13/97	Houston	TX	Cs-137 Am-Be	1.5 8
980079	Halliburton Co.	42-01068-07	8/21/97	Houston	TX	Cs-137 Am-Be	1.5 19

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970007	Hartford Incinerator Facility	Non-Licensee	12/30/96	South Winsor	CT	I-131	NR
960635	Health & Human Services, Dept. Of	02-13990-01	10/8/96	Phoenix	AZ	P-32	<0.001
970058	Health & Human Services, Dept. Of	19-00296-10	1/10/97	Bethesda	MD	I-125	0.001
980092	Hercules Engineering & Testing Services	NR	2/6/97	Houston	TX	Cs-137 Am-Be	0.008 0.04
980180	Hercules	NR	7/25/97	Houston	TX	Cs-137 Am-Be	0.01 0.04
970296	Hewlett Packard	07-28762-01	3/24/97	Wilmington	DE	Ni-63	0.015
970904	Hewlett Packard	07-28762-01	5/9/97	Wilmington	DE	Ni-63 Ni-63	0.015 0.015
970041	Hillis-Carnes Engineering Associates, Inc.	19-30304-01	1/13/97	Annapolis	MD	Cs-137 Am-Be	0.01 0.04
970583	Holston Valley Hospital	TN-R-82033-97	1/25/97	Kingston	TN	I-131	NR
980154	Honeywell Micro Switch	IL-92109-31	6/5/97	Freeport	IL	Po-210	0.01
970438	Hospital San Pablo	52-21325-01	4/15/97	Bayamon	PR	Cs-137 Cs-137 Co-60 Co-60 Co-57 Co-57	<0.001 <0.001 0 0 0 0
980168	IHS Geotech CMT	NR	7/7/97	San Antonio	TX	Cs-137 Am-Be	0.008 0.04
980153	Illinois, University of	IL-01271-01	1/1/97	Champaign /Urbana	IL	Ni-63	0.015
970036	Industrial Laboratories	TN-R-33017-I97	10/2/96	Chattanooga	TN	Co-60 Co-60 Co-60	0.6 3 12
970452	Interior, Dept. of the	22-19667-01	5/22/97	Minneapolis	MN	Kr-85 Kr-85 Kr-85 Kr-85 Kr-85	0.005 0.005 0.005 0.005 0.005
960730	Jaca & Sierra Testing Laboratories	52-19064-01	12/31/96	San Juan	PR	Cs-137 Am-Be	0.01 0.05

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970797	Jeanette Municipal Authority	Non-Licensee	8/8/97	Jeanette	PA	I-131	NR
970621	Kaw Valley Engineering & Development, Inc.	15-26870-01	6/26/97	Junction	KS	Cs-137 Am-Be	0.008 0.04
970386	Kentucky Electric Steel	KY-201-130-5	4/28/97	Ashland	KY	Cs-137	NR
970854	Koch Engineering Co., Inc.	07-28386-01	8/28/97	Newark	DE	Cs-137 Cs-137 Cs-137	0.022 0.001 0.066
970841	Law Engineering, Inc.	35-27045-01	8/25/97	Tulsa	OK	Am-Be Cs-137	0.04 <0.001
970847	Law Engineering, Inc.	45-21498-01	8/27/97	Chantilly	VA	Cs-137 Am-Be	0.008 0.04
970968	Leslie W. Williams, DVM	03-12-0155-01	10/22/96	Las Vegas	NV	Sr-90	NR
970447	Libson Incinerator	Non-Licensee	5/20/97	Taftville	CT	I-131	NR
970006	Lisbon Incinerator Facility	Non-Licensee	12/23/96	Moosup	CT	I-131	NR
970701	Los Angeles County Ranchos Los Amigos Medical Center	CA-0508-70	3/7/97	Downey	CA	I-131	NR
960821	Lower Bucks Hospital	SNM-1800	12/10/96	Bristol	PA	Pu-238	4.8
970932	Lower Bucks Hospital	SNM-1800	6/2/97	Bristol	PA	Pu-238	NR
980264	Lucent Technology	General License	7/21/97	Orlando	FL	H-3	6.3
971028	M P Enterprises	General License	9/15/97	Brookfield	WI	Po-210	0.004
980321	Mack Molding Co.	NC-049-1356-0G	7/3/97	Statesville	NC	Po-210	0.01
970872	Macon Office of Geosciences	GA-1211-1	9/1/97	Albany	GA	Cs-137 Am-Be	0.009 0.044
970201	Marion Steel Co.	34-21123-01	3/7/97	Marion	OH	Cs-137	0.5
970293	Mattingly Testing Services, Inc.	25-21479-01	4/4/97	Great Falls	MT	Ir-192	25

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
971081	Memorial Hospital	13-18881-01	8/27/97	South Bend	IN	I-125	NR
970321	Merck & Co., Inc.	29-00117-06	4/11/97	Rahway	NJ	I-125	<0.001
970637	Metaphysics	NR	7/2/97	Atlanta	GA	I-125	NR
970281	Metro South Transfer Station	Non-Licensee	2/5/97	Oregon City	OR	I-131	NR
970287	Metro South Transfer Station	Non-Licensee	2/25/97	Oregon City	OR	Sn-113	NR
960751	Michigan State University	21-00021-29	10/21/96	East Lansing	MI	Cf-252	0
980013	Micron Technology	General License	8/28/97	Boise	ID	Po-210	<0.001
970392	Millstone, Unit 1	DPR-0021	5/1/97	Waterford	CT	Pu-239	0
970016	Milwaukee County Medical Complex	48-04193-01	12/10/96	Milwaukee	WI	I-125	<0.001
970028	Mobile Nuclear Medicine Service	NR	1/3/97	North Wilkesboro	NC	Cs-137	0.00025
980094	Motorola, Inc.	NR	2/12/97	Seguin	TX	Po-210 Po-210 Po-210 Po-210	0.01 0.01 0.01 0.01
980094	Motorola, Inc.	NR	2/12/97	Seguin	TX	Po-210 Po-210	0.01 0.01
970509	Mt. Sinai Hospital	NR	6/3/97	New York	NY	I-125	0.176
970054	Navy, Dept. of the	45-23645-01N	1/21/97	Portsmouth	VA	Am-241 Am-241	0 0
970948	Navy, Dept. of the	45-23645-01N	9/14/97	Portsmouth	VA	Am-241 Am-241	0 0
970949	Navy, Dept. of the	45-23645-01N	9/15/97	Portsmouth	VA	Am-241 Am-241	0 0
970700	NDC Systems	CA-1451-19	2/18/97	Irwindale	CA	Kr-85	0.2
970421	New Jersey Dept of Environmental Protection	Non-Licensee	5/10/97	Union	NJ	H-3	20

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
971049	Non-Destructive Inspection Corp.	NR	10/22/96	Clute	TX	Ir-192 Ir-192 Ir-192 Ir-192 Ir-192 Ir-192	NR NR NR NR NR NR
980371	North Mississippi Medical Center	MS-378-01	1/16/97	Tupelo	MS	I-131	NR
970813	North Shore University Hospital	NR	4/14/97	Manhasset	NY	I-125	<0.001
970193	Northwestern Steel and Wire	Non-Licensee	3/3/97	Sterling	IL	Cs-137	0.05
970151	NR	NR	12/27/96	NR	SC	Cs-137	0.1
970075	Nuclear Pharmacy of Idaho, Inc.	11-27398-01MD	1/29/97	Boise	ID	I-131	0.01
980280	Nucor Steel Corp.	General License	2/26/97	Norfolk	NE	H-3	7.5
980280	Nucor Steel Corp.	General License	2/26/97	Norfolk	NE	H-3 H-3 H-3	7.5 7.5 75
970177	Nutting Engineers of Florida, Inc.	FL-934-1	3/4/97	Boynton Beach	FL	Am-Be Cs-137	0.04 0.008
970198	Ohio State University	34-00293-02	2/26/97	Columbus	OH	P-32	<0.001
970340	Ohio State University	34-00293-02	3/28/97	Columbus	OH	P-32	<0.001
970270	Oregon State University	OR-90005	11/18/96	Corvallis	OR	Cf-252	<0.001
970553	Palm Beach Solid Waste Authority	Non-Licensee	10/4/96	West Palm Beach	FL	I-131	NR
970051	Paradyme Corp.	FL-G-0018-1	12/4/96	Largo	FL	Po-210	0.01
960720	Pinkerton Chevrolet	General License	11/13/96	Salem	VA	Po-210 Po-210	<0.001 <0.001
970666	Porocel Corp.	AR-637	7/14/97	Little Rock	AR	Cs-137	0.02
970379	Portland Adventist Medical Center	OR-90158	3/25/97	Portland	OR	I-131	0.0001
960670	Portsmouth General Hospital	45-09102-02	10/15/96	Portsmouth	VA	Cs-137	<0.001
970754	Potomac Hospital	16618	7/31/97	Woodbridge	VA	I-125	<0.001

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970787	Precision Products Group, Inc.	General License	3/24/97	College Park	MD	Po-210	0.027
970009	Private Individual	Non-Licensee	1/2/97	South Burlington	VT	H-3	20
970267	Private Individual	Non-Licensee	3/27/97	Lake Elsinore	CA	Sr-90	<0.001
970262	Professional Service Industries, Inc.	12-16941-01	3/7/97	Lombard	IL	Am-Be	0.04
970575	Providence Milwaukie Hospital	OR-90312	4/4/97	NR	OR	I-131	NR
980233	Pruett Industries, Inc.	CA-6098-15	9/8/97	Bakersfield	CA	I-131	<0.001
970442	R.M. Wester and Associates	21-20091-01	5/17/97	Saint Peters	MO	Am-241	<0.001
970185	Radcliff Inspections	NR	10/10/96	Long Beach	CA	Ir-192	17
971003	Regents of University of California - Los Angeles	CA-1335-19	6/4/97	Los Angeles	CA	P-32	0.005
970289	Regional Medical Center of Memphis	TN-R-79160-L97	10/31/96	Memphis	TN	I-125	<0.001
970316	Rhone Engineers	NR	11/7/96	Dallas	TX	Am-Be Cs-137	0.04 0.008
970050	Ricker, Atkinson, McBee & Associates	AZ-7-406	1/10/97	Phoenix	AZ	Am-Be Cs-137	0.04 0.04
970897	Riverside Regional Medical Center	45-09001-01	5/28/97	Newport News	VA	Tc-99M	NR
970250	Rochester Manufacturing	Non-Licensee	3/19/97	Rochester	MI	I-131	NR
970866	Roger Adams GMC	General License	4/21/97	Rolla	MO	Po-210	NR
960696	Rone Engineers, Inc.	TX-L02356	11/7/96	Dallas	TX	Cs-137 Am-Be	0.008 0.04
970869	Royal Green Metal Recyclers	Non-Licensee	8/27/97	Temple	PA	Am-241 Am-241	0.1 0.1

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970707	RSA Laboratories, Inc.	06-30007-01	6/5/97	Hebron	CT	Sr-90	<0.001
						Sr-90	<0.001
						Sr-90	<0.001
						Sr-90	<0.001
						Sr-90	<0.001
						Sr-90	<0.001
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						Sr-90	<0.001
970516	Saint Elizabeth Hospital	29-04333-01	4/18/97	Elizabeth	NJ	I-131	0.02
970817	Saint Joseph's Hospital	NR	10/14/96	Syracuse	NY	Tc-99M	NR
970578	Saint Jude Children's Research Hospital	TN-R-79056-I96	11/12/96	Memphis	TN	I-125	<0.001
970477	Saint Luke's Hospital Association	FL-0269-1	5/21/97	Jacksonville	FL	Am-241	0.014
970318	Saint Mary of the Plains	NR	11/14/96	Lubbock	TX	Pu-238	3
970375	Salem Hospital	OR-90151	3/10/97	Salem	OR	Tc-99m	NR
980158	Sandoz Agro, Inc.	IL-01706-01	7/9/97	Des Plaines	IL	C-14	<0.001
970008	Sanitary Services Corp.	Non-Licensee	12/27/96	NR	CT	I-131	NR
970775	SCC Corp. Waste Transfer Station	Non-Licensee	3/10/97	Holtsville	NY	I-131	<0.001
980177	Schlumberger Technology	NR	6/12/97	Houston	TX	Cs-137	1.7

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
980188	Schlumberger Technology	NR	7/16/97	Sugarland	TX	Am-Be Cs-137	16 1.7
970130	Schlumberger Technology Corp.	42-00090-03	2/19/97	Houston	TX	Cs-137 Am-Be	1.7 16
970582	Schlumberger Technology Corp.	42-00090-03	6/17/97	Houston	TX	H-3	1.5
970304	Schlumberger, Inc.	NR	10/8/96	Houston	TX	Am-Be Cs-137	16 1.7
971068	Schlumberger, Inc.	NR	12/18/96	Houston	TX	Cs-137	1.7
960690	Scientific Inspection Technologies, Inc.	TN-R-33092-C	11/4/96	Chattanooga	TN	Ir-192	67.0
970081	Sheffield Steel Corp.	35-19883-01	2/7/97	Sand Springs	OK	Cs-137	0.2
970946	Shell Chemical Co.	34-13012-01	7/14/97	Belpre	OH	Cf-252	<0.001
971011	Soils Engineering, Inc.	CA-3473-15	8/1/97	Bakersfield	CA	Am-Be Cs-137	0.0 0.0
970027	Southern Can Co.	Non-Licensee	1/6/97	Memphis	TN	Am-241	NR
980225	Southern Pine Wood Preserving	MS-GL-316	4/28/97	Picayune	MS	Cm-244 Am-241	0.013 <0.001
970338	Spectratek Services	NM-TA-0172	4/16/97	Albuquerque	NM	Am-241	0.0002
980124	Sperry-Sun Drilling	NR	4/28/97	Houston	TX	Am-Be Cs-137	4.0 2.0
970080	Sperry-Sun Drilling Services, Inc.	42-26844-01	12/23/96	Houston	TX	Am-Be Cs-137	3.0 2.0
970455	Sperry-Sun Drilling Services, Inc.	42-26844-01	2/9/97	Houston	TX	Cs-137 Cs-137 Cs-137 Am-Be	<0.001 2.0 <0.001 3.0
970323	Sperry-Sun Drilling Services, Inc.	42-26844-01	4/13/97	Houston	TX	Am-Be Cs-137	3.0 2.0
970606	Sperry-Sun Drilling Services, Inc.	42-26844-01	4/21/97	Houston	TX	Cs-137 Am-241	2.0 4.0
970851	Sperry-Sun Drilling Services, Inc.	42-26844-01	6/10/97	Houston	TX	Cs-137 Am-Be	2.0 3.0
970935	Sperry-Sun Drilling Services, Inc.	42-26844-01	7/22/97	Houston	TX	Cs-137 Am-Be	2.0 4.0
971033	Sperry-Sun Drilling Services, Inc.	42-26844-01	8/24/97	Houston	TX	Cs-137 Am-Be	2.0 3.0

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970510	Steel of West Virginia	Non-Licensee	6/4/97	Huntington	WV	Cs-137	0.5
970351	Steelastic Co.	General License	4/22/97	Akron	OH	Am-241 Am-241	0.15 0.15
970068	Stevens Graphics, Inc.	General License	1/24/97	Birmingham	AL	Po-210 Po-210 Po-210	<0.001 <0.001 <0.001
980123	Structural Metals	Non-Licensee	3/3/97	Seguin	TX	Cs-137	NR
970215	Sullivan Transfer Co.	Non-Licensee	3/10/97	Holtsville	NY	I-131	NR
970347	Summit, Inc.	MA-30-1800	4/18/97	Everett	MA	Am-Be Cs-137	0.04 0.008
980199	Sunny Ridge Enterprises	KY-40'-092-1	6/18/97	Phelp	KY	Cs-137	0.064
970702	Syncor International Corp.	CA-3317-14	3/29/97	Torrance	CA	Tc-99m	NR
970649	Syncor International Corp.	TN-R-19149-A98	5/12/97	Nashville	TN	I-131	NR
970448	Toledo Hospital	34-01710-05	5/22/97	Toledo	OH	I-125	<0.001
970532	Torrington Incinerator	Non-Licensee	6/10/97	Torrington	CT	Tc-99m	NR
970005	Transfer Station	Non-Licensee	12/31/96	New Haven	CT	I-131	NR
970908	Tri-state Testing & Drilling Co.	TN-R-33105	9/15/97	Chattanooga	TN	Am-Be Cs-137	0.05 0.01
960701	Troxler Electronics Laboratories, Inc.	NC-032-0182-1	10/23/96	Research Triangle Pk	NC	Cf-252	<0.001
970839	Uintah Engineering, Inc.	UT-24000-46	8/21/97	Vernal	UT	Cs-137 Am-Be	<0.001 0.05
960672	United Metro Materials, Inc.	AZ-7-227	12/17/96	Tucson	AZ	Am-Be	0.1
970311	Universal Engineering	FL-1136-4	4/9/97	Rockledge	FL	Am-Be Cs-137	0.04 0.008
970589	University of New Mexico	NM-BM-0233	2/24/97	Albuquerque	NM	P-32	<0.001
970581	University of Tennessee	TN-R-79019-J97	1/8/97	Memphis	TN	S-35	0.02
970097	UTS of Massachusetts, Inc.	20-28399-01	1/25/97	Stoneham	MA	Am-Be Cs-137	0.04 0.008

Table A-3 Loss of Control of Material Events

Item No.	Licensee	License Number	Event Date	City	State	Isotope	Activity (Ci)
970868	V.A. Medical Center	04-00421-05	8/18/97	San Francisco	CA	P-32	<0.001
970930	W.l. Gore and Associates	NR	9/8/97	Cherry Hill	MD	Kr-85	0.86
970623	Walter Reed Army Medical Center	08-01738-02	6/10/97	Washington	DC	I-125	<0.001
980367	Waste Management	Non-Licensee	9/15/97	Chicago	IL	I-131	NR
970259	WCI Steel, Inc.	34-25956-01	3/25/97	Warren	OH	Co-60	NR
970844	Weavexx Corp.	32-18405-02	8/26/97	Wake Forest	NC	Am-241	0.08
970567	West Florida Regional Medical Center, Inc.	FL-1087-4	11/26/96	Pensacola	FL	I-131	NR
980116	Western Atlas International, Inc.	NR	4/21/97	Houston	TX	Cs-137 Am-Be	2.0 18.0
970610	Western Atlas International, Inc.	42-02964-01	6/24/97	Houston	TX	Cs-137	<0.001
970883	Western Atlas International, Inc.	42-02964-01	6/28/97	Houston	TX	Am-Be Cs-137	NR NR
970200	Western Wake Medical Center	NC-092-0297-4	3/9/97	Cary	NC	Tc-99m	0.039
970344	Westinghouse Electric Corp.	SNM-1107	3/20/97	Columbia	SC	U-235 U-235	NR NR
970594	White Salvage	Non-Licensee	1/2/97	Ripley	TN	Am-241	NR

Table A-4 Leaking Sources

Item No.	Licensee	Number	Date	City	State	Radio-nuclide
970865	Battelle Columbus Laboratories	SNM-0007	6/18/97	Columbus	OH	Ni-63
971116	Commerce, Dept. Of	SNM-0362	8/12/97	Gaithersburg	MD	Sr-90
970608	Digital Logging, Inc.	35-19815-0	4/24/97	Tulsa	OK	Cs-137
970639	Emory University	GA-153-1	6/30/97	Alanta	GA	Sr-90
971115	Fort Howard Paper Co.	48-13485-0	8/18/97	Green Bay	WI	Ni-63
970231	Health & Human Services, Dept. Of	17-09756-0	12/18/96	New Orleans	LA	Ni-63
970233	Idaho State University	11-27280-0	1/13/97	Pocatello	ID	Fe-55
970662	Maryland Dept. of Health and Mental Hygiene	MD-07-040-	2/28/97	Baltimore	MD	Ni-63
980222	McKenna General Hospital	NR	8/18/97	New Braunfels	TX	Cs-137
970609	Metorex, Inc.	37-28461-0	4/22/97	Langhorne	PA	Fe-55
980102	North Texas, University Of	NR	3/21/97	Denton	TX	Cm-244
960691	Ohmart Corp.	34-00639-0	11/5/96	Cincinnati	OH	Cs-137
970372	Smithkline Beecham Clinical Laboratories	CA-0094-7	1/27/97	Van Nuys	CA	Ni-63
970112	Tennessee Radiological Health	NR	12/13/96	Knoxville	TN	Cl-36
971070	TN Technologies	NR	1/22/97	Round Rock	TX	Cs-137

Table A-5 Release of Material Events

Item No.	Licensee	Licensee Number	Date	City	State	Release Type	Radio-nuclide
970164	Air Force, Dept. of the	42-23539-01AF	3/3/97	Brooks AFB	TX	Person Surface	I-125 I-125
970398	Alaron Corp.	37-20826-01	5/5/97	Wampum	PA	Surface	Co-60
960830	Allied-Signal, Inc.	SUB-0526	12/16/96	Metropolis	IL	Air	UF6
970410	American Radiolabeled Chemicals	24-21362-01	2/12/97	Saint Louis	MO	Surface	C-14
970333	Army, Department of the - Rock Island Arsenal	12-00722-13	4/14/97	Rock Island	IL	Surface	Am-241
970246	Army, Department of the - Rock Island Arsenal	12-00722-06	3/21/97	Rock Island	IL	Surface Person	H-3 H-3
970176	Army, Department of the - Rock Island Arsenal	12-00722-06	2/28/97	Rock Island	IL	Person Surface	H-3 H-3
970334	Army, Department of the - Rock Island Arsenal	12-00722-06	4/14/97	Rock Island	IL	Surface	H-3
970354	Army, Department of the - Rock Island Arsenal	12-00722-06	4/23/97	Rock Island	IL	Surface	H-3
970090	Army, Department of the - Rock Island Arsenal	12-00722-06	2/3/97	Rock Island	IL	Surface	H-3
970086	Army, Department of the - Rock Island Arsenal	12-00722-06	2/6/97	Rock Island	IL	Surface	H-3
960716	Army, Department of the - Rock Island Arsenal	12-00722-06	11/7/96	Rock Island	IL	Surface	H-3
970153	Army, Department of the - Rock Island Arsenal	12-00722-06	2/21/97	Rock Island	IL	Surface	H-3
960673	Babcock & Wilcox Co.	SNM-0042	10/30/96	Lynchburg	VA	Surface	U-235
960785	Du Pont Merck Pharmaceutical Co.	20-28598-01	12/1/96	North Billerica	MA	Surface Surface	Mo-99 Tc-99M
970639	Emory University	GA-153-1	6/30/97	Atlanta	GA	Surface	Sr-90
970464	Federal Express	Non-Licensee	5/29/97	Baton Rouge	LA	Surface	U-DEP
980200	Garden State Cancer Center	29-28554-01	6/11/97	Belleville	NJ	Surface	I-131

Table A-5 Release of Material Events

Item No.	Licensee	Licensee Number	Date	City	State	Release Type	Radio-nuclide
970914	Hospital Ramon De Betances	52-13598-03	9/17/97	Mayaguez	PR	Surface	I-131
980157	Koch Engineering	IL-00109-01	7/7/97	Canton	IL	Surface	Na-24
970439	Larchmont Imaging Associates	29-23540-01	5/14/97	Mount Laurel	NJ	Person	Tc-99M
970434	Mallinckrodt Medical, Inc.	24-04206-01		Maryland Heights	MO	Surface Person	Re-186 Re-186
970791	Michael Reese Hospital & Medical Center	IL-86-01097-01	2/18/97	Chicago	IL	Surface	Tc-99m
970830	Middletown Regional Hospital	34-08279-02	8/13/97	Middletown	OH	Surface	I-131
970591	Minnesota, University of	22-00187-46	6/16/97	Minneapolis	MN	Person Surface	P-32 P-32
970421	New Jersey Dept. of Environmental Protection	Non-Licensee	5/10/97	Union	NJ	Person Surface	H-3 H-3
970095	Palisades	DPR-0020	2/5/97	South Haven	MI	Person	NR
970862	Puerto Rico, University of	52-01946-07	8/10/97	San Juan	PR	Person Surface	I-131 I-131
960657	South Florida Research Compliance Office, University of	FL-806-1	10/24/96	Tampa	FL	Surface	P-32
970592	Spectratek Services	NM-TA-0172	3/25/97	Albuquerque	NM	Surface Person	Ir-192 Ir-192
980165	Syncor	NR	5/28/97	Dallas	TX	Surface	Tc-99M
970511	Syncor International Corp.	04-26507-01MD	6/3/97	Allentown	PA	Surface	Tc-99M
970404	Syncor International Corp.	04-26507-01	5/6/97	Saint Louis	MO	Person Surface	Tc-99M Tc-99M
960695	Syncor International Corp.	FL-1264-10	11/6/96	Gainesville	FL	Surface	Tc-99M
970933	Temple, University of the Comm. Sys.	37-00697-31	9/24/97	Philadelphia	PA	Surface Person	P-32 P-32
971067	Texas A & M University	NR	2/22/97	College Station	TX	Surface	S-35

Table A-5 Release of Material Events

Item No.	Licensee	Licensee Number	Date	City	State	Release Type	Radio-nuclide
970251	U.S. Enrichment Corp.	USEC-O	3/20/97	Piketon	OH	Air	UF6
970594	White Salvage	Non-Licensee	1/2/97	Ripley	TN	Surface	Am-241

Table A-6 Transportation Events

Item No.	Licensee	License Number	Event Date	City	State
970622	Abington Memorial Hospital	37-00432-02	6/24/97	[illegible]	PA
970398	Alaron Corp.	37-20826-01	5/5/97	[illegible]	PA
970031	Alaron Corp.	37-20826-01	12/30/96	[illegible]	PA
970719	Babcock & Wilcox Co.	SNM-0042	7/25/97	[illegible]burg	VA
960832	CIS-US, Inc.	20-20973-01	12/17/96	[illegible]dford	MA
970942	Cotter Corp.	NR	9/30/97	[illegible]olden	CO
960836	Davies Medical Center	NR	12/16/96	San [illegible]ancisco	CA
960590	Du Pont Merck Pharmaceutical Co.	20-28598-01	10/4/96	North Billerica	MA
970587	Federal Express	Non-Licensee	2/21/97	Memphis	TN
970417	Federal Express	Non-Licensee	12/17/96	NR	NH
980267	Florida Department of Transportation	FL-0109-01	8/28/97	Jacksonville	FL
980265	Florida Department of Transportation	FL-0109-01	8/12/97	Lake City	FL
980263	Florida Department of Transportation	FL-0109-01	6/27/97	Gainesville	FL
970556	Florida Department of Transportation	FL-0109-01	10/16/96	Gainesville	FL
970562	Florida Department of Transportation	FL-0109-01	11/5/96	Gainesville	FL
970226	Frank Barker Associates, Inc.	29-28783-01	3/17/97	Pequannock	NJ
970415	Good Samaritan Hospital	34-00991-02	5/8/97	Cincinnati	OH
980234	ICN Pharmaceuticals	CA-1828-30	1/22/97	Irvine	CA
970132	Lala, Michael, M.D., P.C.	21-24380-01	2/25/97	Orchard Lake	MI
970439	Larchmont Imaging Associates	29-23540-01	5/14/97	Mount Laurel	NJ
970653	Mallinckrodt Medical, Inc.	24-04206-01	7/8/97	Maryland Heights	MO
970003	Mallinckrodt Medical, Inc.	24-04206-11MD	12/31/96	Saint Louis	MO
970640	Mallinckrodt Nuclear Medicine	29-28064-01	7/8/97	Pinebrook	NJ
970638	Mallinkrodt, Inc.	NR	7/2/97	Portland	OR
970029	Mecosta County General Hospital	21-18566-01	1/8/97	Big Rapids	MI
970472	Mercy Catholic Medical Center	37-00993-05	5/29/97	Darby	PA
970679	Missouri Highway & Transportation	24-20415-01	7/17/97	Jefferson City	MO

Table A-6 Transportation Events

Item No.	Licensee	License Number	Event Date	City	State
970060	Monticello	DPR-0022	1/22/97	Monticello	MN
970069	Monticello	DPR-0022	1/26/97	Monticello	MN
970763	Northwest Airlines Air Freight	Non-Licensee	10/18/96	Queens	NY
970070	P.E.T. Net Pharmaceuticals	FL-2728-1	1/27/97	Tampa	FL
960626	Roadway Express	Non-Licensee	10/16/96	White Sands	NM
970799	Rutgers University	NR	12/10/96	New Brunswick	NJ
960739	Siemens Power Corp.	SNM-1227	10/1/96	Richland	WA
970094	Siemens Power Corp.	SNM-1227	1/24/97	Richland	WA
970624	Source Production and Equipment Co.	NR	6/24/97	Saint Rose	LA
960702	Susquehanna, Unit 1	NPF-0014	11/11/96	Berwick	PA
960625	Syncor International Corp.	04-26507-01	10/8/96	St. Paul	MN
960695	Syncor International Corp.	FL-1264-10	11/6/96	Gainesville	FL
960777	Syncor International Corp.	37-17461-01MD	11/27/96	Sharon Hill	PA
960835	Syncor International Corp.	04-26507-01MD	12/18/96	Saint Paul	MN
970511	Syncor International Corp.	04-26507-01MD	6/3/97	Allentown	PA
970907	Syncor International Corp.	04-26507-01MD	9/15/97	Allentown	PA
970453	Syncor International Corp.	MS-493-01	1/9/97	Flowood	MS
970796	Syncor International Corp.	NR	8/8/97	Louisville	KY
970297	Syncor International Corp.	NR	11/6/96	NR	FL
970404	Syncor International Corp.	04-26507-01	5/6/97	Saint Louis	MO
970761	Syncor International Corp.	NR	10/2/96	Buffalo	NY
970152	Syncor International Corp.	NR	2/27/97	Silver Springs	MD
980231	Syncor Pharmacy Services	NH-42-0146	4/24/97	Woburn	MA
980184	Terra Engineers	NR	6/30/97	Lubbock	TX
971067	Texas A & M University	NR	2/22/97	College Station	TX
970033	Twin Ports Testing, Inc.	48-23476-01	10/18/96	Superior	WI

Table A-7 Equipment Problems

Item No.	Licensee	Licensee Number	Event Date	City	State	Equipment
960666	ABB Process Automation, Inc.	34-00255-0	10/27/96	Columbus	OH	Gauge, Thickness
970284	Abbott Laboratories	NC-064-096	4/2/97	Rocky Mountain	NC	Irradiator
971014	Agra Earth and Environmental	CA-2370-3	6/25/97	Anaheim	CA	Gauge, Portable, Moisture/Den.
970656	Ambric Engineering, Inc.	37-20968-0	6 25/97	Philadelphia	PA	Gauge, Other
970229	Army, Department of the	19-17250-0	1/20/97	Adelphi	MD	Alarm, Personnel Warning
970720	Army, Department of the	19-17250-0	7/25/97	Adelphi	MD	Irradiator
960716	Army, Department of the - Rock Island Arsenal	12-00722-0	11/7/96	Rock Island	IL	Radioluminescent Gun Sight
970153	Army, Department of the - Rock Island Arsenal	12-00722-0	2/21/97	Rock Island	IL	Radioluminescent Gun Sight
970333	Army, Department of the - Rock Island Arsenal	12-00722-1	4/14/97	Rock Island	IL	Detector, Chemical Agent
980174	AT Laboratories, Inc.	NR	6/28/97	Dallas	TX	Gauge, Portable, Moisture/Den.
970492	Atlantic Testing Laboratories	NR	3/10/97	Melbourne	FL	Gauge, Portable, Moisture/Den.
960623	Babcock & Wilcox Co.	SNM-0042	10/15/96	Lynchburg	VA	Line, Sampling
960673	Babcock & Wilcox Co.	SNM-0042	10/30/96	Lynchburg	VA	Pipe, Other
960678	Baxter Healthcare Corp.	52-21175-0	10/29/96	Aibonito	PR	Interlock, Irradiator
960719	Baxter Healthcare Corp.	52-21175-0	11/13/96	Aibonito	PR	Irradiator
970941	Baxter Healthcare Corp.	52-21175-0	9/30/97	Aibonito	PR	Protective System
970750	Bowser-Morner, Inc.	34-17390-0	7/25/97	Dayton	OH	Gauge, Portable, Moisture/Den
960616	BP Oil Toledo Refinery	34-07269-0	10/12/96	Toledo	OH	Gauge, Density
970445	Braun Intertec Corp.	22-16537-0	3/26/97	Minneapolis	MN	Camera, Radiography

Table A-7 Equipment Problems

Item No.	Licensee	Licensee Number	Event Date	City	State	Equipment
970245	Braun Intertec Northwest	OR-90633	10/22/96	NR	OR	Gauge, Portable, Moisture/Den.
970590	CIBA-GEIGY Corp.	07-20696-0	6/18/97	Newport	DE	Gauge, Level
971116	Commerce, Department of	SNM-0362	8/12/97	Gaithersburg	MD	Sealed Source
970961	Cornforth Consultants	OR-90652	8/6/97	McMinnville	OR	Gauge, Portable, Moisture/Den.
970934	Crow Butte Resources, Inc.	SUA-1534	8/12/97	Denver	CO	Pond, Evaporation
970271	Dee Forest Products	OR-93164	11/19/96	Hood River	OR	Sealed Source
970782	Design Plumbing & Heating Serivce	NY-2479-3	4/20/97	Staten Island	NY	Gauge, Other
971010	Diaz-Yourman & Associates	CA-6001-3	4/18/97	Tustin	CA	Gauge, Portable, Moisture/Den.
970608	Digital Logging, Inc.	35-19815-0	4/24/97	Tulsa	OK	Sealed Source
08-224	Drash Consulting	NR	9/25/97	San Antonio	TX	Gauge, Portable, Moisture/Den.
970228	Edwards Pipeline Testing, Inc.	35-23193-0	12/18/96	Tulsa	OK	Camera, Radiography
970878	Edwards Pipeline Testing, Inc	35-23193-0	7/17/97	Tulsa	OK	Camera, Radiography
970639	Emory University	GA-153-1	6/30/97	NR	GA	Sealed Source
980268	Florida Department of Transportation	FL-0109-01	9/10/97	Bartow	FL	Gauge, Portable, Moisture/Den.
970435	Florida Department of Transportation	TN-R-79171	5/6/97	Memphis	TN	Dust Collection System
960814	General Dynamics Corp.	06-01781-0	10/30/96	Groton	CT	Camera, Radiography
960671	General Electric Co.	SNM-1097	10/29/96	Wilmington	NC	Scrubber, Centrifuge
960803	General Electric Co.	SNM-1097	11/30/96	Wilmington	NC	Calciner
970076	General Electric Co.	SNM-1097	2/2/97	Wilmington	NC	Filter, Exhaust
970345	General Electric Co.	SNM-1097	4/19/97	Wilmington	NC	Furnace, Other
970401	General Electric Co.	SNM-1097	5/5/97	Wilmington	NC	Tank
970711	Geobase, Inc.	CA-5461-3	3/14/97	Laguna Hills	CA	Gauge, Portable, Moisture/Den.
970032	Geomechanics, Inc.	37-17332-0	1/11/97	Elizabeth	PA	Gauge, Portable, Moisture/Den

Table A-7 Equipment Problems

Item No.	Licensee	Licensee Number	Event Date	City	State	Equipment
970706	Geotechnical Engineering, Inc.	CA-4674-0	5/30/97	Fremont	CA	Gauge, Other
970874	Geotechnology, Inc.	24-24459-0	9/6/97	St. Louis	MO	Gauge, Portable, Moisture/Den.
971077	Global X-Ray & Testing Corp.	NR	2/11/97	Aransas Pass	TX	Camera, Radiography
970232	Globe X-ray Service, Inc.	35-15194-0	12/2/96	Tulsa	OK	Camera, Radiography
970469	Gonzales X-Ray	LA-4641-LO	5/22/97	NR	LA	Camera, Radiography
971020	Gorian & Associates	CA-3051-5	7/23/97	Westlake Village	CA	Gauge, Portable, Other
971069	H&G Inspection Radiography	NR	1/9/97	Houston	TX	Camera, Radiography
960628	H.C. Nutting Co.	34-18882-0	10/15/96	Cincinnati	OH	Gauge, Portable, Moisture/Den.
970233	Idaho State University	11-27280-0	1/13/97	Pocatello	ID	Sealed Source
970879	Illinois Power Co.	IL-01523-01	9/5/97	Decatur	IL	Gauge, Other
970867	Indiana Department of Transportation	13-26341-0	8/27/97	Greenfield	IN	Gauge, Portable, Moisture/Den.
960678	Industrial NDT Services Division	13-06147-0	7/10/97	Indianapolis	IN	Camera, Radiography
970788	Isomedix, Inc.	IL-01123-02	5/27/97	Libertyville	IL	Irradiator
980181	Johnson & Johnson Medical, Inc.	NR	6/25/97	Sherman	TX	Irradiator
970854	Koch Engineering Co., Inc.	07-28386-0	8/28/97	Newark	DE	Container, Shipping
971057	Longview Inspection	NR	12/9/96	La Porte	TX	Camera, Radiography
970964	Longview Inspection	OR-90621	8/29/97	Portland	OR	Camera, Radiography
971000	Los Angeles City	CA-5904-1	5/2/97	Los Angeles	CA	Gauge, Portable, Other
970858	Marshall Miller & Associates	45-17195-0	8/18/97	Bluefield	VA	Well Logging Tool
960734	Massachusetts General Hospital	20-03814-8	11/15/96	Boston	MA	Pump, Other
980186	Maxim Technologies	NR	6/3/97	Dallas	TX	Gauge, Portable, Moisture/Den.

Table A-7 Equipment Problems

Item No.	Licensee	Licensee Number	Event Date	City	State	Equipment
980222	McKenna General Hospital	NR	8/18/97	New Braunfels	TX	Sealed Source
970609	Metorex, Inc.	37-28461-0	4/22/97	Langhorne	PA	Sealed Source
970755	Michigan, State of	21-03039-0	7/6/97	Lansing	MI	Gauge, Portable, Moisture/Den.
971133	Michigan, State of	21-03039-0	7/30/97	Lansing	MI	Gauge, Portable, Moisture/Den.
970770	MQS Inspections, Inc.	NY-1349-0	2/18/97	Elk Grove Village	IL	Camera, Radiography
970884	MQS Inspections, Inc.	12-00622-0	9/8/97	Elk Grove Village	IL	Camera, Radiography
970408	Navy, Department of the	45-23645-0	10/11/96	Portsmouth	VA	Camera, Radiography
980102	North Texas, University of	NR	3/21/97	Denton	TX	Sealed Source
970906	Nucor Steel Co.	NR	9/14/97	Armorel	AR	Gauge, Density
970877	Nucor Steel Corp.	NE-07-04-0	9/3/97	Norfolk	NE	Gauge, Level
960691	Ohmart Corp.	34-00639-0	11/5/96	Cincinnati	OH	Sealed Source
970762	Paratt-Wolff, Inc.	NY-2171-3	10/3/96	East Syracuse	NY	Gauge, Other
960833	Piedmont Hospital	NR	12/18/96	Atlanta	GA	HDR Unit
960699	Professional Service Industries, Inc.	45-25088-0	11/6/96	Bristol	VA	Gauge, Portable, Moisture/Den.
970786	Ratrie, Robbins, and Schweitzer	MD-05-116	7/31/97	Baltimore	MD	Gauge, Portable, Asphalt Cont.
970849	S. K. McBryde, Inc.	NR	5/19/97	Summerfield	NC	Camera, Radiography
970946	Shell Chemical Co.	34-13012-0	7/14/97	Belpre	OH	Gauge, Level
960819	Siemens Power Corp.	SNM-1227	12/10/96	Richland	WA	Breaker Box
970242	Smurfit Newsprint Corp.	OR-90266	10/1/96	Newberg	OR	Gauge, Other
971030	Spec Group Holdings, Inc.	NR	8/20/97	Trafford	PA	Camera, Radiography
960784	Sterigenics	IL-01220-01	10/3/96	Gurnee	IL	Irradiator
970861	Syncor International Corp.	04-26507-0	8/29/97	Allentown	PA	Fan, Exhaust
980118	Technical Welding Laboratory	NR	4/26/97	Pasadena	TX	Camera, Radiography

Table A-7 Equipment Problems

Item No.	Licensee	Licensee Number	Event Date	City	State	Equipment
970112	Tennessee Radiological Health	NR	12/13/96	Knoxville	TN	Sealed Source
970308	Texas Nuclear Technologies	NR	10/14/96	Round Rock	TX	Gauge, Level
971070	TN Technologies	NR	1/22/97	Round Rock	TX	Gauge, Other
970196	U.S. Enrichment Corp.	USEC-K	3/4/97	Paducah	KY	Alarm, Criticality
970663	U.S. Enrichment Corp.	USEC-K	3/12/97	Paducah	KY	Fire Suppression System
970219	U.S. Enrichment Corp.	USEC-K	3/14/97	Paducah	KY	Valve, Other
970224	U.S. Enrichment Corp.	USEC-K	3/18/97	Paducah	KY	Alarm, Criticality
970236	U.S. Enrichment Corp.	USEC-K	3/18/97	Paducah	KY	Sprinkler System
970235	U.S. Enrichment Corp.	USEC-K	3/19/97	Paducah	KY	Sprinkler System
970251	U.S. Enrichment Corp.	USEC-O	3/20/97	Piketon	OH	Valve, Other
970247	U.S. Enrichment Corp.	USEC-K	3/20/97	Paducah	KY	Sprinkler System
970261	U.S. Enrichment Corp.	USEC-K	3/16/97	Paducah	KY	Fire Suppression System
970260	U.S. Enrichment Corp.	USEC-K	3/27/97	Paducah	KY	Fire Suppression System
970286	U.S. Enrichment Corp.	USEC-K	4/3/97	Paducah	KY	Fire Suppression System
970303	U.S. Enrichment Corp.	USEC-K	4/7/97	Paducah	KY	Alarm, Criticality
970515	U.S. Enrichment Corp.	USEC-O	4/7/97	Piketon	OH	Cylinder, UF6 Product
970312	U.S. Enrichment Corp.	USEC-O	4/9/97	Piketon	OH	Fire Suppression System
970313	U.S. Enrichment Corp.	USEC-K	4/9/97	Paducah	KY	Fire Suppression System
970341	U.S. Enrichment Corp.	USEC-O	4/9/97	Piketon	OH	Autoclave
970342	U.S. Enrichment Corp.	USEC-K	4/9/97	Paducah	KY	Autoclave
970327	U.S. Enrichment Corp.	USEC-K	4/14/97	Paducah	KY	Fire Suppression System
970336	U.S. Enrichment Corp.	USEC-K	4/15/97	Paducah	KY	Fire Suppression System
970339	U.S. Enrichment Corp.	USEC-K	4/16/97	Paducah	KY	Fire Suppression System
970353	U.S. Enrichment Corp.	USEC-K	4/23/97	Paducah	KY	Autoclave
970357	U.S. Enrichment Corp.	USEC-K	4/23/97	Paducah	KY	Fire Suppression System

Table A-7 Equipment Problems

Item No.	Licensee	Number	Licensee Date	Event City	State	Equipment
970382	U.S. Enrichment Corp.	USEC-K	4/24/97	Paducah	KY	Fire Suppression System
970388	U.S. Enrichment Corp.	USEC-K	4/24/97	Paducah	KY	Autoclave
970383	U.S. Enrichment Corp.	USEC-K	4/25/97	Paducah	KY	Fire Suppression System
970384	U.S. Enrichment Corp.	USEC-K	4/26/97	Paducah	KY	Fire Suppression System
970385	U.S. Enrichment Corp.	USEC-K	4/28/97	Paducah	KY	Fire Suppression System
970389	U.S. Enrichment Corp.	USEC-K	4/30/97	Paducah	KY	Fire Suppression System
970395	U.S. Enrichment Corp.	USEC-K	5/1/97	Paducah	KY	Fire Suppression System
970399	U.S. Enrichment Corp.	USEC-K	5/4/97	Paducah	KY	Fire Suppression System
970425	U.S. Enrichment Corp.	USEC-K	5/12/97	Paducah	KY	Fire Suppression System
970426	U.S. Enrichment Corp.	USEC-K	5/13/97	Paducah	KY	Fire Suppression System
970427	U.S. Enrichment Corp.	USEC-O	5/13/97	Piketon	OH	Autoclave
970440	U.S. Enrichment Corp.	USEC-O	5/18/97	Piketon	OH	Autoclave
970451	U.S. Enrichment Corp.	USEC-K	5/22/97	Paducah	KY	Alarm, Criticality
970450	U.S. Enrichment Corp.	USEC-O	5/23/97	Piketon	OH	Autoclave
970473	U.S. Enrichment Corp.	USEC-K	5/30/97	Paducah	KY	Breaker
970475	U.S. Enrichment Corp.	USEC-O	6/1/97	Piketon	OH	Autoclave
970636	U.S. Enrichment Corp.	USEC-K	7/1/97	Paducah	KY	Alarm, Criticality
970664	U.S. Enrichment Corp.	USEC-K	7/13/97	Paducah	KY	Electrical Device
970667	U.S. Enrichment Corp.	USEC-K	7/14/97	Paducah	KY	Autoclave
970728	U.S. Enrichment Corp.	USEC-O	7/25/97	Piketon	OH	Boiler
970756	U.S. Enrichment Corp.	USEC-K	8/1/97	Paducah	KY	Autoclave
970860	U.S. Enrichment Corp.	USEC-K	8/31/97	Paducah	KY	Autoclave
970903	U.S. Enrichment Corp.	USEC-O	9/13/97	Piketon	OH	Cascade Data Processing System
970925	U.S. Enrichment Corp.	USEC-K	9/18/97	Paducah	KY	Pin Connector
970918	U.S. Steel Corp.	13-26104-0	5/25/97	Gary	IN	Gauge, Thickness
960456	Union Carbide	NR	12/5/96	Seadrift	TX	Gauge, Level

Table A-7 Equipment Problems

Item No.	Licensee	Number	Licensee Event Date	City	State	Equipment
970693	University Hospital	CO-870-01	4/21/97	Denver	CO	Applicator, Delcose
970431	University of Massachusetts Lowell Research Reactor	R-125	12/20/96	Lowell	MA	Reactor Building Air System
970827	University of Rochester	NR	12/9/96	Rochester	NY	Irradiator
960703	V.A. Medical Center	04-00181-1	11/27/96	Los Angeles	CA	Teletherapy Unit
971071	Wichita General	NR	1/23/97	Wichita Falls	TX	Teletherapy Unit
970680	Williamette Industries	OR-90141	5/1/97	NR	OR	Gauge, Other
960815	William Beaumont Hospital	21-01333-0	11/29/96	Royal Oak	MI	HDR Unit
970669	Wills Eye Hospital	37-00783-0	2/3/97	Philadelphia	PA	Gamma Knife Unit

APPENDIX B

Summary of FY 1997 Abnormal Occurrences

CONTENTS

NRC Licensees

Report No. 97-2 Overexposure of a Worker at Mallinckrodt, Inc., in Maryland Heights, Missouri

On May 14, 1997, an employee was removing radioactive waste from the hot cell where rhenium-186 (Re-186) was used. The employee was performing this task manually, using gloves, instead of remotely. When he left the area, he attempted to perform a personal contamination survey but the survey meter immediately went off the scale. He assumed that the high count rate was due to background radiation from an adjacent radioactive material transport cart and, subsequently, forgot to resurvey himself in a low background area before he left the facility that evening. Upon arrival at work the next day, he was told that his urine sample, which he had submitted before going home the previous night, indicated iodine-131 (I-131) radiation contamination and that he was restricted from working with radioactive material. At that time, he performed a personal contamination survey and detected significant levels of contamination on his left thumb which subsequently was identified as Re-186. The I-131 contamination level did not exceed the AO criteria for exposure to radiation from licensed material.

The licensee estimates that the individual received a shallow-dose equivalent of 6090 millisievert (609 rem) to an area of about 0.75 square centimeters (0.12 square inches) on the palm side of the thumb of his left hand. Lower levels of contamination were found on the back of his right hand and fingers. On May 15, 1997, the employee had undergone decontamination to the extent that only approximately 4 percent of the activity remained.

The licensee surveyed the offsite locations where the employee had been after leaving work on May 14, 1997. Low levels of Re-186 contamination were found on three locations inside the employee's vehicle and on various items in the bathroom and kitchen of his home. The employee's vehicle and home were decontaminated. The employee was examined by a physician who identified no immediate health effects. However, according to a report from an NRC consultant, a small possibility exists for skin cancer to develop in the exposed area of the thumb.

The cause of the event was determined to be a procedural deficiency in handling waste from the Re-186 hot cell. Normally, radioactive waste in other hot cells at the facility was handled with remote tools. However, in this case, procedural controls did not require remote handling of the waste. Once the employee completed the work, poor radiation work practices were exhibited as he cross-contaminated his hands when he removed his gloves. In addition, the worker did not investigate the detection of high count rates during his first attempt to perform a contamination survey.

The staff was instructed on the importance of conducting proper personal contamination surveys and the proper use of protective clothing. The use of Re-186 was suspended until improvements to existing waste disposal procedures could be evaluated and implemented. Plans were made (1) to compile all existing contamination protection procedures into one contamination protection procedure, (2) to evaluate the use of a portal type monitoring system, and (3) to post personal-monitoring reminder signs at all laboratory exits.

NRC conducted a special safety inspection, proposed a $55,000 civil penalty on December 17, 1997, and the licensee paid the civil penalty on January 20, 1998.

Agreement State Licensees

Report No. AS 97-1 Multiple Transuranic Overexposures to a Worker at Isotope Products Laboratories in Burbank, California

The overexposures occurred between January 1 and December 31, 1995, when a radiochemist was assigned to make transuranic and other types of sources. The transuranics included Pu-238, Pu-239, Pu-240, Am-241, and Cm-244. In January 1995, while making a Cm-244 source, it was discovered that the exhaust fan of the fume hood where the source was being fabricated was not working. An analysis of room air samples confirmed the loss of Cm-244 into the working area.

Bioassay results disclosed that fecal and urine samples provided by the radiochemist contained Cm-244 and Am-241. The licensee hired dosimetry and radiation protection consultants as directed by the State Agency. Careful analysis of the bioassay data by these consultants, which included dose summation and retrospective time correction for various intakes, suggested that during 1995 the radiochemist received a TEDE of 383.20 mSv (38.32 rem) and a CDE of 6900 mSv (690 rem) to the bone surfaces. The specific exposures were as follows: (1) committed effective dose equivalent (CEDE) of 271.8 mSv (27.18 rem) from Cm-244, (2) CEDE of 80 mSv (8 rem) from Am-241, (3) CEDE of 4.4 mSv (0.44 rem) from Pu-238, Pu-239, and Pu-240, and (4) DDE of 27.0 mSv (2.70 rem) from external radiation.

The State Agency discovered this incident during a routine inspection on December 5, 1995, and was initially reported to NRC in January 1996. During a follow-up inspection, the State Agency learned that another Cm-244 incident took place and was significant. The State Agency also learned of other exposure incidents that indicated the licensee had a deficient contamination control program, an inability to conduct internal dose assessments, and inadequate management oversight. The State provided additional information on these events to NRC in 1997.

The licensee's radiation protection program was inadequate and lacked important elements needed to ensure the radiation safety of its workers. Some of these inadequacies were the lack of (1) work permits, (2) glove boxes for certain types of work, and (3) radiation procedural controls.

After the licensee's consultants conducted their review and comprehensive audit of the existing radiation protection program, they made recommendations to ensure future compliance with the license and regulations. The licensee hired a competent radiation safety officer, and the radiochemist was assigned duties that did not involve the handling or processing of radioactive materials.

The State Agency completed its investigation and is committed to closely tracking the licensee's radiation protection program to ensure continued compliance.

Report No. AS 97-2 Overexposure of a Radiographer and an Untrained Technician at Wolf Creek Mine in Walker County, Alabama

On July 1, 1996, a radiographer, employed by Certified Testing and Inspection of Cottondale, Alabama, and a technician, employed by Ultron, Inc., of Mt. Vernon, Illinois, were performing industrial radiography at the Wolf Creek Mine in Walker County, Alabama, when they became so distracted by problems with excessively exposed film that they forgot they had an exposure in progress and entered the high radiation area without making a survey and changed the film with the source in the unshielded exposed position. The radiographer had received prior radiation safety training, however, the technician, an employee of Ultron, Inc., had not received prior radiation safety training. The radiography film and the device used to support the source and the film during exposures were being supplied to the radiographer by Ultron, Inc.

Consequently, both individuals received unintended radiation exposure. The State Agency estimated that the radiographer received a dose of 530 millisievert (mSv) (53 rem) to his head and 48 mSv (4.8 rem) to the center of his body and the Ultron,

Inc., technician received a dose of 110 mSv (11 rem) to his head and 28 mSv (2.8 rem) to the center of his body. Neither individual reported any acute radiation symptoms.

The radiography film supplied by Ultron, Inc., had faster and different exposure characteristics than the film usually used by Certified Testing and thus was being overexposed during processing in the darkroom. The darkroom, which was supplied by Certified Testing, utilized a homemade "safe light," which had been made a safe light by the application of red spray paint. The radiographer did not realize beforehand that the light would not be "safe" for the film supplied by Ultron, Inc.

The radiographer entered a designated high radiation area with his alarm ratemeter turned off and without following his normal practice of cranking in the source and surveying the guide tube and camera. The radiographer interpreted the silence from the alarm ratemeter as an indication of safe conditions. Unfortunately, when turned off, the alarm ratemeter gives the same indication as it does when indicating safe conditions. In addition, the radiographer did not utilize a collimator to reduce the exposure to himself and the Ultron, Inc., technician.

The licensee stated that the radiographer did not develop any symptom of acute radiation exposure and that its personnel were reinstructed in the importance of performing surveys and using a collimator. The licensee committed to the State Agency to verify the training of all technicians, including those of the company that hires the licensee to perform radiography.

The State Agency cited the Licensee for the following four violations: (1) excessive exposure to a radiation worker, (2) excessive exposure to a member of the public (the Ultron, Inc., technician representative), (3) failure to prevent unauthorized entry into the High Radiation Area, and (4) failure to exercise ALARA by using a collimator. A civil penalty was considered but not imposed. The State Agency recommended that both individuals contact the State and seek medical attention if any symptoms of acute exposure should appear.

Report No. AS 97-3 Radiopharmaceutical Misadministration at Mad River Community Hospital in Arcata, California

On February 28, 1996, a patient was prescribed a dosage of 3.7 megabecquerel (MBq) (0.1 millicurie [mCi]) of iodine-131 (I-131) for a thyroid scan and uptake procedure. However, the patient was administered a dosage of 262.7 MBq (7.1 mCi) of I-131. As a result, the patient's thyroid received a dose of about 9100 centigray (cGy) (9100 rad), instead of the prescribed dose of 130 cGy (130 rad). The wrong dosage was administered on the assumption that the patient was prescribed a whole body thyroid scan for a cancer metastatic disease evaluation.

The licensee stated that such a dose may induce a hypothyroid state requiring the patient to take thyroid hormone. Procedures for scheduling a whole body scan for thyroid cancer metastases were revised to include a detailed patient preparation and history. The revised procedures required that the approving radiologist sign the I-131 administration policy before ordering a radiopharmaceutical. In addition, the nuclear medicine technologist attended a continuing education program at San Francisco General Hospital, which included a segment on the effects of studies involving therapy dosages.

The State Agency conducted numerous follow-up inspections to ensure that the licensee's actions taken to prevent recurrence had been implemented.

Report No. AS 97-4 Radiopharmaceutical Misadministration at Tuomey Regional Medical Center in Sumter, South Carolina

On December 11, 1996, a patient was prescribed a dose of 74 megabecquerel (MBq) (2.0 millicurie [mCi]) of iodine-131 (I-131) for a treatment of Graves disease. However, the patient was

administered a 388.5 MBq (10.5 mCi) dosage of I-131. As a result, the patient's thyroid received a dose of 40,400 centigray (cGy) (40,400 rad) instead of the prescribed dose of 7700 cGy (7700 rad). The wrong dosage was administered to the patient because the written order for the I-131 procedure was misread by the administering technologist.

The licensee will have the written order on hand before ordering radiopharmaceuticals from the pharmacy and will have a second person verify the dosage before administration to the patient.

The State Agency accepted the licensee's report and corrective action as appropriate. No further action was requested.

APPENDIX C

Reports and Videotapes Issued From 1981 Through 1997

Reports and Videotapes Issued from 1981 Through 1997

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1995		
	Special Studies		
08/95	Human Performance Evaluation of Industrial Radiography Exposure Events	INEL-95/0387	S. Pettijohn
07/95	Misadministrations and Other Medical Events H. Karagiannis Caused by Computer Errors	Memorandum to D.A. Cool from C.E. Rossi	
	Nuclear Materials Reports Issued in 1994		
	Videotapes		
04/94	Taking Control - Safety Procedures for Industrial Radiographers	– S.Pettijohn	
	Nuclear Materials Reports Issued in 1993		
	Videotapes		
04/93	Good Practices in Cobalt-60 Teletherapy	– H. Karagiannis	
	Nuclear Materials Reports Issued in 1992		
	Engineering Evaluations		
08/92	Report on 1991 Nonreactor Events	NUREG-1272, Vol. 6, No.2, App. A	K. Black

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1992 (cont.)		
	Engineering Evaluations (cont.)		
08/92	Report on 1991 NRC Licensee Misadministrations	NUREG-1272 Vol. 6, No. 2, App. B	H. Karagiannis
08/92	Report on 1991 Agreement State Licensee Nonreactor Events and Misadministrations	NUREG-1272 Vol. 6, No. 2, App. C	H. Karagiannis
	Nuclear Materials Reports Issued in 1991		
	Engineering Evaluations		
01/91	Brachytherapy Incidents Involving a Handloading, Endobronchial Technique	N91-01	H. Karagiannis
07/91	Report on 1990 Nonreactor Events	NUREG-1272 Vol.5, No. 2, App. A	K. Black
07/91	Medical Misadministration Report)Medical Misadministrations Reported to NRC From January 1990 Through December 1990	NUREG-1272 Vol. 5, No. 2, App. B	H. Karagiannis
	Videotapes		
02/91	Good Practices in Preparing and Administering Radiopharmaceuticals	–	H. Karagiannis
	Nuclear Materials Reports Issued in 1990		
	Engineering Evaluations		
06/90	Report on 1989 Nonreactor Events	NUREG-1272 Vol. 4, No. 2, App. A	K. Black

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1990 (cont.)		
	Engineering Evaluations (cont.)		
06/90	Medical Misadministration Report)Medical Misadministrations reported to NRC From January 1989 Through December 1989	NUREG-1272 Vol. 4, No. 2, App. B	H. Karagiannis
	Nuclear Materials Reports Issued in 1989		
	Engineering Evaluations		
06/89	Use of Radioactive Iodine for Infrequent Medical Studies and those Performed Under an FDA Investigational Exemption of a New Drug (IND)	N901	H. Karagiannis
06/89	Report on 1988 Nonreactor Events	NUREG-1272 Vol. 3, No. 2, App. B	K. Black
06/89	Medical Misadministration Report) Medical Misadministrations Reported to NRC From January 1988 Through December 1988	NUREG-1272 Vol. 3, No. 2, App. B	H. Karagiannis
05/89	Review of Therapy Misadministrations That Involved Multiple Patients and the Use of Computer Programs	T908	K. Black
	Nuclear Materials Reports Issued in 1988		
	Engineering Evaluations		
09/88	Review of Events at Large Pool-Type Irradiators (NUREG-1345, March 1989)	S807	E. Trager
10/88	Report on 1987 Nonreactor Events	N801	K. Black
10/88	Medical Misadministration Reported to NRC for the Period January Through December 1987	N802	S. Pettijohn

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1987		
	Special Reports		
10/87	Radiography Overexposure Events Involving Industrial Field Radiography	S703	S. Pettijohn
	Engineering Evaluations		
01/87	Diagnostic Misadministrations Involving the Administration of Millicurie Amounts of Iodine-131	N701	S. Pettijohn
03/87	Diagnostic Misadministrations Reported to NRC for for the Period January 1986 Through December 1986	N702	S. Pettijohn
03/87	Report on 1986 Nonreactor Events	N703	K. Black
	Technical Review Reports		
11/87	Review of Data on Teletherapy Misadministrations Reported to the State of New York That Were the Title of PNO-1-87-74A	T711	S. Pettijohn
12/87	Distribution of Information Notices and Other "Mass Mailing" Information to Licensees That Have Users at Locations Remote From the Headquarters Locations	T714	S. Pettijohn
	Nuclear Materials Reports Issued in 1986		
	Case Studies		
08/86	Rupture of an Iodine-125 Brachytherapy Source at the University of Cincinnati Medical Center	C601	S. Pettijohn
	Engineering Evaluations		
06/86	Report of 1985 Nonreactor Reported and Five-Year Assessment for 1981-1985 Reports	N601	K. Black

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1986 (cont.)		
	Engineering Evaluations (cont.)		
06/86	Medical Misadministrations Reported for 1985 and Five-Year Assessment of 1981-1985	N602	S. Pettijohn
	Nuclear Materials Reports Issued in 1985		
	Case Studies		
12/85	Therapy Misadministrations Reported to NRC Pursuant to 10 CFR 35.42	C505	S. Pettijohn
05/85	Summary of the Nonreactor Event Report Data Base for the Period January Through June 1984	N501	K. Black
	Engineering Evaluations		
06/85	Summary of the Nonreactor Event Data Base for the Period July Through December 1984	N502	K. Black
07/85	Report on Medical Misadministrations for January Through December 1984	N503	S. Pettijohn
	Nuclear Materials Reports Issued in 1984		
	Case Studies		
09/84	Breaching of the Encapsulation of Sealed Well-Logging Sources	C405	S. Pettijohn
05/84	Report on Medical Misadministrations for January Through June 1983	N204D	S. Pettijohn
06/84	Nonreactor Event Report Database for the Period July Through December 1983	N401	K. Black

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1984 (cont.)		
	Case Studies (cont.)		
06/84	Events Involving Undetected Unavailability of the Turbine-Driven Auxiliary Feedwater Train	N402	E. Trager
07/84	Report on Medical Misadministrations for July Through December 1983	N403	S. Pettijohn
	Nuclear Materials Reports Issued in 1983		
	Engineering Evaluations and Technical Reviews		
01/83	Nonreactor Event Report Database for the Period January Through June 1982	N209A	E. Trager
03/83	I-125/I-131 Effluent Releases by Material Licensees	N301	S. Pettijohn
06/83	Mound Laboratory Fabricated Pu-Be Sources	N302	K. Black
06/83	Americium Contamination Resulting From Rupture of Well-Logging Sources	N303	K. Black
06/83	Nonreactor Event Report Database From July Through December 1982	N209B	K. Black
07/83	Americium-241 Sources	N304	
07/83	Report on Medical Misadministrations for January 1981 Through December 1982	N204C	S. Pettijohn
12/83	Potentially Leaking Americium-241 Sources Manufactured by Amersham Corporation	N306	S. Pettijohn
12/83	Nonreactor Event Report Database for the Period January Through June 1983	N307	K. Black
03/83	Internal Exposure to Am-241	NT301	K. Black

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1983 (cont.)		
	Engineering Evaluations and Technical Reviews (cont.)		
04/83	KayRay, Inc. Reports of Suspected Leaking Sealed Sources Manufactured by General Radioisotope Products	NT302	S. Pettijohn
08/83	Possession of Unauthorized Sealed Source/Exposure Device Combinations by MidCon Inspection Services, Inc.	NT303	S. Pettijohn
	Nuclear Materials Reports Issued in 1982		
	Engineering Evaluations		
02/82	Report on Medical Misadministrations for the Period November 10, 1980-September 30, 1981	N201	S. Pettijohn
01/82	Buildup of Uranium-Bearing Sludge in Waste Tanks	N202	K. Black
02/82	Lost Plutonium-238 Source	N203	K. Black
03/82	Report on Medical Misadministrations for CY 1981	N204	S. Pettijohn
04/82	Preliminary AEOD Review of Iodine-125 Sealed Source Leakage Incidents	N205	E. Trager
05/82	Eberline Instrument Corporation Part 21 Report	N206	K. Black
05/82	AEOD Review of Iodine-125 Sealed Source Leakage Incidents	N207	E. Trager
08/82	Potentially Leaking Plutonium-Beryllium Neutron Sources	N208	S. Pettijohn
08/82	A Summary of the Nonreactor Event Report Data Base for 1981	N209	K. Black
11/82	Leaking Hoses on Self-Contained Breathing Apparatus (SCBA) Manufactured by MSA	N210	K. Black

Date	Title	No.	Author
	Nuclear Materials Reports Issued in 1981		
	Engineering Evaluations		
03/81	Interim Report on Brown Boveri Betatron Calibration Check Source	N101	E. Trager
03/81	Irradiator Incident at an Agreement State Facility (Becton-Dickinson, Broken Bow, Nebraska)	N102	K. Black
04/81	Interim Report on the October 1980 Fire at the Licensee's Sweetwater Uranium Mill	N103	E. Trager
04/81	Interim Report on the January 2, 1981, Fire at the Atlas Uranium Mill	N104	E. Trager
05/81	Interim Report on Tailings Impoundment Liner Failure at the Sweetwater Uranium Mill	N105	E. Trager
08/81	Review of Reports of Leaking Radioactive Sources	N106	E. Trager
12/81	Engineering Evaluation of Fire Protection at Nonreactor Facilities	N107	E. Trager
12/81	Notes on AEOD Review of Emissions From Tritium Manufacturing and Distribution Licensees	N108	E. Trager

APPENDIX D

Status of AEOD Recommendations

STATUS OF AEOD RECOMMENDATIONS

The Office for Analysis and Evaluation of Operational Data (AEOD) tracking system ensures that all formal AEOD recommendations are tracked until resolution. At this time, no issues involving AEOD recommendations regarding nuclear materials activities are unresolved that warrant the attention of the Executive Director for Operations.

APPENDIX E

Status of NRC Staff Actions for Events Investigated by Incident Investigation Teams

STATUS OF NRC STAFF ACTIONS FOR EVENTS INVESTIGATED BY INCIDENT INVESTIGATION TEAMS (NUCLEAR MATERIALS)

In accordance with NRC Management Directive 8.3, "NRC Incident Investigation Program," dated August 12, 1992, the Executive director for Operations (EDO) shall, upon receipt of an Incident Investigation Team (IIT) report, identify and assign NRC office responsibilities for generic and plant-specific actions resulting from the investigation that are safety significant and warrant additional attention or action. Office Directors designated by the EDO as having responsibility for the resolution of issues or concerns are responsible for providing written status reports on the disposition of assigned actions. AEOD is responsible for monitoring the status of assigned staff actions, evaluating the adequacy of the actions taken by the responsible office(s), and documenting the resolution of all staff actions.

This appendix provides the status or disposition, along with appropriate references, for each of the NRC staff action items that the EDO assigned to the various NRC offices that were not documented as resolved in previous AEOD Annual Reports on Nuclear Materials. Included are actions associated with the IIT reports on the 1991 event at General Electric Nuclear Fuels Component Manufacturing Facility and the 1992 event at the Indiana Regional Cancer Center.

Action Source: IIT Report on the "Potential Criticality Accident at the General Electric Nuclear Fuel and Component Manufacturing Facility, May 29, 1991," NUREG-1450, dated August 1991 (Reference 1).

Item 1: **Adequacy of Criticality Safety Reviews**

Action (a): Evaluate existing regulatory requirements, guidance, and review standards for criticality safety analyses of fuel facility licensees to modify processes, procedures, and facilities and develop new regulatory guidance, requirements, and review standards. (Responsible Office: NMSS/RES)

Status: Ongoing

The NMSS Division of Fuel Cycle Safety and Safeguards (FCSS) developed an action plan (SECY-93-128) that presented an integrated approach to revamping the regulations and guidance for fuel facility licensing and developing a Standard Review Plan (SRP) for license reviews. As stated in SECY-93-128, FCSS is taking a fresh look at the fuel cycle facility regulatory, licensing, and inspection programs, emphasizing activities that will offer the greatest and/or near-term safety benefit without placing undue burden on the licensees. Among the principal products of the effort, a revision of 10 CFR Part 70 and its supporting regulatory guidance, and issuance of a review standard in the form of an SRP is expected. The review is expected to require performance of an Integrated Safety Analysis (ISA) for the initial application and, as appropriate, reanalysis to support amendment of the application or a 10 CFR 50.59-type process. Criticality safety would be one part of an ISA. The activities, described above, supersede the recommendation to consider separate action on criticality safety.

Following the development of a draft revision to 10 CFR Part 70 in March 1995, workshops were held in May and November 1995 to solicit comments and information from interested parties. Based on this input, six alternatives were developed and presented in SECY-96-079. The staff is currently awaiting additional guidance from the Commission before proceeding.

Action (b): Evaluate the use of safety operating specifications for radiation and nuclear safety instruments and controls. (Responsible Office: NMSS)

Status: Ongoing

The staff has evaluated the need for a requirement for licensees to include in their applications technical specifications for nuclear safety instrumentation and controls and concluded that it is not warranted. Instead, the staff intends to address radiation and nuclear safety instrumentation and controls in the same manner as other safety-related structures, systems, and components.

Revision to 10 CFR Part 70 and accompanying Standard Format and Content Guidance (SF&CG) for fuel cycle facility license applications will reflect this intent. It is expected that the planned revision to Part 70 will require licensees to perform ISAs. These ISAs will allow determination of defects or failures which could lead to accidents. Once the ISAs are in place, licensees will have NRC-approved analyses that identify equipment, personnel, and procedures needed to assure safety. The licensing project manager and the inspection staff will ensure that a licensee does not significantly change its ISA process without NRC approval, and that the ISA is used on an ongoing basis to evaluate any changes to the

operations. The rule will make clear that the licensee can make changes to the facility, including the plant operations and equipment, without prior Commission approval, only under certain limited conditions that involve no additional risk. This rulemaking and associated guidance will address management control and oversight of safety-related equipment and procedures, including assurance of reliability and availability, human factors aspects, and training regarding safety significance and deviations from the licensee's safety basis standard (Reference 23). This staff action has been included in the action plan in SECY-93-128. This item is on hold pending further direction from the Commission.

Action (c): Evaluate the need to change the licensing practice of incorporating a license condition by reference in fuel facility licenses. Ensure that the resultant licensing practice is mutually understood by all involved in the process. (Responsible Office: NMSS)

Status: Ongoing

The staff has been working with the fuel facility licensees during the amendment and renewal processes to include greater specificity in their application commitments. This addresses the deficiency of having vague commitments that are difficult to inspect or enforce. The revamping of the regulations and guidance for fuel facility licensing, discussed in action (a) above, will provide a better regulatory base for obtaining better commitments.

Presently, NMSS is going through a review process with licensees in an effort to develop a better understanding with licensees concerning the objectives of the new Part 70 (Reference 23). This item is on hold pending further direction from the Commission.

Action (d): Evaluate the existing NRC programs and develop new guidance for the inspection of changes to criticality safety controls at fuel fabrication facilities. (Responsible Office: NMSS)

Status: Ongoing

The staff determined that completion of this item was dependent on issuance of the new Part 70, the new SRP and associated SF&CG, and staff guidance documents concerning management controls and content of ISA documents. These will provide an improved basis for inspection guidance in this area. NMSS is presently going through a review process with licensees in an effort to develop a better understanding with licensees concerning the objectives of the new Part 70.

Even though the new Part 70 has not been issued in final form, FCSS staff has initiated actions to upgrade Manual Chapter 2600 and associated inspection procedures. Once the revised Part 70 is issued in its final form, any additional required changes to the manual chapter or inspection procedures will be initiated (Reference 23). This item is scheduled to be completed by December 30, 1996.

Item 2: Adequacy of Facility Operational Safety

Action (a): Upgrade existing inspection guidance related to management controls and oversight, including audits, personnel training, and procedure adequacy and compliance for major materials licensees. (Responsible Office: NMSS/RFS)

Status: The staff determined that completion of this item was dependent on issuance of the revised Part 70, the new SRP and associated SF&CG, and staff guidance documents concerning management controls and content of ISA documents. These will provide a more specific basis for improved inspection guidance. NMSS is presently going through a review process with licensees in an effort to develop a better understanding with licensees concerning the objectives of the new Part 70.

FCSS staff has initiated actions to upgrade Manual Chapter 2600 and associated inspection procedures even though new Part 70 has not been issued in final form. Once revised Part 70 is issued in its final form, any additional required changes to the manual chapter or inspection procedures will be initiated (Reference 23). This item is scheduled to be completed by December 30, 1996.

Action (b): Determine the need for regulatory requirements, guidance, and standard review plans regarding management controls and oversight, including audits, personnel training, and procedural adequacy and compliance for major materials licensees. Conduct reviews or inspections at selected licensees to collect additional information on management controls and practices. If necessary, on the basis of these assessments, develop new guidance, requirements, and standards as appropriate. (Responsible Office: NMSS/RES/NRR)

Status: Ongoing

In February 1992, the NMSS Materials Regulatory Task Force issued NUREG-1324, "Proposed Method for Regulating Major Materials Licensees," which set forth recommendations concerning deficiencies and needed improvements in licensing and regulation of major materials licensees. NUREG-1324 placed considerable emphasis on improving licensees' management controls because past incidents can be traced directly to breakdowns in these controls. The staff was to analyze the costs and benefits of performing safety analyses and preparing safety evaluation reports for initial materials licensing, renewals, and major amendment actions for the large materials plants.

The planned revision to 10 CFR Part 70, discussed in Action (a) above, will include requirements for management controls and oversight which are being addressed in detail in the SRP for review of applications for fuel cycle facility licenses, both in general and in chapters on specific topics, such as nuclear criticality safety. The SF&CG, derived directly from the SRP, will convey the details to the licensees.

Policy and Guidance Directive (P&GD) FC 85-7, Revision 1; "Standard Review Plan for Applications for Type A Licenses of Broad Scope," was issued June 20, 1994. This document stresses the necessity of strong management controls and oversight to ensure that licensed activities in an extensive radioactive materials program are conducted properly. The document also includes specific guidance on the duties and responsibilities of the Radiation Safety Committee (RSC) and Radiation Safety Officer (RSO), to include immediate termination of any activity that is a threat to public health and safety. As part of the licensing process, licensees are requested to provide certification that the RSO understands and accepts all the responsibilities of the position. In addition, NUREG-1516, "Management of Radioactive Material Safety Programs at Medical Facilities," was published in January 1995. This NUREG introduces the concept of the "management triangle" to emphasize that three parties (executive management, the RSC, and the RSO) are responsible for providing effective oversight of the radiation safety program.

The staff expects that review of this issue will be conducted as part of the overall Business Process Re-engineering effort which will examine the licensing process. In the meantime, the revised licensing guidance, in addition to the revised inspection guidance contained in Manual Chapter 2800, is adequate to identify safety concerns for large materials licensees (Reference 23). However, because of recent incidents at the National Institutes of Health and Massachusetts Institute of Technology, the responsible office will keep this item open until a review and any needed revisions of existing regulations and guidance are completed.

Action (c): Examine the overall inspection process for monitoring and collecting fuel facility safety performance information. Include in the evaluation the merits of (1) a resident inspector program; (2) more frequent inspections, including use of team inspections; (3) establishment of a systematic performance appraisal and feedback program analogous to the Systems Assessment of Licensee Performance for 10 CFR Part 50 licensees. (Responsible Office: NMSS/NRR)

Status: Ongoing

The staff determined that completion of this item was dependent on issuance of the revised Part 70, the new SRP and associated SF&CG, and staff guidance documents concerning management controls and content of ISA documents.

Part 70 is presently going through a review process with licensees in an effort to develop a better understanding with licensees concerning the objectives of new Part 70. Even though new Part 70 has not been issued in final form, FCSS staff has initiated actions to upgrade Manual Chapter 2600, Manual Chapter 2604, and their associated inspection procedures (Reference 23). Once revised Part 70 is issued in its final form, any additional required changes to the manual chapters or inspection procedures will be initiated. This item is scheduled to be completed by December 30, 1996.

Item 4: Adequacy of Operating Experience Reviews

Action (b): Reevaluate NRC operating experience review and feedback program for fuel facilities. Revise the program as appropriate. (Responsible Office: NMSS)

Status: Ongoing

The staff determined that completion of this item was dependent on issuance of the revised Part 70, the new SRP and associated SF&CG, and staff guidance documents concerning management controls and content of ISA documents.

NMSS is presently going through a review process with licensees in an effort to develop a better understanding with licensees concerning the objectives of new Part 70. Even though new Part 70 has not been issued in final form, FCSS staff has initiated actions to upgrade Manual Chapter 2600 and associated inspection procedures. Once the revised Part 70 is issued in its final form, any additional required changes to the manual chapter or inspection procedures will be initiated (Reference 23). This item is scheduled to be completed by December 30, 1996.

Action (c): Develop NRC inspection guidance for licensee event reporting and reviews for fuel facilities. Issue new guidance as appropriate. (Responsible Office: NMSS/AEOD)

Status: Ongoing

The staff determined that completion of this item was dependent on issuance of the revised Part 70, the new SRP and associated SF&CG, and staff guidance documents concerning management controls and content of ISA documents. NMSS is presently going through a review process with licensees in an effort to develop a better understanding with licensees concerning the objectives of new Part 70. Even though new Part 70 has not been issued in final form, FCSS staff has initiated actions to upgrade Manual Chapter 2600 and associated inspection procedures (Reference 23). Once revised Part 70 is issued in its final form, any additional required changes to the manual chapter or inspection procedures will be initiated. This item is scheduled to be completed by December 30, 1996.

References:

1. NUREG-1450, "Potential Criticality Accident at the General Electric Nuclear Fuel and Component Manufacturing Facility, May 29, 1991," August 1991.
2. Memorandum from J. Taylor to NRC staff, "Staff Actions Resulting from the Investigation of the Potential Criticality Accident at the General Electric Nuclear Fuel and Component Manufacturing Facility, May 29, 1991 (NUREG-1450)," August 13, 1991.
3. Memorandum from E. Jordan to J. Taylor, "Staff Actions in Response to the Investigation of the Potential Criticality Accident at the General Electric Nuclear Fuel and Component Manufacturing Facility Findings" (NUREG-1450), September 6, 1991.
4. Memorandum from R. Bernero to J. Taylor, "Staff Action Plan Responding to the Investigation of the May 29, 1991, Incident at the General Electric (GE) Nuclear Fuel and Component Manufacturing Facility" (NUREG-1450) September 9, 1991.
5. Letter to S.D. Ebneter to W. Ogden, "NRC Incident Investigation Team Report Follow-up" (NUREG-1450), August 13, 1991.
6. NRC Inspection Report No. 70-1113/91-0, August 12, 1991.
7. Letter from J. Stohr to W. Ogden, "Management Meeting Summary," October 2, 1991.
8. Letter from B. Wolfe (GE) to J. Taylor (NC), August 26, 1991.
9. Letter from W. Ogden to J. Taylor, August 27, 1991.
10. NRC Inspection Report No. 70-1113/91-04, December 23, 1991.
11. NRC Inspection Report No. 70-1113/91-09, January 15, 1992.
12. NRC Inspection Report No. 70-1113/91-06, January 22, 1992.
13. Regulatory Guide 3.67, "Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities," January 1992.
14. Letter from G. Bidinger to T. P. Winslow, January 7, 1992.
15. NRC Bulletin No. 91-01, "Reporting Loss of Criticality Safety Controls," October 18, 1991.
16. NUREG-1324, "Proposed Method for Regulating Major Materials Licensees," dated February 1992.

17. Memorandum from R. Bernero to J. Taylor, "Staff Actions Resulting from the Investigation of the May 29, 1991, Incident at General Electric (GE) Wilmington," dated September 29, 1993.

18. Memorandum from R. Bernero to J. Taylor, "Completion of Item 1.F to General Electric Staff Action Plan, Response to Investigation of the May 29, 1991, Incident at the General Electric Nuclear Fuel and Component Manufacturing Facility" (NUREG-1450), dated August 2, 1993.

19. Memorandum from E. Jordan to R. Bernero, "Completion of Items 1.E and 2.D to General Electric Staff Action Plan, Response to Investigation of the May 29, 1991, Incident at the General Electric Nuclear Fuel and Component Manufacturing Facility," dated September 13, 1993.

20. Memorandum from R. Bernero to J. Taylor, "Completion of Item 3.B to General Electric (GE) Staff Action Plan Response to Investigation of the May 29, 1991, Incident at the GE Nuclear Fuel and Component Manufacturing Facility" (NUREG-1450), dated December 2, 1992.

21. Memorandum from R. Bernero through H. Thompson to J. Taylor, "Staff Actions Resulting From the Investigation of the Incident at General Electric Wilmington," dated October 6, 1994.

22. Memorandum from E. Jordan to J. Taylor, "Staff Action Plan Responding to Investigation of the May 29, 1991, Incident at the General Electric (GE) Nuclear Fuel and Component Manufacturing Facility (NUREG-1450)," dated October 12, 1994.

23. Memorandum from E. Q. Ten Eyck to S. Rubin, "Status of Staff Actions," dated October 30, 1995.

Action Source: IIT Report on "Loss of an Iridium-192 Source and Therapy Misadministration at Indiana Regional Cancer Center, Indiana, Pennsylvania, on November 16, 1992 (NUREG-1480)," dated March 12, 1993 (Reference 1).

Item 1: Adequacy of Oncology Services Radiation Protection Program

Action (b): Evaluate whether NRC regulations and guidance need to be modified to explicitly define the functions and responsibilities of the radiation safety officer (RSO) and the authorized user. (Responsible Office: NMSS)

Status: Ongoing

Draft NUREG 1515 "Management of Radioactive Material Safety Programs at Medical Facilities," was distributed for peer review and discussed with the Advisory Committee on the Medical Uses of Isotopes at the November 1993 and May 1994 meetings. The NUREG was published for public comment in January 1995. The staff will evaluate the need to further define and provide guidance on the responsibilities of the RSO and authorized user during a major revision of Part 35 tentatively scheduled for 1999 following review of the National Academy of Sciences report on NRC's medical use program. Additionally, Policy and Guidance Directive (P&GD) FC 85-7, "Standard Review Plan for Applications for Type A Licenses of Broad Scope," was published in June 1994. This provided guidance on the duties and responsibilities of the RSO and authorized users. (References 2&3)

Item 2: Adequacy of NRC Protocols for Informing the Public and Authorities of Radiation Exposures Resulting from Licensed Activities.

Action (b): Evaluate the need to further define licensee responsibility for assessing radiation exposure and notifying members of the public and authorities. (Responsible Office: NMSS/NRR)

Status: Resolved (Pending AEOD Independent Review)

The staff received guidance from Office of General Counsel regarding the applicability of Parts 19 and 20 to licensees for assessing radiation exposure and notifying members of the public and authorities. A final rule, making minor clarifying modifications to Parts 19 and 20 regarding reports to members of the public required by Part 20, was published on July 13, 1995 (60 FR 36038) and became effective on August 14, 1995. Additionally, MC 1302 and MD 8.10 were issued and provide additional guidance on notifying local authorities in response to an event involving the release of licensed material into the public domain. The Responsible Office considers this item resolved (Reference 2).

Item 3: Adequacy of Regulatory Oversight of Sealed Sources and Devices and Medical Licenses

Action (a): **Evaluate the need to update licensing and inspection guidance and requirement for high-dose-rate (HDR) afterloaders. (Responsible Office: NMSS/RES)**

Status: **Ongoing**

The staff has undertaken several efforts in this regard. A NRC Bulletin 93-01, "Release of Patients After Brachytherapy Treatment With Remote Afterloader Devices," was sent to all remote afterloader users, imposing specific requirements including: the physical presence of the physician authorized user and physicist or RSO during patient treatments; device specific training; and patient surveys following treatment. Policy and Guidance Directive

86-4 was revised to incorporate the requirements of the bulletin. A Temporary Instruction was issued to provide guidance on routine inspection of HDR afterloaders. In addition, contract efforts were undertaken for quality control/quality assurance plans for remote afterloaders and human factors evaluations related to brachytherapy. The results of these various efforts will be incorporated into a user-need memorandum to RES to revise Part 35.

Policy and Guidance Directive 86-4 is being revised and will be included as a module to Regulatory Guide 10.8, Revision 2. Training was provided to the regions on the guidance in P&GD 86-4 in September 1994. A brachytherapy issues paper, which included a discussion of the requirements for HDR afterloads, was prepared for discussion with the Advisory Committee on the Medical Uses of Isotopes (ACMUI) and the regulated community. The comments received along with the contractor's findings will be evaluated and incorporated into the proposed revisions to 10 CFR Part 35, when indicated. (Reference 2)

Action (b): Evaluate the relative merits of a performance-based approach versus schooling or certification to verify the radiation safety knowledge of HDR afterloader users. (Responsible Office: NMSS/NRR)

Status: Ongoing

The staff will conduct an evaluation as requested and continue to discuss this issue with the ACMUI. The staff will incorporate this issue into the user need memorandum described in Action 3(a). above, as appropriate.

The staff's plan to evaluate all current training and experience criteria will include a determination regarding the relative merits of different training approaches to ensure that all users have adequate radiation safety knowledge. The staff plans to hold facilitated public workshops during the major revision of Part 35 to discuss this issue.

Action (d): Revise the inspection guidelines to trigger consideration for licensees whose programs have significantly expanded or changed. (Responsible Office: NMSS)

Status: Resolved (Pending AEOD independent review)

The staff revised the guidance in Manual Chapter 2800, "Materials Inspection Program," to provide guidance on inspection of satellite facilities, field offices, and temporary job sites. Policy and Guidance Directive 94-04 was issued June 21, 1994 to provide guidance for the staff reviewers in identifying programs that have undergone significant growth and warrant on-site inspection.

The revised Manual Chapter 2800 was issued March 30, 1995. The staff is developing additional guidance to assist the staff in review of applications requesting authorization for use of NRC licensed material at multiple facilities under one license. The Responsible Office considers this item resolved (Reference 2).

References: 1. NUREG-1480, "Loss of an Iridium-192 Source and Therapy Misadministration at Indiana Regional Cancer Center, Indiana, Pennsylvania, on November 16, 1992," February 1993.

2. Memorandum from Elizabeth Q. Ten Eyck, Director, Division of fuel cycle Safety and Safeguards, NMSS to Stuart D. Rubin, Chief, Diagnostic Evaluation and Incident Investigation Branch, Incident Response Division, AEOD, "Status of Staff Actions," dated October 30, 1995.

3. Memorandum from Stewart D. Ebneter, Regional Administrator, to Edward L. Jordan, Director, AEOD, "Status of Staff Actions," dated October 31, 1995.

Action Source:	IIT Report on the "Ingestion of Phosphorus-32 at Massachusetts Institute of Technology, Cambridge, Massachusetts, Identified on August 19, 1995," NUREG-1535, dated December 1995 (Reference 1).
Item 1:	Security and Control of Radioactive Materials
Action (a):	Evaluate existing regulations, guidance, and standard review plans for security and control of radioactive materials as well as establishment of restricted, unrestricted, and controlled areas. Determine the need to develop new or revised standards, guidance, and regulations, as appropriate. (Responsible Office: NMSS/RES)
Status:	Ongoing
Action (b):	Evaluate current regulations, guidance, and review standards with regard to accounting for and inventory of radioactive materials. Determine the need to develop requirements for inventory of material in use and additional guidance for accounting and inventory of unsealed byproduct materials in general. Develop and implement new or revised standards, guidance, and regulations, as appropriate. (Responsible Office: NMSS/RES)
Status:	Ongoing
Item 2:	Adequacy of NRC's Events Databases
Action (a):	Review current mechanisms for the collection, review, and dissemination of nuclear materials events and implement appropriate modifications. (Responsible Office: AEOD/NMSS)
Status:	Ongoing
Action (b):	Review the Agreement States Program with regard to the compatibility of event reporting requirements and voluntary participation in providing event summaries for the NRC data base. Modify and revise, as appropriate. (Responsible Office: OSP/AEOD/NMSS)
Status:	Ongoing
Action (c):	Evaluate the need to include similar international nuclear materials events in NRC's review process. Develop mechanisms to collect and incorporate relevant information, as appropriate. (Responsible Office: AEOD/OIP)
Status:	Ongoing
Item 3:	Reporting Requirements
Action (a):	**Evaluate current regulations and guidance regarding the reporting of internal contamination and modify, as appropriate. (Responsible Office: RES/NMSS)**
Status:	**Ongoing**
Item 4:	Management Oversight
Action (a):	Evaluate existing regulations, guidance and review standards for management oversight of broad scope licensed programs with regard to the roles of the radiation safety officer, the radiation protection committee, supervision, and the authorized user, as well as the use of audits. Develop new or revised guidance, standards and regulations, as needed. (Responsible Office: NMSS/RES)

Status: Ongoing

Action (b): Evaluate the need to put the guidance provided in Draft Regulatory Guide DG-0005 in the regulations in Part 33 and/or Part 30. Develop and implement appropriate policy to ensure that consistent application of the requirements is achieved and finalize the Regulatory Guide, as appropriate. (Responsible Office: NMSS/RES)

Status: Ongoing

Item 5: Adequacy of NRC's Guidance and Procedures for NRC Response

Action (a): Evaluate the adequacy of procedures and guidance for conduct of an Augmented Inspection Team. Issue, if appropriate, revised procedures or modify the Management Directive to cover exit and entrance interviews, exchange of information with the individuals, use of transcribed interviews, media coverage and decisions to recommend that an AIT should be upgraded to an IIT. (responsible Office: AEOD/NRR)

Status: Ongoing

Action (b): Evaluate the adequacy of guidance for chartering IITs and AITs for events involving deliberate acts. In particular evaluate the adequacy of guidance for interfacing with criminal investigations (Office of Investigations, State or Federal law enforcement, and local or private police). Issue, if appropriate, revised procedures and guidance for IITs and AITs. (Responsible Office: AEOD)

Status: Ongoing

Item 6: Adequacy of NRC's Guidance and Procedures for Licensee Response to Intakes of Radioactive Material by Individuals

Action (a): Evaluate the adequacy of regulatory guidance for collecting data to analyze intakes of radioactive materials, for analyzing fetal dose based upon maternal intake, for licensees seeking outside medical expertise, and for NRC staff who monitor the licensee's analysis of an intake. Issue revised guidance and procedures, as appropriate. (Responsible Office: NMSS/RES)

Status: Ongoing

References: 1. NUREG-1531, "Ingestion of Phosphorus-32 at Massachusetts Institute of Technology, Cambridge, Massachusetts, Identified on August 19, 1995," December 1995.

NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

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1997 Annual Report

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Same as in item 8

10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This annual report of the U.S. Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD) describes activities conducted during 1997. The report is published in three parts. NUREG-1272, Vol. 11, No. 1, covers power reactors and presents an overview of the operating experience of the nuclear power industry from the NRC perspective, including comments about trends of some key performance measures. The report also includes the principal findings and issues identified in AEOD studies over the past year and summarizes information from such sources as licensee event reports and reports to the NRC's Operations Center. NUREG-1272, Vol. 11, No. 2, covers nuclear materials and presents a review of the events and concerns during 1997 associated with the use of licensed material in nonreactor applications, such as personnel overexposures and medical misadministrations. Both reports also contain a discussion of the Incident Investigation Team program and summarizes both the Incident Investigation Team and Augmented Inspection Team reports Each volume contains a list of the AEOD reports issued from CY 1980 through 1997. NUREG-1272, Vol. 11, No. 3, covers technical training and presents the activities of the Technical Training Center in support of the NRC's mission in 1997.

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

nuclear materials
Nuclear Materials Events Database
leaking sources
transportation events
test, research, and training reactor
Incident Investigation Program
Committee to Review Generic Requirements
nonreactors
medical misadministration
radiation exposure
release of material
equipment problems
abnormal occurrences
incident response
AEOD recommendations
AEOD studies
emergency response
non-power reactors
radiation exposure
loss of control of licensed material
fuel cycle facility
operating experience
NRC staff actions
AEOD reports
Operating Center Data
gaseous diffusion

13. AVAILABILITY STATEMENT

Unlimited

14. SECURITY CLASSIFICATION

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