POLICY ISSUE
INFORMATION

April 18, 2003

FOR: The Commissioners SECY-03-0060

FROM: William D. Travers
Executive Director for Operations

SUBJECT: ANNUAL REPORT TO THE COMMISSION ON PERFORMANCE IN THE MATERIALS AND WASTE ARENAS

PURPOSE:

This paper provides the first annual update on significant nuclear materials issues, as well as performance trends in the Materials and Waste Arenas, pursuant to Staff Requirements Memorandum SRM-SECY-02-0216, "Proposed Process for Providing Information on Significant Nuclear Materials Issues and Adverse Licensee Performance," dated February 25, 2003.

SUMMARY:

Staff evaluated performance trends and significant issues based on aggregated information obtained from operating experience associated with reportable events and generic issues affecting the industry. The aggregated information, obtained through existing processes and systems, includes the following: (1) Abnormal Occurrence (AO) data; (2) Strategic Goal and Performance Goal data; (3) data derived through escalated enforcement actions; (4) significant issues identified based on existing criteria; (5) generic and special event study results; and (6) quarterly report data based on assessment of events reported to the Nuclear Materials Events Database (NMED). The performance data presented in this paper encompasses all NRC Materials and Waste Arena licensees and Agreement State licensees.

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Based on the staff's evaluations, it was determined that: (1) there are no discernable trends from the assessment of the overall performance data; and (2) four nuclear materials issues have met the significant issues criteria as described in Table 2 of SECY-02-0216. Among the four significant issues, three of them (PermaGrain, Fansteel, and Safety Light) shared a common issue of deficiencies in the financial assurance area, which leads to a potential risk to public health and safety. The fourth significant issue (Schlumberger) revealed the limitations of cytogenetic blood testing in the United States.

BACKGROUND:

On June 28, 2002, the Commission issued SRM M020501, concerning the Agency Action Review Meeting (AARM). In the SRM, the Commission stated the following:

> The staff should propose a process for providing the Commission with annual updates on significant nuclear materials issues (such as overexposures, medical misadministrations, and lost or stolen sources) and on adverse licensee performance. This information could be provided in conjunction with the Agency Action Review Meeting results and Commission meetings, or through another appropriate mechanism. The staff should inform the Commission of the final criteria that it will use to determine those material licensees that will be discussed at the Agency Action Review Meeting.

On December 11, 2002, staff issued SECY-02-0216. The SRM for SECY-02-0216, dated February 25, 2003, approved the staff's proposal to provide the Commission information on the Materials and Waste Arenas' performance in an annual report. This paper is the first in a series of annual reports developed to keep the Commission informed of the overall performance trends as well as significant issues among U.S. Nuclear Regulatory Commission (NRC) and Agreement State licensees in the Materials and Waste Arenas.

DISCUSSION:

The evaluation of performance trends and significant issues is based on aggregated information on operating experience associated with reportable events and generic issues affecting the industry. As stated in SECY-02-0216, staff has developed an approach for providing the Commission with annual updates on significant issues and performance trends that: (1) builds on existing processes and systems; and (2) has minimal impact on staff resources.

The aggregated information used to evaluate performance trends and significant issues was obtained through existing processes and systems and includes the following: (1) AO data; (2) Strategic Goal and Performance Goal data; (3) data derived through escalated enforcement actions; (4) significant issues identified based on existing criteria; (5) generic and special event study results; and (6) quarterly report data based on assessment of events reported to NMED.

This paper is the first annual report and is a product of an evolving process. In the future, evaluations may be performed through a mechanism being developed under the pilot National Materials Program. In addition, a longer-term goal is to also use risk insights derived from the application of NUREG/CR-6642, "Risk Analysis and Evaluation of Regulatory Options for Nuclear Byproduct Material," and to incorporate inspection findings data in the analysis of trends, to perform an integrated assessment of overall safety in Materials and Waste Arenas.

The following sections discuss the evaluation of the performance trends and significant issues using the aggregated information stated above, followed by overall conclusions of performance in Materials and Waste Arenas.

AO Data:

Nine events reported to NRC in Fiscal Year (FY) 2002, involving the Materials and Waste arena, were determined by the staff to meet the criteria for AOs. The FY 2002 AO Report will be available in the 2nd quarter of the year 2003. The AO events include four Medical Events (i.e., misadministrations), four Personnel Overexposure events, and one event involving a loss of package integrity for a radioactive material shipment. Although the 9 AO events proposed for FY 2002 represent an increase from the number reported for FY 2001 (only one event was found to meet the AO criteria in FY 2001), there is no discernable increasing trend in AO events when 5 years of data are compared (Table 1.0 of Attachment 1).

A significant finding is that several of the AOs reported for FY 2002 exceeded the AO criteria by a substantial margin and resulted in, or had a high potential to result in, acute effects to personnel involved. For example, three of the personnel overexposures involved high doses to radiographers. In one case, a radiographer received an extremity dose of 150 sieverts (Sv) [15,000 (rem)]. In two other cases, one radiographer received a whole-body dose of 2.7 Sv (270 rem) and another received a whole-body dose of 0.70 Sv (70 rem). The AO criterion for extremity exposures is 2500 millisieverts (mSv) (250 rem), and the AO criterion for whole-body exposure is 250 mSv (25 rem). The circumstances that led to the occurrence of these events are the same as recorded for less serious events of the same type (i.e., a failure to perform adequate radiation surveys and follow procedures for properly monitoring doses). The "Generic and Special Event Study Results" section of this report and Attachment 2 contain further discussions of personnel exposure data.

Strategic Goal and Performance Goal Data:

The Strategic Plan Performance Goal and Measures data highlighted in the report are the values that exceed a performance goal or measure or will likely exceed a performance goal or measure, within 80 percent of the maximum value.

No events reported for FY 2002 met the criteria for Strategic Goal Measures. Although events occurred in FY 2002, the Performance Goal Measures were not exceeded. However, three Performance Goal measures were within 80 percent of the Performance Measure goal for FY 2002. The Measures were the following: (1) loss or theft of material; (2) loss or theft of

sources greater than 0.37 terabecquerel (TBq) (10 Ci); and (3) release of material. Overall, the number of reported thefts and losses of material reported for FY 2002 and through the first quarter of FY 2003 was not substantially different from the number of events reported for previous years. In addition, NRC has achieved all of its strategic goals and performance goals in both Materials and Waste Arenas since 2000.

The theft of portable moisture/density gauges continue to dominate the theft of material. Although there appears to be a slight increase in thefts of these devices in FY 2002 and the first quarter of FY 2003, there is no evidence that thefts of these devices are associated with intended malevolent use of radioactive material. The loss or thefts of sources greater than 0.37 TBq (10 Ci) in calendar years 2001 and 2002 involved the thefts of three radiography exposure devices (two of which were recovered). There is no evidence that the thefts of these devices are associated with intended malevolent use of radioactive material. The “Generic and Special Event Study Results” section and Attachment 3 contain further discussions of lost and stolen material.

Data Derived Through Escalated Enforcement Actions:

There is no apparent trend for escalated enforcement actions over the last five years. The NRC issued an average of 61 escalated actions per year (including civil penalties, orders, and Notices of Violation for Severity Level I, II, and III violations without civil penalties). The number of civil penalty actions increased in FY 2001 and FY 2002, based on the Commission’s Enforcement Policy revision addressing the loss, abandonment, or improper transfer or disposal of sources that became effective on February 16, 2001. Over the last five years, an average of three events per year resulted in Severity Level I or II violations, ranging from a single event per year to six events per year. Summaries of Severity Level I or II violations for FY 2001 and FY 2002 are described in Attachment 4.

Significant Issues Identified Based on Existing Criteria:

There are three nuclear materials licensee issues and one incident that meet the significant issues criteria as described in Table 2 of SECY-02-0216. These significant issues demonstrated a high potential to impact public health and safety, which warranted a discussion in this paper. Event details are provided in Attachment 5, which include a discussion of issues at PermaGrain Products, Inc., Fansteel, Inc., and Safety Light Corporation, and an incident that occurred at Schlumberger Technology Corporation. The three licensee issues (PermaGrain, Fansteel, and Safety Light) shared a common issue of deficiencies in the financial assurance area, which leads to a potential risk to public health and safety. The staff is addressing the financial assurance program as part of its analysis of the License Termination Rule (SRM-SECY-01-0194 and SECY-02-177) as well as a draft final rule that amends financial assurance requirements. The staff's analysis will more fully outline the issues associated with decommissioning financial assurance and identify a number of potential improvements that may be implemented.

In the case of the PermaGrain Products, Inc., the licensee declared bankruptcy, resulting in potential abandonment of a substantial inventory of cobalt-60 sources. The cost of removal and

disposal of these sources is approximately 10 times greater than the amount of financial assurance required in current regulations. Recently, the U.S. Environmental Protection Agency (EPA) has agreed to implement a Federal removal of the sources. A draft rulemaking (in the final stage) will require that financial assurance for irradiators be based on site-specific decommissioning cost, rather than a fixed amount, as specified in the current regulations.

Due to bankruptcy, Fansteel, Inc. is not able to provide the necessary amount of financial assurance for decommissioning activities, as required in 10 CFR 40.36. Subsequently, staff denied the license renewal application submitted by Fansteel. To date, Fansteel has not provided an acceptable plan to emerge from bankruptcy and fund remediation of the Muskogee site. Safety Light Corporation is also deficient in the financial assurance needed to perform effective remediation work. The staff, working in concert with EPA and the Commonwealth of Pennsylvania, has approved a work plan for removal of the silo wastes from this site. Because of the considerable shortfall in licensee funds relative to ultimate cleanup cost, EPA is also considering adding the site to the National Priorities List and possible remediation under the Comprehensive Environmental Response, Compensation and Liability Act.

Staff upgraded the inspection effort concerning Schlumberger Technology Corporation to an Augmented Inspection Team (AIT) because of the significant discrepancies between the estimated radiation doses and the cytogenetic test results, and because of the potential for a high radiation dose to a member of the public. The Armed Forces Radiobiology Research Institute is the only facility in the United States that is currently available to NRC for cytogenetic testing on an ongoing and on-demand basis for use in radiation dose assessments. There is a need to have more than one facility available to NRC for cytogenetic testing within the United States. The staff is working to establish additional capability so that testing results can be compared and verified if discrepancies arise.

Generic and Special Event Study Results:

Staff performed reviews of reported data on radiography overexposures, radiopharmacy extremity overexposures, and the loss and theft of radioactive material. The results of the reviews of radiography exposures and radiopharmacy extremity exposures were published in an addendum to the 4th NMED Quarterly Report (Attachment 2). A summary for each of the three data reviews is presented below. Attachment 3 contains the full text of the data review on the loss and theft of radioactive material.

Review of Radiography Overexposures (1997 to 2002):

A review of data, reported to NRC, that involved reportable overexposures, was performed for the period of January 1997 through May 2002. A total of 70 individuals received doses that exceeded regulatory limits: 67 whole-body doses and six extremity doses. Approximately 23 percent of reported causes of radiography overexposures were failures to perform surveys and follow procedures. Approximately 49 percent of radiography overexposures were attributed to poor administrative practices (i.e., overexposures because of improper oversight of workers' annual doses). These administrative doses ranged between 50 and 60 mSv (5-6 rem).

Review of Radiopharmacy Extremity Overexposures (1997 to 2002):

A review of data reported to NRC involving hand and finger exposures in excess of regulatory limits at radiopharmacies was performed for the period of January 1997 through May 2002. Events reported during this period involved exposures to 126 persons. One event, which occurred over a 5-year period, accounted for 116 of the 126 persons. Except for the overexposures that occurred because of this event, an average of two events was reported annually, from 1997 through 2001. Although this number may appear low, the overall data suggest that, in the absence of radiation safety procedures that involve the use and frequent monitoring of dosimetry results and the use of shielding and remote-handling tools, the potential for extremity exposures in excess of regulatory limits is high.

Analysis of Lost and Stolen Data for Trend Identification, Calendar Years (2001-2002):

An analysis of data from NMED for calendar years 2001 and 2002 was conducted to identify a pre-9/11 baseline and post-9/11 trends for lost and stolen moisture/density gauges and radiographic cameras. Each moisture/density gauge contains approximately 0.3 gigabecquerel (GBq) [8 millicuries (mCi)] of cesium-137, and 1.48 Gbq (40 mCi) of americium-241/beryllium, in the form of sealed sources. With the exception of radiographic cameras that contain high-activity sources, the remaining percentage of stolen sources (~20 percent) have an activity in the μCi to mCi range, and are typically contained in gauging/measuring devices, and ionization devices used for static elimination. Because of the low-activity range, the stolen sources are not likely to be candidates for malevolent use. Based on the analysis, staff did not identify any trend or information indicating that reported losses and thefts of licensed material over the last 2 years represent a substantive safety risk. In addition, there was no identifiable pattern to support the idea that individuals are stealing portable moisture/density gauges for malevolent use. However, the theft of a portable gauge may still pose a potential risk to public health and safety if the gauge is abandoned in the environment, is recycled in a steel mill, or is used inappropriately. An NRC/Agreement State Working Group has developed a draft proposed rule to reduce the opportunity for portable gauge theft.

Assessment of Data Reported to NMED

NMED contains records of events involving nuclear materials reported to NRC by NRC licensees, Agreement States, and non-licensees. The events are reported to NMED based on requirements defined by Title 10 of the Code of Federal Regulations. The event reports are evaluated to identify any safety-significant events and their causes. NMED data are reviewed quarterly and presented in a quarterly report, in which 18 months of historical data are aggregated for evaluation of potential trends. The NMED quarterly report is posted on the NMED web site at http://NMED.inel.gov and is directly available to NRC and Agreement State staff. Using event analysis and reviews published in the NMED quarterly report, trends can be identified. The NMED format and content of the NMED quarterly report are being revised to include statistical analysis and trending. Future fourth quarter reports will include an annual summary of data.

Attachment 6 is a copy of the 4th Quarter FY 2002 NMED quarterly report. For the 18-month period ending September 30, 2002, 852 events (not including fuel cycle facility events) were

reported to NRC. Among them, 49 percent were classified as Loss of Control of Material. The remaining 51 percent were divided among Equipment Problems (21 percent), Leaking Sources (9 percent), Transportation (7 percent), Medical Events (6 percent), Radiation Overexposures (4 percent), Release of Licensed Material or Contamination (2 percent), and Other (2 percent).

The event-reporting rate is about 2.7 events per 100 licensees annually, for all events, and about 0.7 events per 100 licensees, annually, for Medical Events. The calculated reporting rates are based on an estimate of about 21,000 materials licensees (about 5000 NRC licensees and 16,000 Agreement-State licensees) that reported 568 events (annual rate) and about 5000 medical licensees that reported 37 Medical Events (annual rate).

The 18-month assessment of NMED data does not reveal any overall discernable trends in performance. Although the number of events reported annually is low, the event data do, in some cases, highlight areas, such as radiography overexposures, for follow-up studies. Data were reviewed for the first quarter of FY 2003 and was found to be consistent with the results of the 18-month assessment in the 4th Quarter FY 2002 NMED Quarterly Report.

OVERALL PERFORMANCE CONCLUSIONS:

The review of current processes for assessing performance in the Materials and Waste arenas does not reveal any discernable trend in declining performance. These processes do identify areas for improvement through highlighting where problems occur and also enable lessons-learned for feedback to the industry and regulatory community. Based on existing criteria, four significant nuclear materials issues have been identified. Three of them shared a common issue of deficiencies in the financial assurance area, and the fourth revealed the limitations of cytogenetic blood testing in the United States. The staff is addressing the financial assurance program as part of its analysis of the License Termination Rule as well as a draft final rule that amends financial assurance requirements.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objections.

/RA/

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Attachments:
1. Annual Trend in AO Events and Summary of FY 2002 AO Events
2. Addendum to the Fourth Quarter FY 2002 NMED Quarterly Report
3. Analysis of Lost and Stolen Data for Trend Identification, Calender Year 2001-2002
4. Summary of Severity Level I and II Enforcement Actions for FY 2001 and FY 2002
5. Significant Issues and Incident Investigations
6. Fourth Quarter FY 2002 NMED Quarterly Report

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Annual Trend in AO Events and Summary of FY 2002 AO Events

1. Trend in Abnormal Occurrence Events

Table 1.0 shows the number of events reported annually that were determined to meet the AO criteria. A total of 35 events were found to meet the AO Criteria for the five year period 1998 - 2002. Sixty percent of the AO events were Medical events. However, the relative higher number of Medical Events determined to be AOs is not necessarily an indication of relative performance. The numerical dose criteria applied to Medical Events also appear to be a factor in Medical Events meeting the AO criteria. For example, the criteria for a Medical Events is that (1) the total dose delivered differs from the prescribed dose by greater than 20% and (2) the dose to an organ is greater than 0.05 Sv (5 rem). Therefore, a broad range of dose deviations can result in a Medical Event AO.

It is noteworthy that while events involving the loss or theft of material account for about 40% (five year average) of the number of events reported to NRC, only one event in five years has been found to meet the AO criteria.

Table 1.0 - Comparison of the Annual Number of Abnormal Occurrence Event

Year (FY)	Lost/Stolen Material	Medical Event	Personnel Overexposure	Fuel Cycle Facility Event	Totals
1998	0	5	1	1	7
1999	0	7	2	1	10
2000	0	5	2	0	7
2001	0	0	1	0	1
2002	1	4	4	1	10
Totals	1	21	10	3	35

INEEL/EXT-02-00358 (FY 2002 QTR 4) Addendum

January 2003

Addendum to Nuclear Materials Events Database (NMED) Quarterly Report

Fourth Quarter Fiscal Year 2002

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Attachment 2

Addendum to Nuclear Materials Events Database (NMED) Quarterly Report

Fourth Quarter Fiscal Year 2002

Samuel L. Pettijohn, NRC

Published January 2003
http://nmed.inel.gov

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Prepared for the
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

SAFETY HIGHLIGHTS

Review of Radiography Overexposures (1997 to 2002)

This addendum presents a Safety Highlights report that was not available in time for inclusion in the regular quarterly report. This report represents the results of a review of data, reported to the NRC, involving the reportable overexposures for the period of January 1, 1997, through May 2002.

Total number of individuals who received doses that exceeded regulatory limits (70):

Whole Body dose: 67
Extremity dose: 6

(In three cases, extremity doses were exceeded but whole body doses were not exceeded.)

Approximately 23 percent of reported causes of radiography overexposures were due to failure to survey and follow procedures. Approximately 49 percent of radiography overexposures were administrative overexposures (i.e. overexposures due to poor oversight of workers annual dose). These administrative doses range between 5 rem to 6 rem. Seven of the forty-one overexposures between 5 rem and 6 rem were due to failure to survey and follow procedures.

Table 1. Whole Body Doses

Dose range for whole body doses (rem)	Number of individuals exposed
5 - 6	41
6 - 10	14
10 - 25	8
>25	4

Table 2. Reported Causes for Whole Body Doses

Whole body dose greater than 25 rem (rem)	Reported cause	Event date
39	Failure to survey and follow procedures	2/16/2001
40	Failure to survey and follow procedures	9/25/2001
70	Failure to survey; could not hear alarming ratemeters due to high noise environment	4/10/2002
77	Possible intentional overexposure to badge	10/1/1999

Table 3. Reported Causes for Extremity Exposures

Extremity dose	Reported cause	Event date
730 rem to the hands	Failure to survey and follow procedures	9/25/2001
150 rem to the left hand	Unshielded source during source exchange	11/22/2000
3000 to 5000 rem to index finger	Failure to survey; Inadequate training	12/31/1998
100 to 680 rem to fingers and hands (contract employee)	Inattention of radiographer; radiography was in parking garage	12/16/1998
1500 rem to left calf	Failure to survey and follow procedures	6/1/2000
80 rem to hand	Failure to survey; could not hear alarming ratemeters due to high noise environment	1/13/2001

Review of Radiopharmacy Extremity Overexposures

This report represents the results of a review of data reported to NRC by radiopharmacies involving hand and finger exposures that exceeded regulatory limits for the period of January 1, 1997, to May 2002. Events reported during this period involved exposures to 126 persons. One event, which occurred over about a five year period, accounted for 116 of the 126 persons. Tables 4 through 6 below summarize the result of the review. Except for the overexposures that occurred from 1995 - 2000 due to a common event, an average of two events were reported annually from 1997 through 2001. While this number may appear low, the overall data suggest that there is a high potential for extremity exposures in excess of regulatory limits. The use of, and frequency of monitoring, dosimetry results, and the use of shielding and remote handling tools (where required) can significantly reduce the potential for extremity exposures.

Table 4. Frequency of Reported Occurrences

Year	Number of events	Number of persons
1995 - 2000	Several events reported as one event	116
1998	1	1
1999	2	2
2000	2	2
2001	4	5
Total	**9**	**126**

A group of overexposures that occurred over the period 1995 - 2000 due to the same causal factors were reported as one event. The overexposures were discovered during the investigation of an extremity overexposure event that occurred March 31, 2001. The licensee reviewed other production processes at the plant where high hand exposures might have occurred. This investigation resulted in the discovery of a total of 116 extremity overexposures from 1995 through 2000. Sixteen of the exposures were in excess of 250 cSv (rem) SDE, the highest of which was 453 cSv (rem) SDE. The causes of these events were

determined to be insufficient training, a failure to follow procedures, inadequate identification of radiological hazards, and the failure to recognize the radiological implications of some work practices. Over 80 percent (103 of 126) of the extremity exposures were less than 250 rem.

The number of extremity overexposure events reported for 2001 is at least twice the number reported for each of the three preceding years. The reason for this increase was not apparent from a review of the data.

Table 5. Task Being Performed by Worker and Associated Cause of Overexposure

Task	Events	Workers	Reported cause(s)	Does range (rem)
Dispensing routine doses	7	8	Poor handling techniques used during the manual recapping of syringes; Workload too high; Radiopharmacist was new and had slower technique; Worker was in training	51 -151
F-18 dose splitting process	1	1	Instead of using of using the remote handling tool provided, the radiopharmacist handled syringes by hand during preparation of F-18 doses	127
Dispensing bulk doses of Tc-99m	1	1	Radiopharmacist used vial shield without a shielded top and used left index finger to hold vial containing Tc-99m	700
Reworking radiopharma-ceutical generators and other production processes	1	117	The individual used his fingers to manipulate needles inside the generator instead of forceps	51 - 1120

One extremity overexposure was calculated to be as high as 1120 rem. This overexposure resulted from an employee working at the rework and packaging stations of a radiopharmaceutical generator manufacturing line. The employee handled a Mo-99/Tc-99m column containing 703 GBq (19 Ci) of Mo-99 and 296 GBq (8 Ci) of Tc-99m with his right hand for 10 to 20 seconds. The individual was supposed to use forceps to manipulate needles inside the generator, but instead used his fingers. Two other events involved specific actions that led to the overexposures. In one event, the worker failed to use a remote handling tool. In the other event, the worker used a vial shield without a shielded top. For 70 percent of the events, workers were involved in routine dispensing of radiopharmaceuticals and received exposures in excess of regulatory limits. These events were due mostly to generally inadequate work procedures.

Table 6. Comparison of Dose Dosimetry Reading with Calculated Dose for Events Where the Difference Was Greater than 20 Percent

Exposure	Dose reported by dosimetry (rem)	Dose determined from calculation (rem)
1	34	151
2	5.8	510 - 1120
3	Reported as low (no value)	700

In three of the reported events, the dose calculated for the extremity was substantially higher than the dosimetry reading. In one event, the calculated dose was approximately 200 times higher.

Table 7. Common Causal Factors Related to the Occurrence of the Events

Causal factor	Number of events = Yes	Number of events = No
Was extremity dosimetry used?	8	2
Was extremity dosimetry monitored at a sufficient frequency?	2	8
Was overexposure event due to specific incident?	2	8
Was worker receiving exposures experienced?	6	4

Extremity dosimetry was reported to be used in most of the events (8 of 10), but the dosimetry was reported to be adequately monitored in only 20 percent of the events. As a result, most of the overexposure events (8 of 10) resulted from poor oversight of workers quarterly doses (i.e., the overexposure dose accumulated throughout the monitoring period rather than from specific incidents). For 40 percent of the events, the experience of the worker was cited as a contributing factor.

Analysis Of Lost And Stolen Data For Trend Identification,
Calendars Year 2001 - 2002

Summary

Based upon the analysis, we did not identify any trend or information indicating that reported losses and thefts of licensed material over the last two years represent a substantive safety risk. In addition, there was no identifiable pattern to support the idea that individuals are stealing portable moisture density gauges for malevolent use.

Discussion

An analysis of data from the NRC's Nuclear Materials Event Database (NMED) for the calendar years 2001 and 2002 was conducted to identify a pre-9/11 baseline and post-9/11 trends for lost and stolen moisture density gauges and radiographic cameras. Each moisture density gauge contains approximately 8 millicuries (0.3 GBq) of Cesium-137 and 40 millicuries (1.48 GBq) of Americium-241/Beryllium in the form of sealed sources. With the exception of radiographic cameras which contain high activity sources, the remaining percentage of stolen sources (~20%) have an activity in the microcurie to low millicurie range and are typically contained in gauging/measuring devices, and ionization devices used for static elimination. Due to the low activity range, the stolen sources are not likely to be candidates for malevolent use.

Graph (next page): Stolen versus lost moisture density gauges, CY 2001-2002

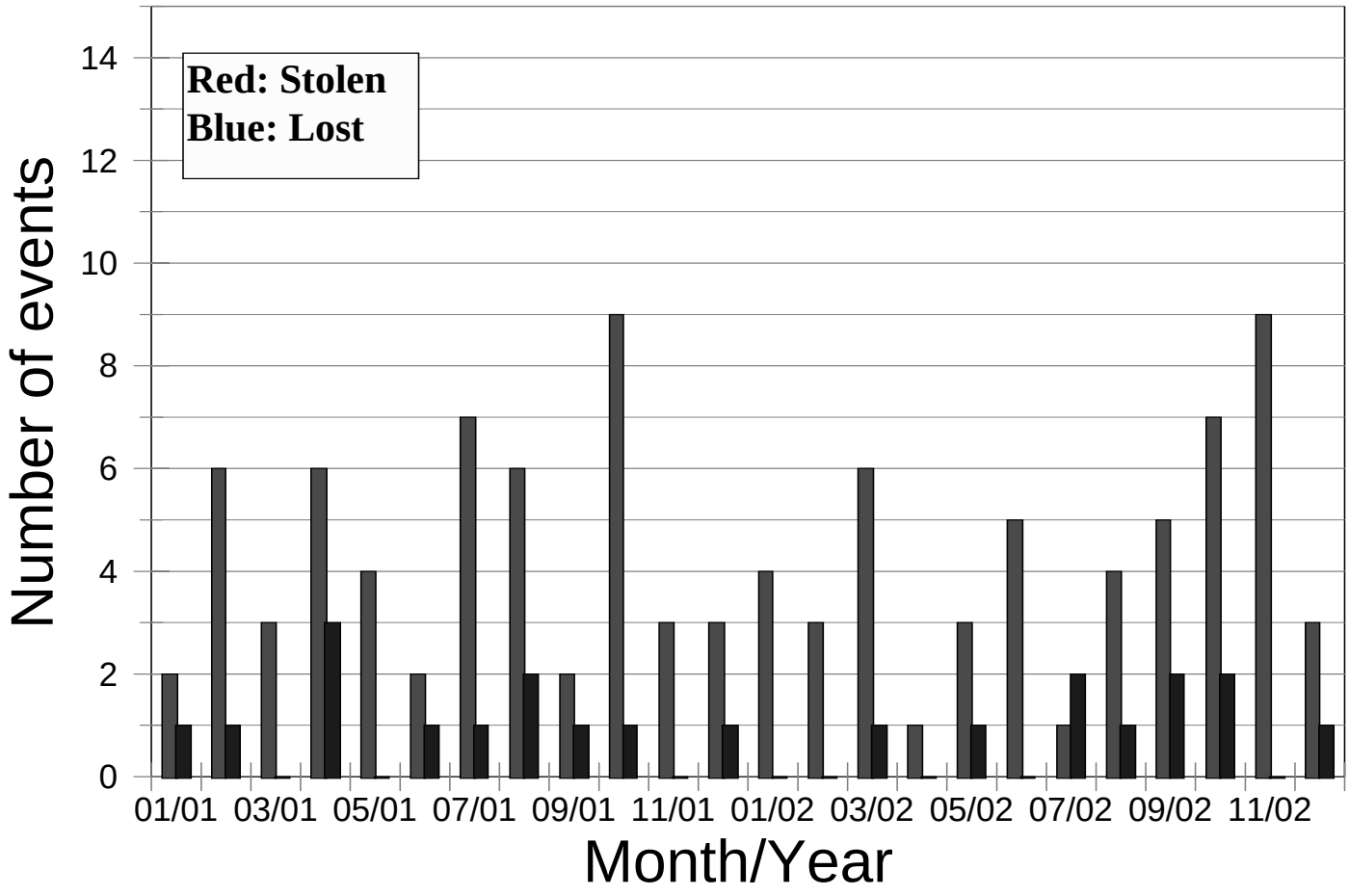
One hundred and four events involving stolen moisture density gauges occurred during CY 01-02 as compared to 22 events involving loss of a moisture density gauge for the same time period.

An average of 4.5 gauges were stolen per month during 2001. The same average of 4.5 stolen gauges per month continued during 2002.

An average of 1 gauge was lost per month during 2001. The same average of 1 lost gauge per month continued during 2002.

Conclusion: The trend for lost and stolen moisture density gauges remained constant between CY 2001 and 2002. There is no evidence of potential accumulation of large number of these types of sources.

Stolen vs Lost Moisture Density Gauges
CY 2001 - 2002



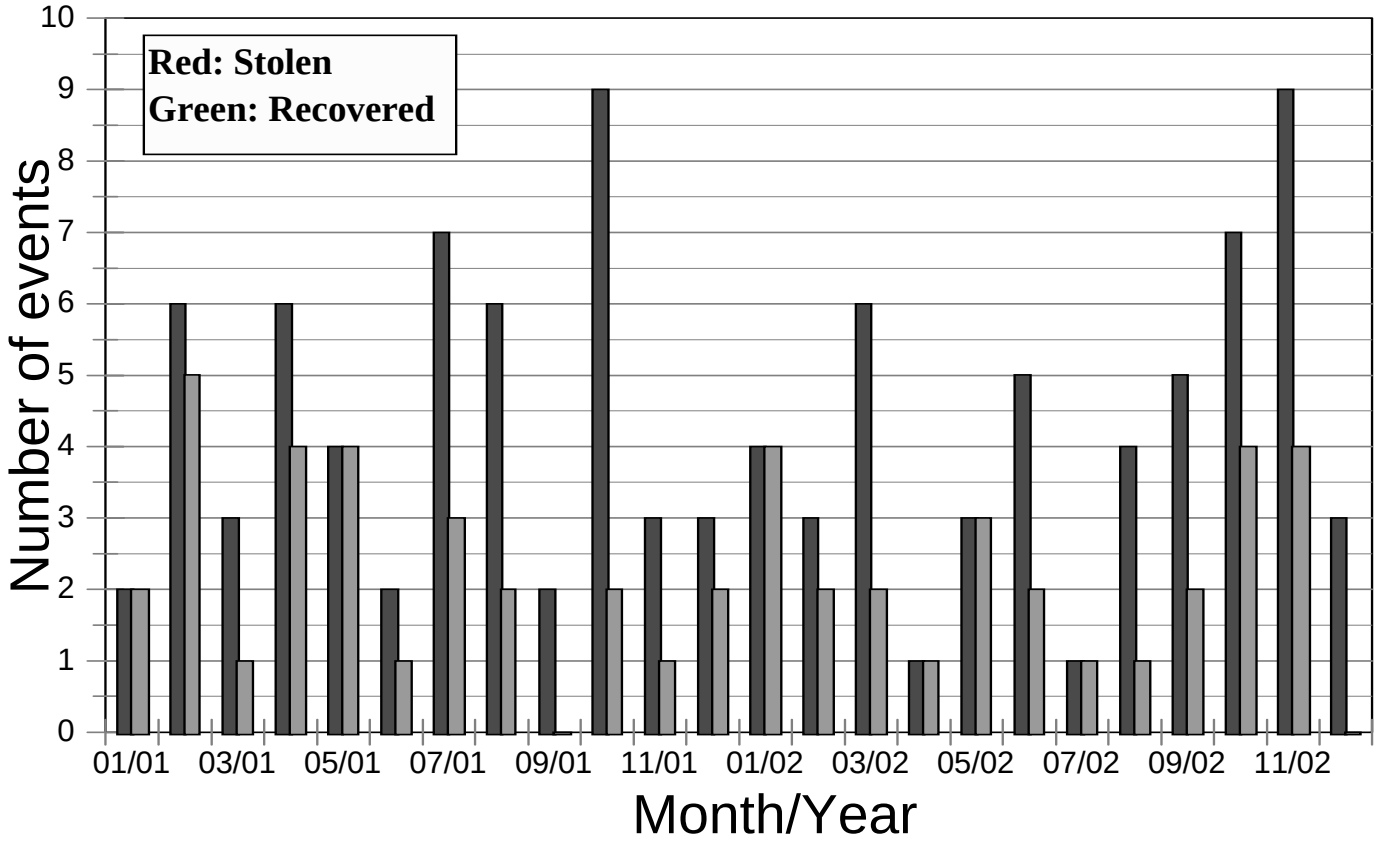
Graph (next page): Stolen versus recovered moisture density gauges, CY 2001-2002

Fifty-three events involving stolen moisture density gauges occurred in 2001. Of these 53 events, 27 resulted in the recovery of the gauges (51% recovery rate).

Fifty-one events involving stolen moisture density gauges occurred in 2002. Of these 51 events, 26 resulted in the recovery of the gauges (51% recovery rate).

Conclusion: At this moment, there is not an identifiable pattern (increasing number of events post 9/11) to support the idea that individuals are stealing moisture density gauges for malevolent use.

Stolen vs Recovered Moisture Density Gauges, CY 2001 - 2002



Graph (next page): Moisture density gauges stolen along with vehicle versus recovery, CY 01-02

Ten events involving moisture density gauges stolen along with a vehicle occurred in 2001. Of these 10 events, 9 resulted in the recovery of the gauge (90% recovery rate).

Five events involving moisture density gauges stolen along with a vehicle occurred in 2002. Of these 5 events, 5 resulted in the recovery of the gauge (100% recovery rate).

Conclusion: There is clear indication that individuals stealing a vehicle containing a moisture density gauge are likely to quickly dispose of the gauge (by leaving it by the side of a road or in a garbage container), since stealing the gauge is not their primary motive (no malevolent intention).

Moisture Density Gauges Stolen Along With Vehicle vs. Recovery, CY 01 - 02

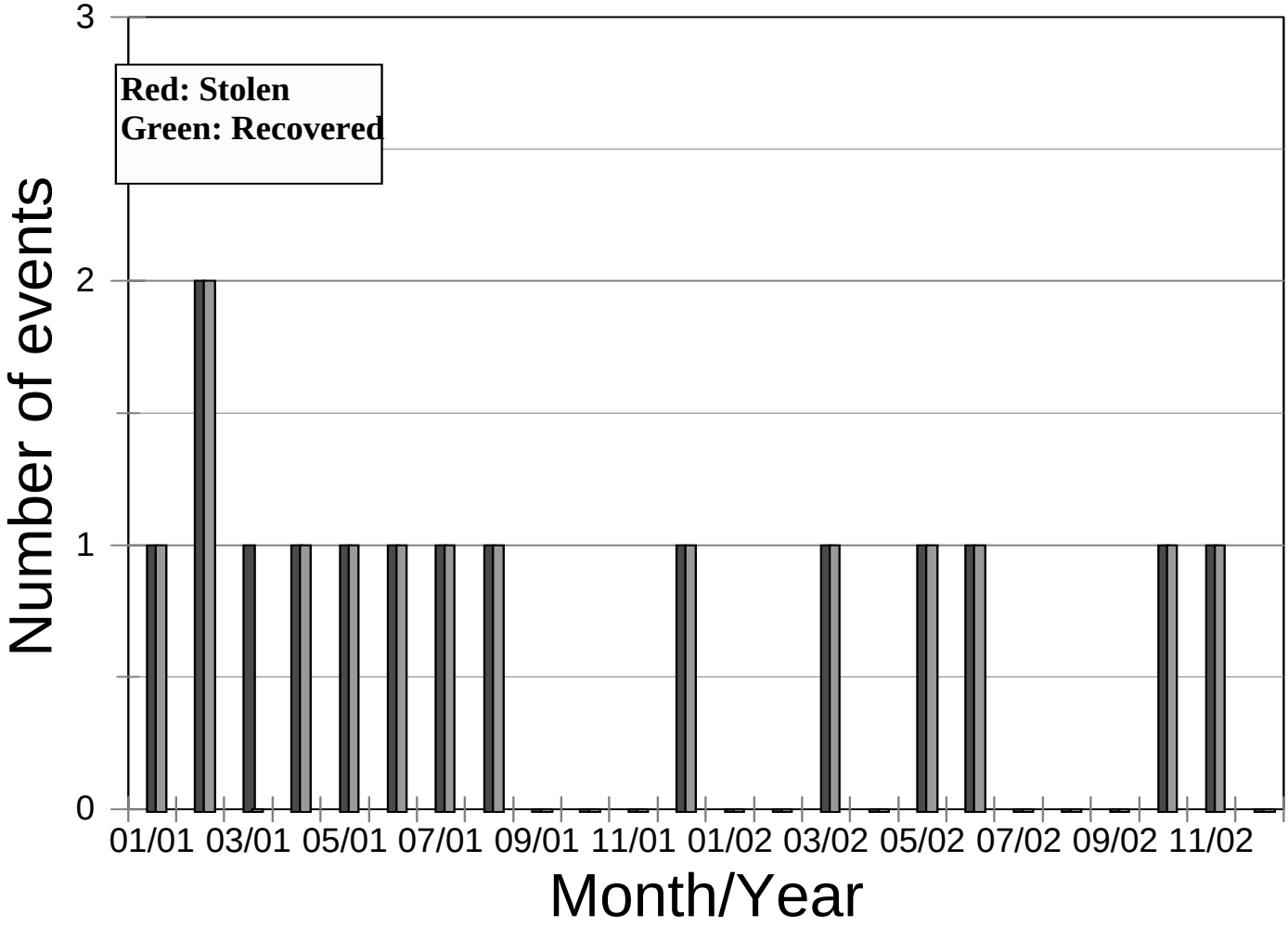


Table 1. Statistics on Stolen Gauges Reported to the NMED, CY 01-02

State	Number of stolen gauges** [A]	Number of recovered gauges** [B]	Recovery rate (%) [B/A]	Number of licensees*	Number of gauges* [C]	Gauges stolen rate (%) [A/C]
Oklahoma	4	3	75	63	130	3.1
Arizona	6	3	50	101	300	2.0
Washington	5	0	0	100	250	2.0
Louisiana	3	1	33	30-40	150-200	1.7
Tennessee	4	3	75	94	267	1.5
Puerto Rico	2	2	100	28	147	1.4
Michigan	5	2	40	125	400	1.3
New Jersey	2	1	50	61	100-200	1.3
California	15	6	40	569	1400	1.1
West Virginia	2	1	50	47	205	1.0
Idaho	1	1	100	48	100	1.0
Texas	15	7	47	348	2000	0.8
North Carolina	2	1	50	100	250	0.8
Indiana	1	0	0	40	120	0.8
Georgia	3	1	33	94	410	0.7
Mississippi	1	1	100	75	150	0.7
Alabama	2	1	50	120	300	0.6
Pennsylvania	2	1	50	143	300-400	0.6
South Carolina	1	0	0	70	200	0.5
Utah	1	0	0	80	200	0.5
Wisconsin	1	1	100	100	200	0.5
Florida	8	5	63	300	1800	0.4
Colorado	4	3	75	130	500-1500	0.4
Oregon	1	1	100	132	285	0.4
Illinois	2	0	0	250	1000	0.2
Nevada	1	0	0	140	500	0.2
Ohio	2	1	50	105	1082	0.2
Kentucky	1	1	100	200	600	0.2

State	Number of stolen gauges** [A]	Number of recovered gauges** [B]	Recovery rate (%) [B/A]	Number of licensees*	Number of gauges* [C]	Gauges stolen rate (%) [A/C]
Maryland	1	1	100	100	500	0.2
New Mexico	1	0	0	n/a	n/a	----
Arkansas	0	----	----	80	250	----
Maine	0	---	----	40	75	----
New York	1	1	100	250	n/a	----
North Dakota	0	----	----	20	50	----

***** Most of these numbers are estimates based on a survey made to the Agreement States in October 2002, and from information collected from the NRC regions.

** The numbers of stolen and recovered gauges are obtained based on information reported to NMED.

Conclusions: Most States with high numbers of stolen moisture density gauges, including high numbers of unrecovered gauges, have a large population of gauges (opportunity for theft) and have recovery rates near the average (~53%) of all the data presented in the above Table. This indicates the absence of targeting for malevolent use.

Graph (next page): Lost versus recovered moisture density gauges, CY 2001-2002

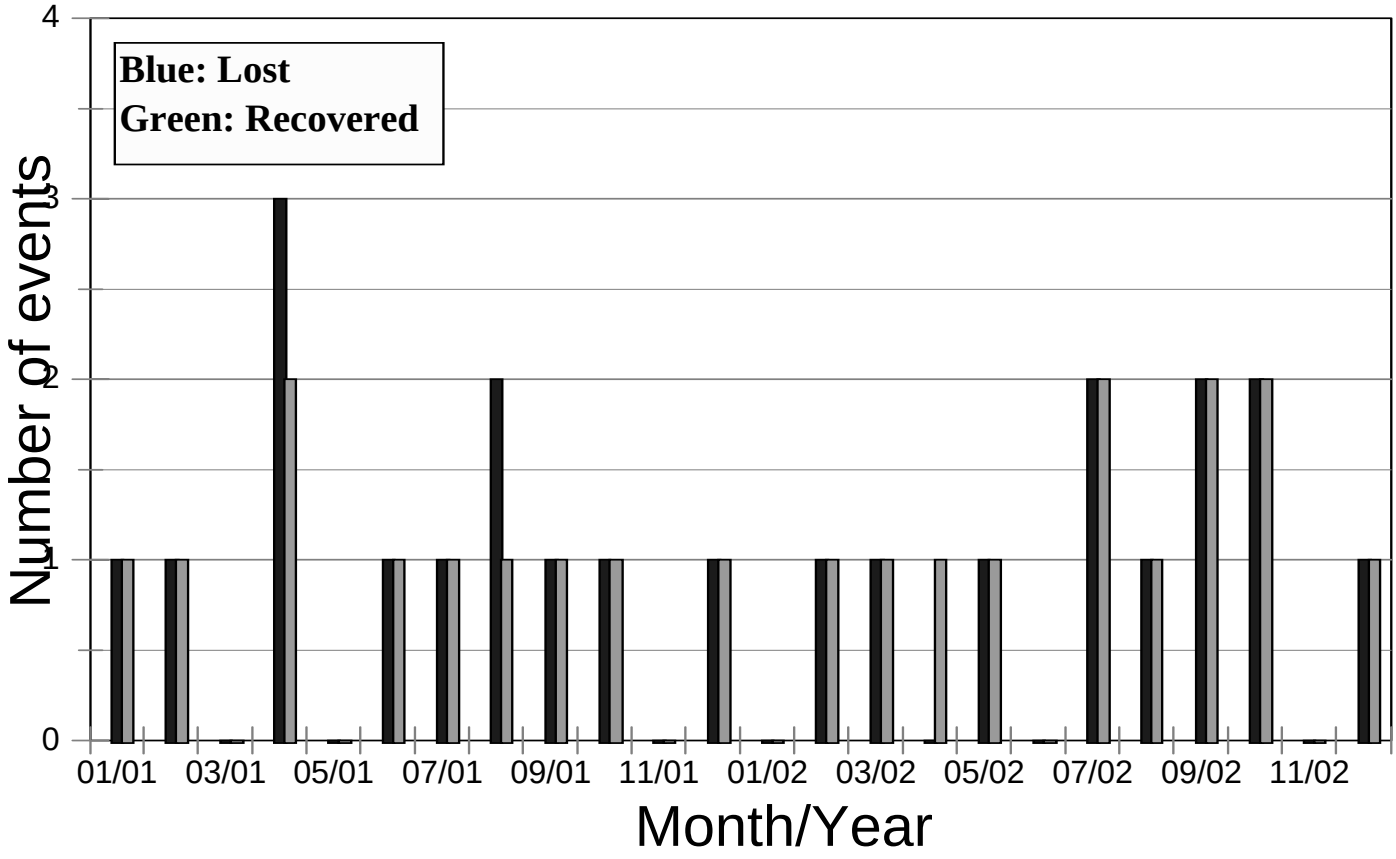
These types of events typically result when the licensee fails to block and brace and the gauge falls from the vehicle when the tailgate opens.

Twelve events involving loss of a moisture density gauge occurred in 2001. Of these 12 events, 10 resulted in the recovery of the gauges (83% recovery rate).

Ten events involving loss of a moisture density gauge occurred in 2002. Moisture density gauges were recovered in all ten events (100% recovery rate). Also an additional event resulted in the recovery of a missing gauge manufactured prior to 1975, for a total of 11 events in which gauges were recovered in the year 2002.

Conclusion: Given the current recovery trend, lost moisture density gauges do not represent a credible source for malevolent use material.

Lost vs Recovered Moisture Density Gauges, CY 2001 - 2002



Graph (next page): Lost and stolen radiographic cameras versus recovery, CY 2001-2002

Two events involving stolen radiographic cameras occurred in 2001. Of these 2 events, 1 resulted in the recovery of the camera.

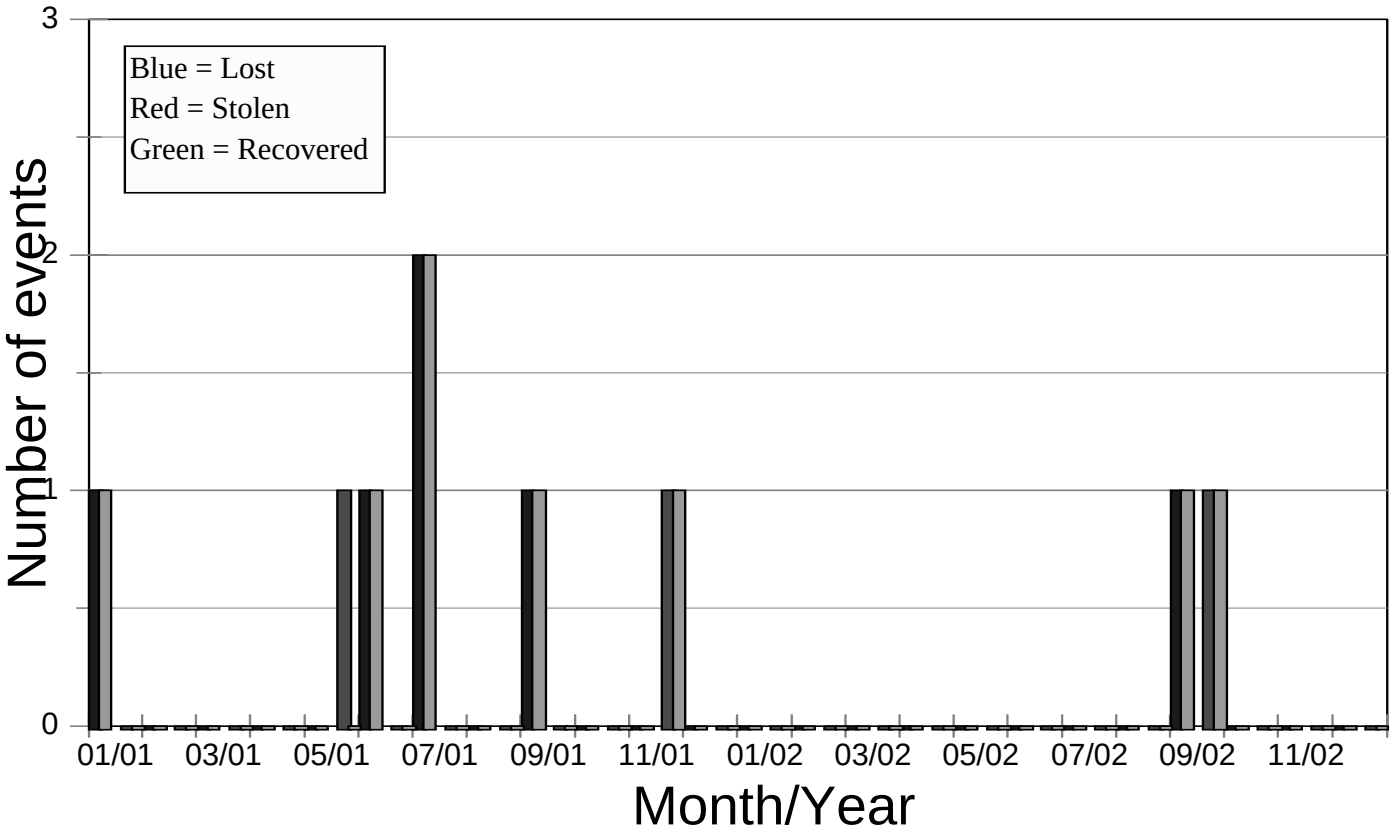
One event involving a stolen radiographic cameras occurred in 2002. The radiographic camera from this event was recovered.

Five events involving lost radiographic cameras occurred in 2001. Of these 5 events, 5 resulted in the recovery of the cameras (100% recovery rate).

One event involving a lost radiographic camera occurred in 2002. The radiographic camera from this event was recovered (100% recovery rate).

Conclusion: There is no indication that radiographic cameras are being stolen for malevolent use.

Lost and stolen radiographic cameras versus recovery, CY 2001 - 2002



Distribution per State of stolen vs recovered stolen moisture density gauges
CY 2001-2002

State, City	Stolen	Recovered	Remarks
Alabama, Scottsboro	1	0	Other items stolen
Alabama, Auburn	1	1	
Arkansas, Little Rock	1	1	
Arizona, Tempe	2	2	Vehicle also stolen
Arizona, Tempe	1	1	
Arizona, Yuma	1	0	
Arizona, Chandler	1	0	
Arizona, Chandler	1	0	Vehicle also stolen
California, Fresno	1	1	
California, San Diego	2	0	
California, Hemet	1	1	
California, Chino Hills	1	0	
California, Redlands	1	0	
California, Long Beach	2	1	
California, Los Angeles	1	0	
California. Diamond Bar	1	0	
California, Modesto	1	0	
California, Escondido	1	1	
California, Stockton	1	0	
California, Gardena	1	1	
California, Orange	1	1	
Colorado, Denver	2	1	
Colorado, Brighton	1	1	
Colorado, Thornton	1	1	
Florida, Key Biscayne	1	0	
Florida, Kissimmee	1	1	
Florida, Valrico	1	1	
Florida, Miami	3	1	Other items stolen in one of the events
Florida, Miami	1	1	Vehicle also stolen
Florida, Fort Lauderdale	1	1	Vehicle also stolen
Georgia, Atlanta	1	0	
Georgia, Loganville	1	0	Other items stolen
Georgia, Duluth	1	1	Vehicle also stolen
Idaho, Lava Hot Springs	1	1	
Illinois, Chicago	2	0	
Indiana, Griffith	1	0	
Kentucky, Park Hills	1	1	
Louisiana, Shreveport	1	1	
Louisiana, Fort Polk	1	0	Other items stolen
Louisiana, Metairie	1	0	
Maryland, Columbia	1	1	
Michigan, Temperance	1	1	Other items stolen
Michigan, Ferndale	1	0	
Michigan, Farmington Hills	2	0	
Michigan, Grand Rapids	1	1	

State, City	Stolen	Recovered	Remarks
Mississippi, Jackson	1	1	
Missouri, Independence	1	1	
Missouri, Joplin	1	1	
Missouri, House Springs	1	1	Vehicle also stolen
Nevada, Las Vegas	1	0	
New Jersey, Jersey City	1	1	
New Jersey, Phillipsburg	1	0	
New Mexico, Ponderosa	1	0	
New York, Queens	1	1	Vehicle also stolen
North Carolina, Winston-Salem	2	1	
Ohio, Columbus	1	1	
Ohio, Toledo	1	0	
Oregon, Portland	1	1	Vehicle also stolen
Oklahoma, Oklahoma City	1	0	
Oklahoma, Del City	1	1	
Oklahoma, Fairfax	1	1	
Oklahoma, Tulsa	1	1	
Pennsylvania, Philadelphia	2	1	
Puerto Rico, San Juan	1	1	Vehicle also stolen
Puerto Rico, Trujillo Alto	1	1	
South Carolina, North Aux. Field	1	0	
Texas, Cross Roads	1	0	
Texas, Rockwall	1	0	
Texas, San Antonio	1	1	
Texas, Austin	1	1	
Texas, Houston	2	0	Other items stolen in both of the events
Texas, Houston	3	3	Vehicle also stolen
Texas, Dallas	3	1	Other items stolen in two of the events
Texas, Garland	1	0	
Texas, Harlingen	1	1	
Texas, Katy	1	0	
Tennessee, Chattanooga	1	1	
Tennessee, Memphis	1	0	
Tennessee, Old Hickory	1	1	
Tennessee, Corryton	1	1	Vehicle also stolen
Utah, West Valley City	1	0	
Washington, Centralia	1	0	
Washington, Seattle	1	0	
Washington, Redmond	1	0	
Washington, Issaquah	1	0	
Washington, Spokane	1	0	
West Virginia, Bridgeport	1	0	
West Virginia, Whitesville	1	1	Vehicle also stolen
Wisconsin, Baraboo	1	1	

Summary of Severity Level I and II Enforcement Actions for FY 2001 and FY 2002

Severity I:

Southeast Missouri State University
Cape Girardeau, Missouri
EA 00-201
Docket No. 030-33508

On September 13, 2001, a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $11,000 was issued for a Severity Level I problem involving the failure to: (1) control activities to limit doses in accordance with requirements, (2) make necessary surveys to determine radiological hazards, and (3) possess only material authorized on the University's license.

Severity II:

Advanced Medical Imaging and Nuclear Services
Easton, Pennsylvania
EA 02-072
Docket No. 030-35594

On October 22, 2002, a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $43,200 was issued for a Severity Level II problem involving willfully using byproduct material without an Authorized User, failing to appoint a Radiation Safety Officer, and creating incomplete and inaccurate records. Although the normal civil penalty assessment process would have resulted in a base civil penalty, the NRC exercised discretion in accordance with Section VIIA.3 of the Enforcement Policy and assessed a base civil penalty for each day the violation continued after the licensee's consultant raised the issue. Discretion was warranted base on the egregiousness of the violations, the level of management involved, the economic benefit of being in noncompliance, and the failure to take corrective action after the consultant's finding.

Bristol-Myers Squibb Radiopharmaceuticals, Inc.
Rio Piedras, Puerto Rico
EA 02-160
Docket No. 030-34187

On August 22, 2002, a Notice of Violation was issued for a Severity Level II problem involving the failure to control occupational dose (two operators received extremity overexposures) and the failure to perform adequate surveys to evaluate radiation exposure to the extremities.

Eastern Isotopes, Inc.
Charlotte, North Carolina
EA 02-097
Docket No. 030-32974

On July 30, 2002, a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $4,800 was issued for a Severity Level II violation involving an overexposure to a pharmacist in excess of NRC requirements. Although the civil penalty would have been fully mitigated based on the normal civil penalty assessment process, the NRC exercised enforcement discretion in accordance with Section VII.A.1 of the Enforcement Policy and proposed a base civil penalty because the violation was assessed at Severity Level II and because it resulted in an overexposure.

J. L. Shepherd and Associates
San Fernando, California
EA 02-043
Docket Nos. 71-0122, 71-6280

On August 13, 2002, an Order Imposing Civil Monetary Penalty in the amount of $19,200 was issued. The action was based on a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $19,200 that was issued on June 11, 2002 for a Severity Level II problem involving the willful failure to comply with a Certificate of Compliance with regard to fabrication and shipment of packages. The licensee's July 10, 2002, response did not deny that the violations occurred as stated in the Notice, but requested mitigation of the penalty. After considering the licensee's response, the NRC concluded that the violations occurred as stated and that there was not an adequate basis for mitigating the civil penalty.

South Pittsburgh Cancer Center
Pittsburgh, Pennsylvania
EA 01-132
Docket No. 030-34832

On August 22, 2001, a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $8800 was issued for a Severity Level II violation involving the deliberate possession of depleted uranium (in the form of bricks used for shielding within two linear accelerators) without authorization in a specific license issued by the NRC.

Significant Issues and Incident Investigations

PERMAGRAIN PRODUCTS, INC.

1.0 SITE IDENTIFICATION

Location: Karthaus, PA
License No.: 37-17860-01
Docket No.: 030-13573
License Status: Active

2.0 SITE STATUS SUMMARY

The Facility is located in the Quehanna Wild Area about 45 miles northwest of State College, PA. License No. 37-17860-01 is issued to Permagrain Products, Inc. (PPI) for the operation of a Cobalt-60 irradiator.

While PPI is licensed to possess and use up to 2,000,000 curies of cobalt-60 to irradiate materials in an underwater irradiator in northcentral Pennsylvania, less than 100,000 curies are actually at the facility. The irradiator was used to cross-link a plastic monomer in wood to make a durable flooring product used in commercial and residential applications. Under NRC regulations in 10 CFR 30.35, PPI was required to have financial assurance in the amount of $75,000. PPI had complied with the requirement by providing NRC with a $75,000 letter of credit.

3.0 MAJOR TECHNICAL OR REGULATORY ISSUES

In response to deteriorating product demand and limits imposed on its operational line of credit, PPI declared bankruptcy in the United State Bankruptcy Court, Eastern District of Pennsylvania, on December 17, 2002. With the bankruptcy filing, the licensee had no resources to maintain or secure the facility or to dispose of the sources and decommission the facility. Region I called in the letter of credit on December 12, 2002 and coordinated with the Commonwealth of Pennsylvania to secure and maintain the facility effective the day of the bankruptcy filing. On February 14, 2003, in recognition of the Commonwealth's limited funds to continue security and maintenance at the site, Region I requested that U.S. Environmental Protection Agency (EPA) perform an emergency removal and disposal of the sources. EPA responded to the Region I letter on February 13 indicating that they were proceeding to gather information in support of implementing federal removal response activities at the site.

The sealed cobalt-60 sources possessed by PPI are old and of low specific activity. New sources are usually about 10,000 curies per source. All of the sources at PPI are less than 1000 curies and many are less than 100 curies. Therefore, they have no economic value and probably will be disposed as radioactive waste.

Current estimates are that removal and disposal of the sources will cost between $1.5 million and $1.9 million, amounts considerably in excess of the financial assurance provided by the licensee.

A soon-to-be-final rulemaking will require, among other things, that financial assurance for irradiators be based on an actual cost estimate rather than a fixed amount specified in the regulations. As long as the staff assures that the cost estimates for irradiators are thorough and complete (including, for example, facility security and maintenance costs) that rulemaking should prevent similar problems at other irradiators. However, the Permagrain case has highlighted the potential risk of financial assurance instruments which may underestimate the actual cost of decommissioning a facility.

FANSTEEL INC.

1.0 SITE IDENTIFICATION

Location:	Muskogee, OK
License No.:	SMB-911
Docket No.:	040-07580
License Status:	Expired (possession only)

2.0 SITE STATUS SUMMARY

From 1958 until 1989, Fansteel Speciality Metals operated a process to recover tantalum, niobium, scandium, and other metals of commercial value from ores and previous process waste residues. Fansteel decontaminated approximately 35 acres of the 110-acre Muskogee facility designated as the "Northwest Property," and the NRC released this area for unrestricted use. Fansteel has an NRC license dated March 25, 1997, to complete the processing of ore residues, calcium fluoride residues, and wastewater treatment residues containing uranium and thorium, in various site impoundments. In November, 2001, Fansteel notified NRC that it had ceased operating the facility. The current license expired in September, 2002; the renewal application was denied because Fansteel wrote off the cost of the facility in its bankruptcy and did not provide sufficient financial assurance.

On January 15, 2002, Fansteel and its U.S. subsidiaries filed for voluntary bankruptcy (Chapter 11) in the U.S. Bankruptcy Court for the District of Delaware; one subsidiary in Mexico and one in Barbados were not included in this action. On June 25, 2002, Fansteel submitted an assessment of financial assurance (FA) in accordance with its license. The letter provided a cost estimate and stated it could not obtain the $57 million in financial assurance -- the cost estimate to decommission for unrestricted use filed with the bankruptcy court -- and asked NRC to defer further consideration of FA until December 22, 2002.

NRC engaged its financial assurance review contractor, ICF, to evaluate the Fansteel site and develop cost estimates for decommissioning for unrestricted use and for restricted use, as defined in Subpart E of 10 CFR 20. ICF provided a report on November 15, 2002 that showed estimated decommissioning costs from $105 - $230 million; the differences are in disposal costs of $5 - $17 per cubic foot.

Fansteel submitted its decommissioning plan (DP) on January 16, 2003. In this DP, Fansteel proposed an industrial land use scenario with the ground water pathway turned off. The estimated cost is given as $26 million (plus $14 million for ground water and chemical remediation for Oklahoma Dept. of Environment Quality (ODEQ); this is a significant reduction from the $57 million estimate in the bankruptcy and the June 25 letter to NRC regarding financial assurance.

Staff has met several times with Fansteel to develop a plan for funding remediation of the Muskogee site. Fansteel has not presented a plan acceptable to the NRC staff.

3.0 MAJOR TECHNICAL OR REGULATORY ISSUES

Fansteel has provided a total of about $4.5 million in financial assurance. The previous Fansteel estimate for decommissioning, by deposition to the Bankruptcy Court, is $57 million for off-site disposal of all wastes greater than 10 pCi/g total rad, a license condition limit. The revised estimate of $26 million is based on dose criteria of 10 CFR 20.1402 using an industrial land use scenario with no ground water pathway. It estimates an additional $14 million for commitments to ODEQ, primarily ground water remediation. Because it is in a bankruptcy proceeding, Fansteel states it is not able to provide the additional assurance. The DP, except portions of Chapter 15 - - financial assurance -- was received in January 16. The letter of transmittal stated that the FA portion would be submitted by February 14. Staff met with Fansteel and various counsel on December 18, February 5, and February 21 at NRC HQ. In addition, there have been several other meetings and phone calls among the relevant parties. As of 26 March, 2003, Fansteel has not provided a plan to emerge from bankruptcy and fund remediation of the Muskogee site that is acceptable to the NRC staff.

Preliminary review of the DP indicates there are short comings in the characterization, the level of detail about planned remedial activities, the final status survey, and, consequently, the cost estimate. The staff is writing a letter rejecting the DP and instructing Fansteel to provide a schedule for resubmittal. Without satisfactory site characterization and plan of activities, the final cost to remediate cannot be reasonably estimated.

Contaminants at the site include natural uranium and decay products, and natural thorium and decay products. Chemical contamination in the form of metals including tantulum, niobium, chromium, antimony, tin, barium, arsenic; ammonia fluoride and methyl isobutyl ketone are also present.

Groundwater contamination is non-uniformly distributed at the Fansteel site. Measurements taken in the shallow groundwater zone during the Spring of 1993 ranged from 19 pCi/l to 2600 pCi/l gross alpha and from 59 to 1300 pCi/l gross beta. A Spring 1993, sampling and analysis of three deep (bedrock) groundwater wells in the process area, and one in the NW property, detected no concentrations above background levels. These wells were closed shortly thereafter. Fansteel estimates $14 million to remediate the ground water in the shallow aquifer. Soil contamination is non-uniformly distributed at the Fansteel site. Gross alpha concentrations range from 21 to 360 pCi/g; uranium concentrations range from 6.2 to 93 pCi/g; and thorium concentrations range from 7.2 to 51 pCi/g. The depth of contamination ranges from the ground surface to 7.9 m (26 ft) below, with the majority concentrated within the top 0.76 m (2.5 ft) of soil, but there is significant contamination deeper in the vicinity of the chemical processing buildings and ponds 2 and 3.

Preliminary radioactivity surveys indicate that surfaces and equipment in the following buildings are contaminated: Chemical A, Chemical C, Thermite, Sodium Reduction, and Research & Development Lab.

Fansteel estimates that the volume of contaminated soil and other material for which metal recovery operations are feasible and that must be transported off-site is 16,810 m^3 (594,000 ft^3). "Offsite" is defined as any other area and may include areas currently owned by Fansteel and located adjacent to the Eastern Property Area.

There is public interest about the decommissioning of this site. There are two primary parties: the State of Oklahoma and the Cherokee Nation. The State Office of the Attorney General has a representative participate in the meetings with Fansteel. ODEQ is also reviewing the DP. The Nation is interested because the Fansteel property is within its area of influence in eastern Oklahoma.

SAFETY LIGHT CORPORATION

1.0 SITE IDENTIFICATION

Location:	Bloomsburg, PA
License No.:	37-00030-02
Docket No.:	030-05980
License Status:	Active

2.0 SITE STATUS SUMMARY

The Safety Light Corporation (SLC) facility is located about five miles east of Bloomsburg, Pennsylvania. SLC is licensed (37-00030-02) to perform site characterization and decommissioning activities. The SLC site is contaminated from manufacturing operations of self-luminous watch and instrument dials and other items involving Ra-226, Cs-137, Sr-90, and Am-241. The site is approximately 10 acres in size and contains about 16 buildings. Work with radioactive materials (Ra-226) began at the site in 1948. License 37-00030-08 is still active for H-3 exit sign work utilizing a full time staff of about 20 individuals.

Radioactive waste was disposed on site in three primary locations: silos, lagoons, and a waste dump. In the fall of 1999, the licensee began removal of the radioactive material from the two underground silos. This radioactive material is currently stored on site in 55 gallon drums and B-25 boxes awaiting further processing/sorting prior to disposal.

NRC staff continue to coordinate activities with Environmental Protection Agency (EPA) and Pennsylvania Department of Environmental Protection (PADEP) regarding remediation of the SLC site. An EPA Administrative Order of Consent (AOC) with SLC for the sorting, characterization, and re-packaging of the drums of mixed waste and radioactive waste that were removed from the onsite silos, became effective on February 3, 2003. On August 15, 2002, NRC amended the SLC license to approve the work plan for this activity, as did PADEP. A separate EPA Order will be prepared for disposal of the waste. If disposal costs exceed the licensee's decommissioning funds, EPA could propose a unilateral Order and use EPA emergency removal funds.

With renewal of License No. 37-00030-02 in December 1994 for a five year period, SLC entered into a settlement agreement with the NRC to place funds into a trust account and contributed $348,000 over five years. USR Industries, a previous responsible party, contributed an additional $48,000. The licensee also received insurance settlements in the amounts of $1.3 million and $500,000. These funds are for site maintenance and decommissioning. With the renewal of the license in December 1999, SLC is required to contribute to the trust account a total of $492,000 over the five year term of the renewal.

3.0 MAJOR TECHNICAL OR REGULATORY ISSUES

A 1995 site characterization identified primary soil contaminates as Ra-226 and Cs-137 with small amounts of Am-241. The onsite ground water is also contaminated with H-3, Sr-90, and Cs-137. The 1998 site decommissioning and decontamination (D&D) report submitted to the NRC called for a "task by task" approach to decommissioning because of limited funding availability. Estimated decommissioning costs were approximately $15 million, excluding H-3 waste.

A more recent decommissioning cost estimate (DCE), submitted in 2000, estimated the decommissioning costs at $29 million, including the H-3 waste. Review by NRC found the DCE significantly underestimated the costs for soil removal. Staff estimates DCE for unrestricted release to be between $94-$120 million.

Lack of financial assurance remains the key issue; effective remediation work cannot be performed because of limited funding. The licensee is proposing that the remaining funds be used to characterize, re-package and dispose of waste that was removed from underground silos. Other decommissioning tasks have been outlined and estimated in the licensee Decommissioning Plan and DCEs that were submitted in 2001.

In December 2001, NRC requested that EPA Region 3 conduct a preliminary site assessment for the purpose of scoring the site for inclusion on the National Priorities List and possible remediation under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). EPA has completed the scoring package. When the package is sent to EPA Headquarters for review, a copy will be shared with NRC.

NRC staff submitted a claim in December 2001 against USR Industries (de jure licenses of NRC for the Bloomsburg facility) before the US Bankruptcy Court for the Southern District of Texas. However, in April and June 2002, the bankruptcy claims were dismissed by the Court, because the debtor failed to prosecute.

Coordination activities continue between NRC, EPA, and PADEP staffs to develop a path forward for this site. The last joint telephone conference was held on February 7, 2003.

SCHLUMBERGER TECHNOLOGY CORPORATION

1.0 SITE IDENTIFICATION

Location:	Sugar Land, TX
License No.:	42-00090-03
Docket No.:	030-06388
License Status:	Active

2.0 SITE STATUS SUMMARY

A Region IV well-logging licensee, Schlumberger Technology Corporation (STC), notified the NRC Operations Center, on May 23, 2002, of an incident involving the loss of control of a radiation source and possible unplanned exposures of 31 oil rig workers. The source was a cesium-137 well-logging source of 44 gigabequerel (1.2 Ci) nominal activity, and the incident occurred on an oil rig in Montana during drilling operations. Region IV conducted a special inspection on May 25-26, 2002, to determine the facts of the event, interview the workers involved, and calculate preliminary dose estimates for the exposed workers.

The licensee submitted its report of the event to the NRC on June 26, 2002. In its report, the licensee estimated that the highest dose to any worker, based on time-and-motion reconstructions of the event and some conservative assumptions, was 0.064 Sv (6.4 rem). To support its bounding dose calculations, the licensee had blood tests performed on 10 of the workers involved in the event. These tests were routine blood counts done at a local hospital, and were intended to rule out high radiation exposures by showing that there were no abnormally low blood counts. The workers were advised to forward their test results to the Radiation Emergency Assistance Center/Training Site (REAC/TS) for interpretation, and six of the 10 workers who took the tests sent their blood test results.

REAC/TS did not find any indications of radiation dose based on its examination of the blood sample results for these workers. REAC/TS did recommended that one of the workers (Worker D) be advised that a cytogenetic test be done. Since REAC/TS currently does not provide cytogenetic testing, the Armed Forces Radiobiology Research Institute (AFRRI) in Bethesda conducted this test. NRC was informed of the cytogenetic test results on August 30, 2002. The results showed a radiation dose on the order of 2 Gy (200 rad) whole body equivalent. The radiation dose assessment completed by the NRC for this worker indicated that the most likely dose was less than 1 cGy (1 rad).

NRC upgraded the inspection effort to an Augmented Inspection Team (AIT) because of the significant discrepancies between the estimated radiation doses and the cytogenetic test results, and because of the potential for a high radiation dose to a member of the public.

NRC decided to repeat the cytogenetic tests for this individual and six other workers who were exposed. In addition, NRC decided to split the blood samples three ways and send these split samples to three different laboratories, one being AFRRI, and the others being the National Radiological protection Board (NRPB) in England, and the Institute for Radiation Protection (IRD) in Brazil.

The results of this second round of testing, as reported by NRPB, were negative, that is, showed zero radiation dose for all but Worker D who had the AFRRI reported dose of 2 Gy. The results from NRPB for Worker D showed a slightly elevated chromosome dicentric frequency, which corresponded to an equivalent whole-body dose in the range of 0-14 cGy (0-14 rad), with a mean of 4 cGy (4 rad). The samples sent to IRD did not pass the Brazilian customs and were not analyzed.

The cytogenetic test results from AFRRI agreed with those of NRPB for all the workers and showed no radiation dose, except for Worker D for whom AFRRI estimated a dose of 1.3-1.5 Gy (130-140 rad). The cytogenetic test slides from NRPB for Worker D were sent to IRD in Brazil for evaluation, and slides from AFRRI's second test for Worker D were sent to IRD for evaluation. Also, the slides from AFRRI's initial cytogenetic test for Worker D were sent to NRPB for evaluation.

Without discussing specifics of the cytogenetic results from the three labs, there appeared to be considerable disagreements in their results. To summarize.

- Results from IRD and NRPB are in agreement, and indicate very low to zero doses for all workers
- Results for AFRRI agreed with IRD and NRPB for all samples except for Worker D.
- Although NRPB and IRD both found very low to zero radiations doses for Worker D, AFRRI reported a radiation dose of 1 Gy (100 rad).
- Discussions between NRC and the three labs led to a probable cause for the disagreements, which involved an unusual characteristic for Worker D 's chromosomes, which resulted in some of Worker D's chromosomes, viewed under the microscope, to look like dicentrics, thus giving an erroneously high radiation dose estimate.

Based on NRC's radiation dose estimates, the most probable doses received by all of the exposed workers are in the range of 0-1 cSV (0-1 rem). Most of the radiation doses are estimated to be at or slightly above NRC's dose limit for members of the public of 0.1 cSv (0.1 rem) per year.

3.0 MAJOR TECHNICAL OR REGULATORY ISSUES

AFRRI's cytogenetic facility is the only lab in the United States that is currently available to the NRC for cytogenetic testing on an ongoing and on-demand basis for use in radiation dose assessments. Although AFRRI has been of assistance in the past, and may be able to assist NRC in the future, there are several significant considerations including:

- The turn-around time for the results, the time from delivery of a blood sample to the lab to receipt of the results of the cytogenetic test is currently at least 3 weeks per sample.

- It is unsatisfactory to have only one lab engaged in this activity, because this leaves no means of verifying the validity of the one lab's methods and results by comparison with the results of other labs on a routine, controlled, and ongoing basis, which is normal practice for any activity involving accurate measurements.

With only one laboratory in the United States currently available, this significantly limits the capability to reliably perform cytogenetic blood testing.

INEEL/EXT-02-00358 (FY 2002 QTR 4)

January 2003

Nuclear Materials Events Database (NMED) Quarterly Report

Fourth Quarter Fiscal Year 2002

Samuel L. Pettijohn, NRC

Stephen B. Conroy, INEEL

Attachment 6

INEEL/EXT-02-00358 (FY 2002 QTR 4)

Nuclear Materials Events Database (NMED) Quarterly Report

Fourth Quarter Fiscal Year 2002

Samuel L. Pettijohn, NRC

Stephen B. Conroy, INEEL

Published January 2003
http://nmed.inel.gov

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Prepared for the
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

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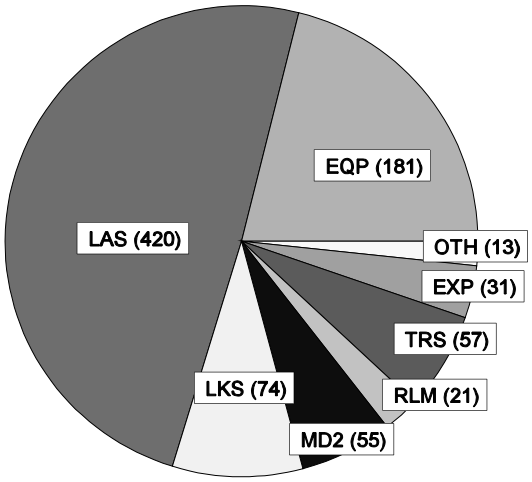
ABSTRACT

This quarterly report presents information on trending and analysis of incidents/accidents (events) reported to the Nuclear Regulatory Commission (NRC) that involve radioactive materials. The events are reported by NRC licensees, Agreement States, and non-licensees, and are recorded in the NRC's Nuclear Materials Events Database (NMED). The reported events are classified into nine categories and "Other." The categories are based on event reporting requirements defined in Title 10 of the Code of Federal Regulations. The categories are (1) Medical Events, (2) Radiation Overexposures, (3) Release of Licensed Material or Contamination, (4) Loss of Control of Material, (5) Leaking Sealed Sources, (6) Equipment Problems, (7) Transportation, (8) Fuel Cycle Facility Events, and (9) Non-Power Reactor Events. The scope of the NMED quarterly report is limited to a discussion and evaluation of categories (1) through (7) and "Other." Events involving fuel cycle facilities and non-power reactors are excluded from this report due to the significant difference in operation of these facilities compared to the operation of other facilities licensed by NRC and Agreement States to use by-product, source, and special nuclear material. Data on trending and analysis of reported events are presented by cause, reporting requirements, event type, and corrective actions for each of the categories. Data on these events are presented for an 18-month period (trending) covering April 1, 2001 through September 30, 2002. Data on reportable events tracked by the NRC as performance measures under the FY 2000 - 2005 Strategic Plan are presented on page *ix*.

Copies of this report are available on the Internet at http://nmed.inel.gov.

EXECUTIVE SUMMARY

The Nuclear Regulatory Commission's Nuclear Materials Events Database contains records of events involving nuclear materials reported to the NRC by NRC licensees, Agreement States, and non-licensees. The reported events are classified based on event reporting requirements defined by Title 10 of the Code of Federal Regulations. The event reports are evaluated to identify any safety-significant events and concerns, and their causes. The reported information aids understanding of why the events occurred and in identifying any actions necessary to improve the effectiveness of the nuclear material regulatory program. Events involving fuel cycle facilities and non-power reactor events are excluded from this report due to the significant difference in operation of these facilities compared to the operation of other facilities licensed by the NRC and Agreement States to use by-product, source, and special nuclear material.



EQP - Equipment Problems
EXP - Radiation Overexposures
LAS - Loss of Control of Material
LKS - Leaking Sealed Sources
MD2 - Medical Events
OTH - Other
RLM - Release of Licensed Material or Contamination
TRS - Transportation

Eight hundred fifty-two events were reported during the 18-month period. One hundred twenty-eight of these events were reported during the current quarter.

- Forty-nine percent of the reported events were classified as Loss of Control of Material.
- The remaining 51% of events were divided between Equipment Problems (21%), Leaking Sealed Sources (9%), Transportation (7%), Medical Events (6%), Radiation Overexposures (4%), Release of Licensed Material or Contamination (2%), and Other (2%).

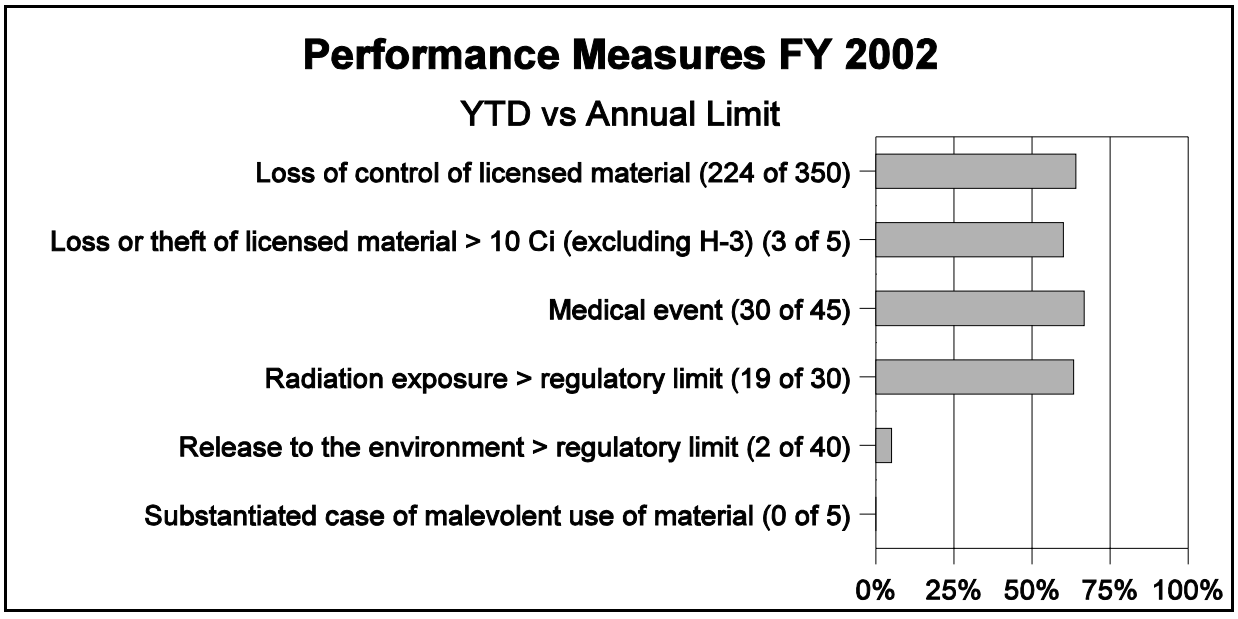
The event reporting rate is about 2.7 events per 100 licensees annually for all events, and about 0.7 events per 100 licensees annually for Medical Events. This is based on an estimate of about 21,000 material licensees (about 6,000 NRC licensees and 15,000 Agreement State licensees) that reported 568 events (annual rate) and about 5,000 medical licensees that reported 37 Medical Events (annual rate). This indicates that, annually, only 2.7% of all licensees report any type of incident/accident involving

licensed material. For incidents involving Medical Events, less than 1% of medical licensees report an event annually.

PERFORMANCE MEASURES

All NMED reportable events for Radiation Overexposures, Medical Events, Loss of Material, Malevolent Acts (intentional violation), and Release of Material (reporting requirement 10 CFR 20.2203(a)(3)(ii) only) are tracked by the NRC as performance measures under the NRC FY 2000 - 2005 Strategic Plan. The NRC Strategic Plan is available on the NRC's website at www.nrc.gov.

The following charts show Fiscal Year 2002 performance measures as a percentage of the annual limits. Data for the performance measure charts represent data at the close of Fiscal Year 2002 (i.e., data through September 30, 2002). Slight variations between these data and data presented in the body of the report (downloaded on January 9, 2002) may exist.



Nuclear Materials Events Database (NMED) Quarterly Report: Fourth Quarter Fiscal Year 2002

1. INTRODUCTION

1.1 Overview and Objectives

Nuclear materials event reports are evaluated to identify any safety-significant events and concerns, their causes, and corrective actions. The reported information aids understanding of why the events occurred and in identifying any actions necessary to improve the effectiveness of the nuclear material regulatory program.

A database for tracking nuclear materials events was developed by the Nuclear Regulatory Commission (NRC) in 1981. In 1993, using existing materials events databases, the NRC developed a new and more comprehensive database for tracking materials events. This database, designated the Nuclear Materials Events Database (NMED), contains records of events involving nuclear materials reported to the NRC by NRC licensees, Agreement States, and non-licensees. The database is maintained by the Idaho National Engineering and Environmental Laboratory (INEEL) and contains almost 14,000 records of materials events submitted to the NRC from approximately January 1990 through September 2002.

The reported events are classified into nine primary categories and "Other," based on event reporting requirements defined by Title 10 of the Code of Federal Regulations (CFR). The categories are (1) Medical Events, (2) Radiation Overexposures, (3) Release of Licensed Material or Contamination, (4) Loss of Control of Material, (5) Leaking Sealed Sources, (6) Equipment Problems, (7) Transportation, (8) Fuel Cycle Facility Events, and (9) Non-Power Reactor Events. The scope of the NMED quarterly report is limited to a discussion and evaluation of categories (1) through (7) and "Other." Events involving fuel cycle facilities and non-power reactors are excluded from this report due to the significant difference in operation of these facilities compared to the operation of other facilities licensed by NRC and Agreement States to use by-product, source, and special nuclear material. A description of categories addressed in this report and associated screening criteria is contained in Appendix A.

1.2 NMED Database

The NMED accommodates multiple events in a single report to be recorded and tracked. For example, a report may describe a loss of control of licensed material that also resulted in an overexposure. In such a case, both events are recorded in the NMED and identified by the same report number. The NMED Quarterly Report, which provides a summary of event data contained within the NMED, has been designed to further enhance the usefulness of the database. Data presented in this report were downloaded from the NMED on January 9, 2002. Be aware that the NMED is a dynamic database and updated daily. Therefore, slight variations in quarterly data may be encountered. Also note that, even though many events were reported and entered in the database for record keeping, only those events required to be reported under 10 CFR are addressed in this report.

In summary, this report focuses on reportable events that occurred between April 1, 2001 and September 30, 2002 that were entered into NMED prior to the data download on January 9, 2002. More specifically, this report includes a depiction of selected NMED 18-month trend data, and a breakdown of event causes, reporting categories, and event type data.

Performance measures data are presented on page *ix*. Appendix A presents a detailed description of the NMED data categories discussed in this report.

Reporting guidance for Agreement States is presented in the *Handbook on Nuclear Material Event Reporting in the Agreement States*. The handbook is an appendix to the NRC Office of State Programs Procedure SA-300, *Reporting Material Events*. Access to NMED is available to the NRC and Agreement State staff at http://nmed.inel.gov.

For assistance on searches or to answer other questions, contact Sam Pettijohn (slp@nrc.gov), (301) 415-6822.

2. ANALYSIS OF NMED DATA

Event reports involving nuclear materials submitted to the NRC are reviewed, categorized, and entered into the NMED. Eighteen-month trend charts with quarterly data points were developed to show general data trends. For this report, Fiscal Quarter 02-4 and 18-month event data were evaluated.

Several event reports did not contain sufficient information to determine the event causes. Such events were categorized as “Insufficient Information” concerning the event causes.

2.1 All NMED Events

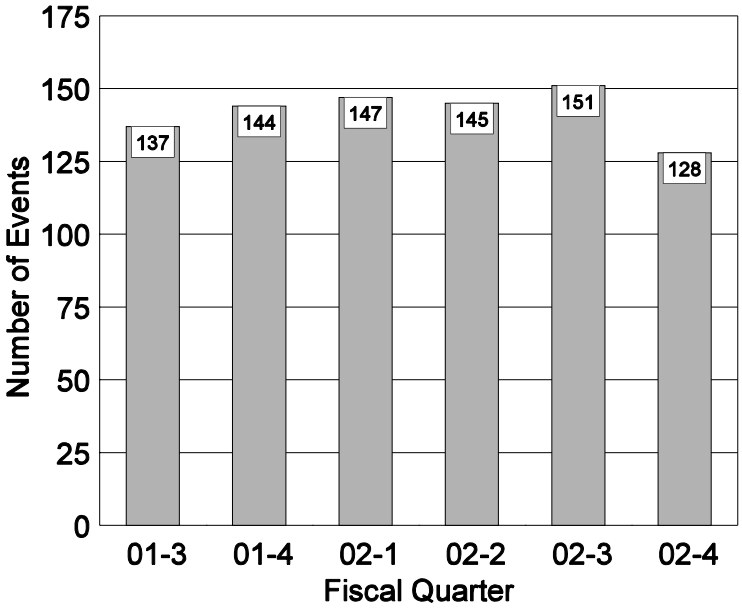


Figure 1. All NMED Events (18-months)

Figure 1 displays the number of NMED events that occurred per fiscal quarter during the 18-month period. The following observations were made concerning NMED events reported in the 18-month period:

- Eight hundred fifty-two reportable events occurred in the 18-month period.
- Events averaged 142 per quarter, with 128 events occurring in Fiscal Quarter 02-4.

2.2 Medical Events (MD2)

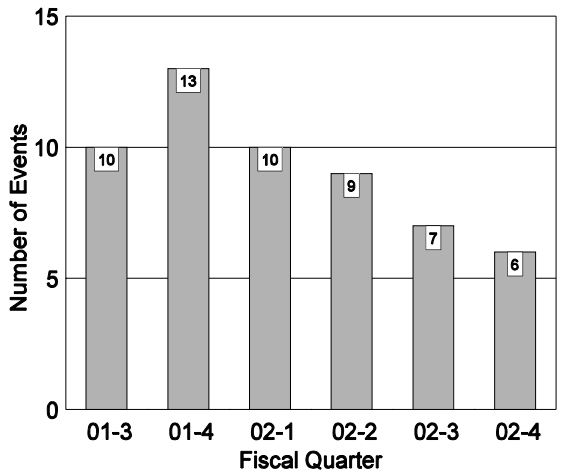


Figure 2. MD2 Events (18-months)

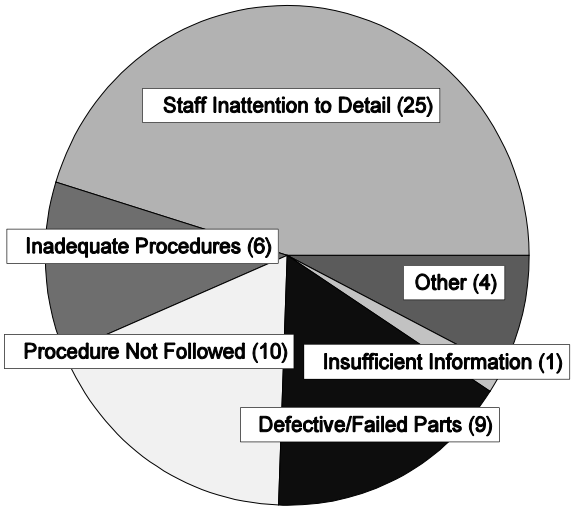


Figure 3. MD2 Event Causes (18-months)

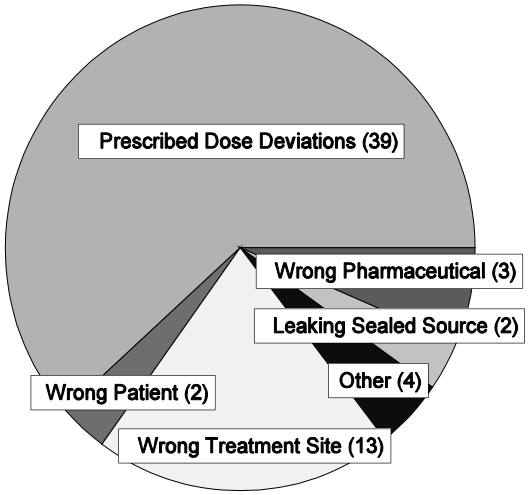


Figure 4. MD2 Event Reporting Requirements (18-months)

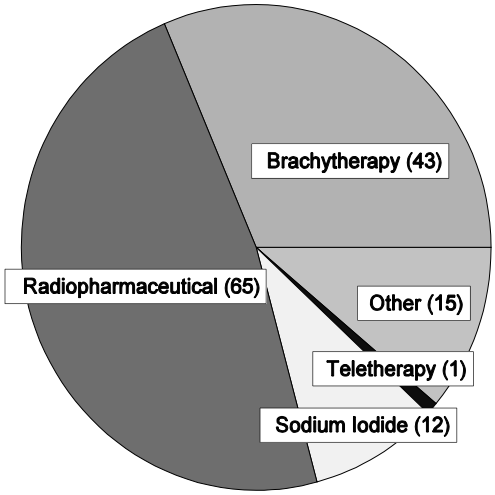


Figure 5. MD2 Event Therapeutic and Diagnostic Procedures (18-months)

Figures 2 through 5 display the number per quarter and breakdown of reportable MD2 events occurring for the 18-month period. The following observations were noted:

- Fifty-five MD2 events occurred in the 18-month period.

1.06 Events averaged nine per quarter, with six events in Fiscal Quarter 02-4.

1.07 Staff inattention to detail and procedure non-compliance were the causes of over half the events.

1.08 Most MD2 events involved prescribed dose deviations or wrong treatment sites (an event can be associated with more than one reporting requirement).

1.09 Almost 80% of the incidents involved radiopharmaceuticals and brachytherapy treatments (one radiopharmaceutical event involved 61 patients). (An event can involve more than one type of

procedure.)

2.3 Radiation Overexposures (EXP)

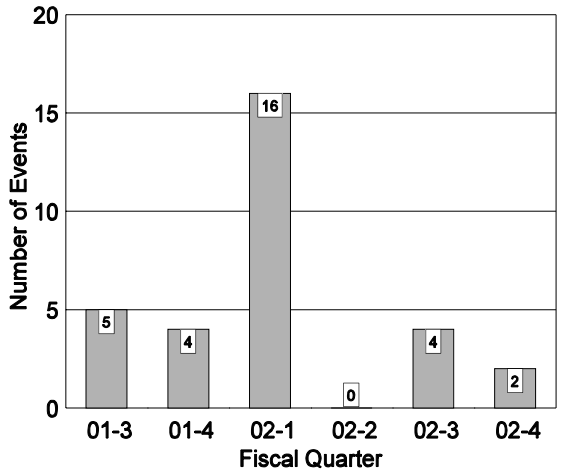


Figure 6. EXP Events (18-months)

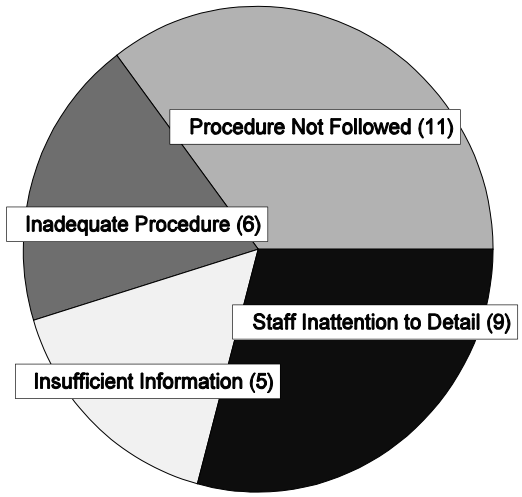


Figure 7. EXP Event Causes (18-months)

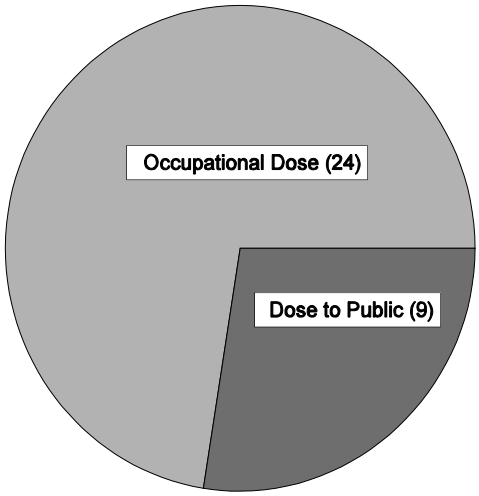


Figure 8. EXP Event Reporting Requirements (18-months)

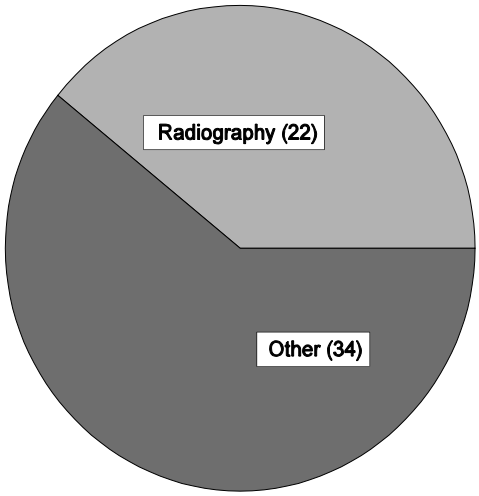


Figure 9. EXP Event Exposures (18-months)

Figures 6 through 9 display the number per quarter and breakdown of reportable EXP events occurring for the 18-month period. The following observations were noted:

- Thirty-one EXP events occurred in the 18-month period.

1.11 Events averaged five per quarter, with two events in Fiscal Quarter 02-4.

1.12 Procedure non-compliance and staff inattention to detail caused most of the events.

1.13 The majority of the EXP events involved exceeding occupational dose limits (an event can involve more than one type of reporting requirement).

1.14 Over half of the events involved radiography (an event can involve more than one type of exposure). A single “Other” event in Fiscal Quarter 02-3 involved the 31 individual exposures

from a well logging source.

2.4 Release of Licensed Material or Contamination (RLM)

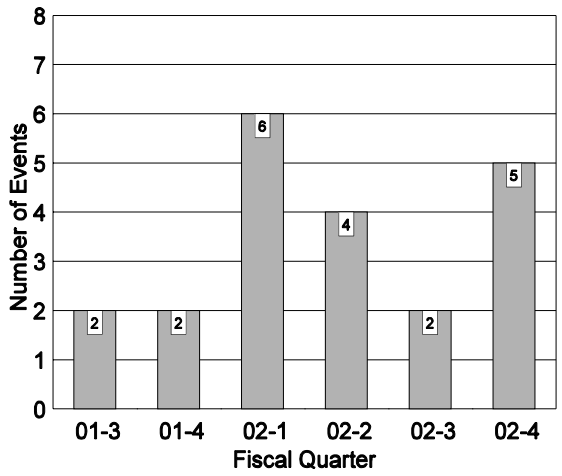


Figure 10. RLM Events (18-months)

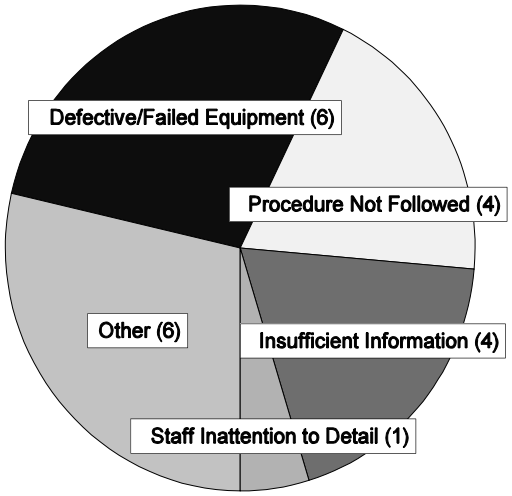


Figure 11. RLM Event Causes (18-months)

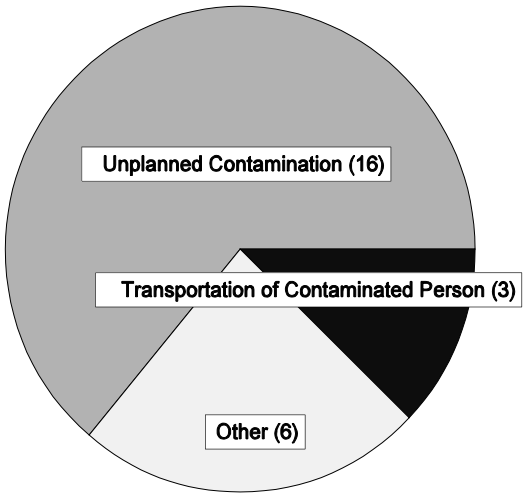


Figure 12. RLM Event Reporting Requirements (18-months)

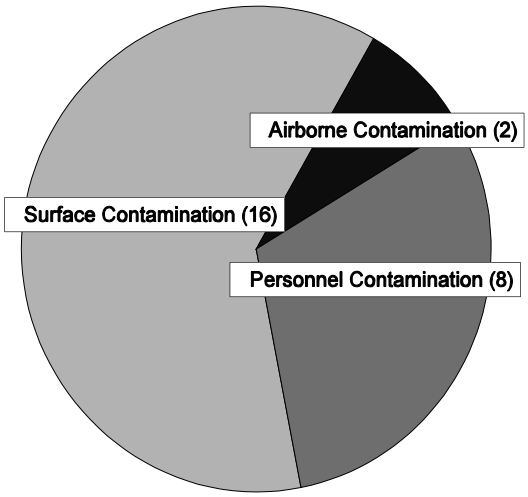


Figure 13. RLM Event Releases (18-months)

Figures 10 through 13 display the number per quarter and breakdown of reportable RLM events occurring for the 18-month period. The following observations were noted:

- Twenty-one RLM events occurred in the 18-month period.

1.16 Events averaged four per quarter, with five events in Fiscal Quarter 02-4.

1.17 Defective/failed equipment was the largest single causal category.

1.18 The majority of the EXP events involved unplanned contamination (an event can be associated with more than one reporting requirement).

1.19 Three-quarters of the events involved surface contamination (an event can involve more than one type of contamination).

2.5 Loss of Control of Material (LAS)

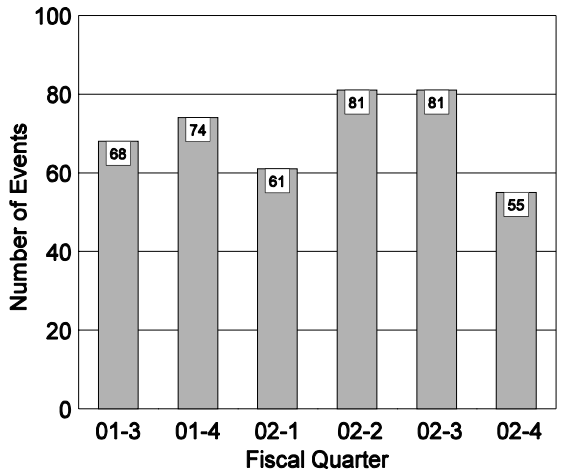


Figure 14. LAS Events (18-months)

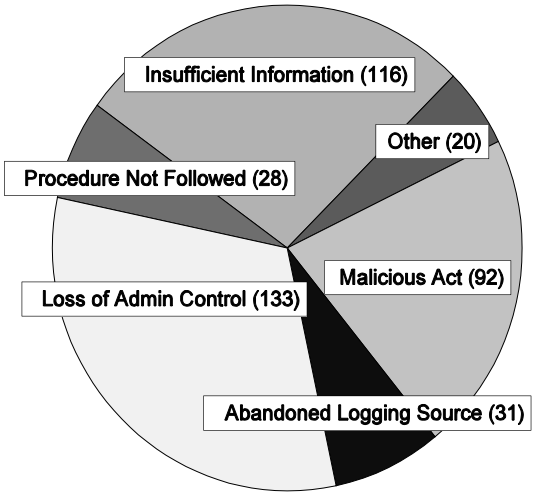


Figure 15. LAS Event Causes (18-months)

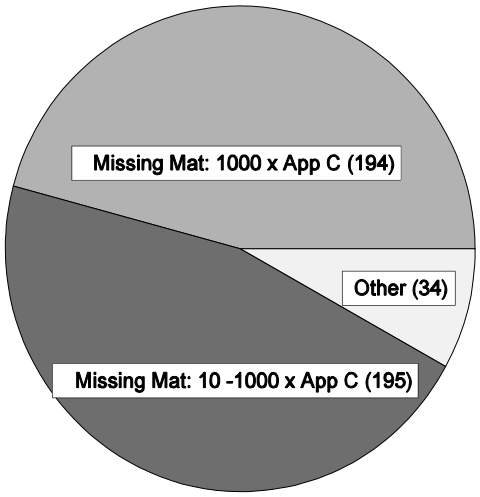


Figure 16. LAS Event Reporting Requirements (18-months)

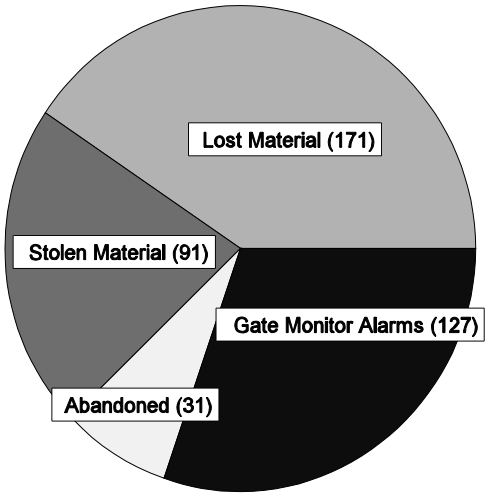


Figure 17. LAS Event Losses (18-months)

Figures 14 through 17 display the number per quarter and breakdown of reportable LAS events occurring for the 18-month period. The following observations were noted:

- Four hundred twenty LAS events occurred in the 18-month period.

1.21 Events averaged 70 per quarter, with 55 events in Fiscal Quarter 02-4.

1.22 Loss of administrative control, insufficient information reported, and malicious act were the largest causal categories.

1.23 The majority of the LAS events involved lost or stolen material (an event can be associated with more than one reporting requirement).

1.24 Almost half of the events involved lost material, followed by alarming gate monitors and stolen material.

2.6 Leaking Sealed Sources (LKS)

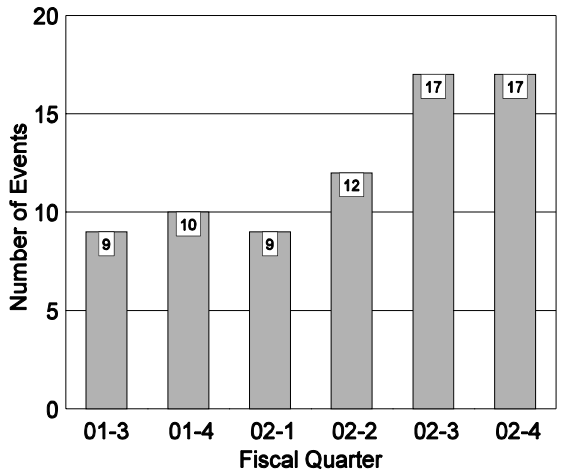


Figure 18. LKS Events (18-months)

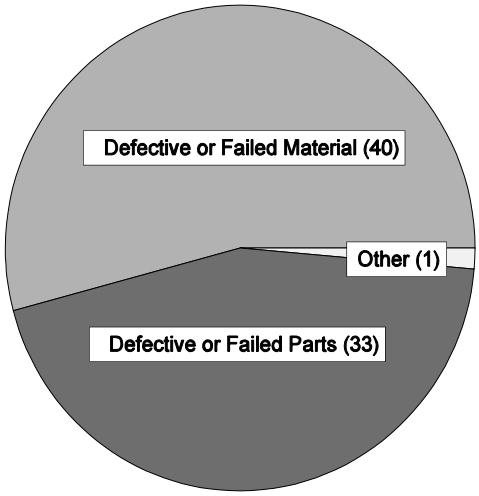


Figure 19. LKS Event Causes (18-months)

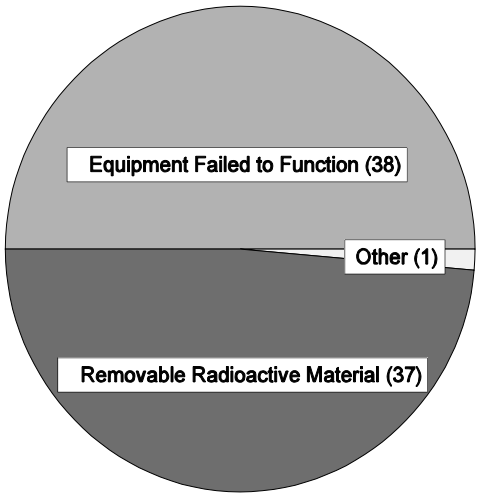


Figure 20. LKS Event Reporting Requirements (18-months)

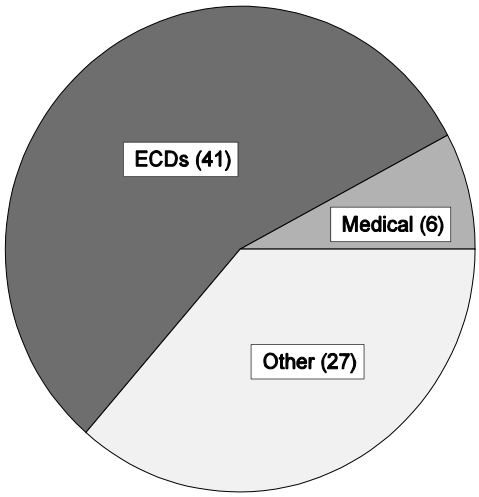


Figure 21. LKS Event Sealed Sources (18-months)

Figures 18 through 21 display the number per quarter and breakdown of reportable LKS events occurring for the 18-month period. The following observations were noted:

- Seventy-four LKS events occurred in the 18-month period.

1.26 Events averaged 12 per quarter, with 17 events in Fiscal Quarter 02-4.

1.27 Defective or failed material and parts were the largest causal categories.

1.28 All but one of the LKS events involved either failed equipment or removable radioactive material (an event can be associated with more than one reporting requirement).

1.29 Over half of the events involved ECDs.

2.7 Equipment Problems (EQP)

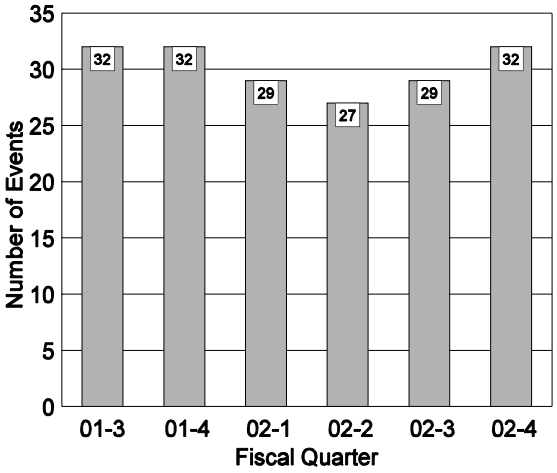


Figure 22. EQP Events (18-months)

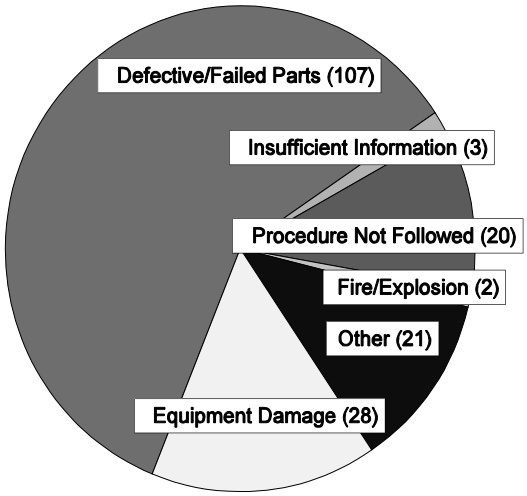


Figure 23. EQP Event Causes (18-months)

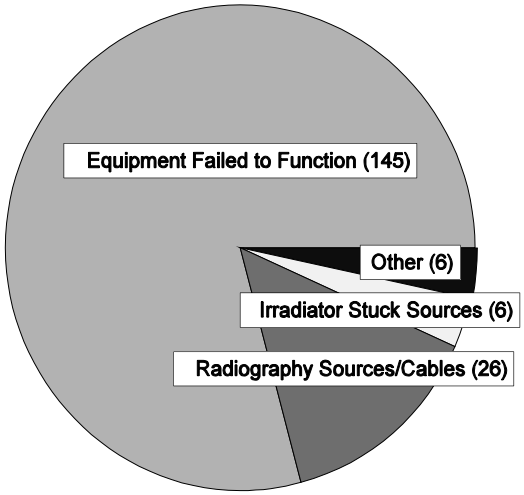


Figure 24. EQP Event Reporting Requirements (18-months)

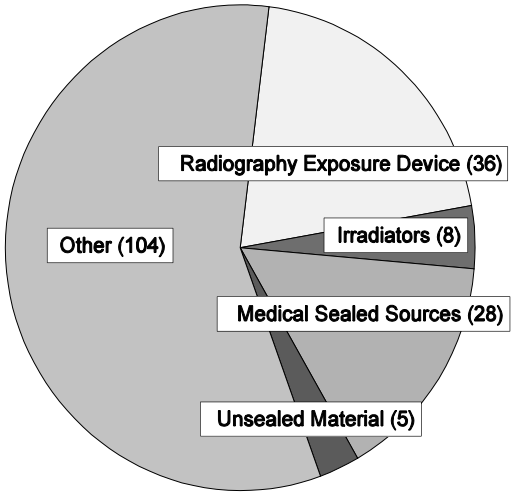


Figure 25. EQP Equipment (18-months)

Figures 22 through 25 display the number per quarter and breakdown of reportable EQP events occurring for the 18-month period. The following observations were noted:

- One hundred eighty-one EQP events occurred in the 18-month period.

1.31 Events averaged 30 per quarter, with 32 events in Fiscal Quarter 02-4.

1.32 Defective or failed parts was the largest causal category.

1.33 Over three quarters of the EQP events involved equipment failing to function (an event can be associated with more than one reporting requirement).

1.34 Over half of the events involved “Other” event types, while the remainder was split primarily between medical sealed sources and radiography exposure devices.

2.8 Transportation (TRS)

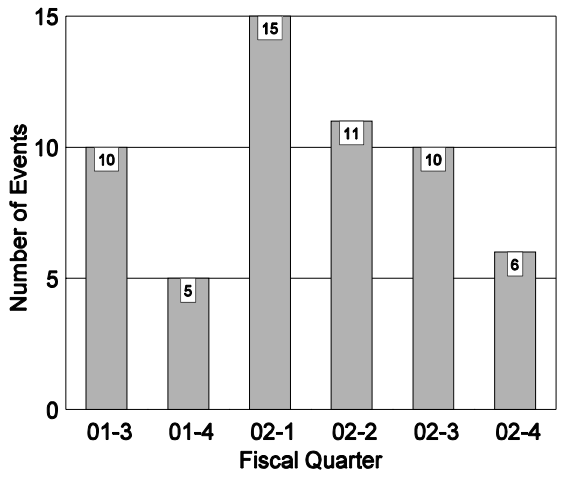


Figure 26. TRS Events (18-months)

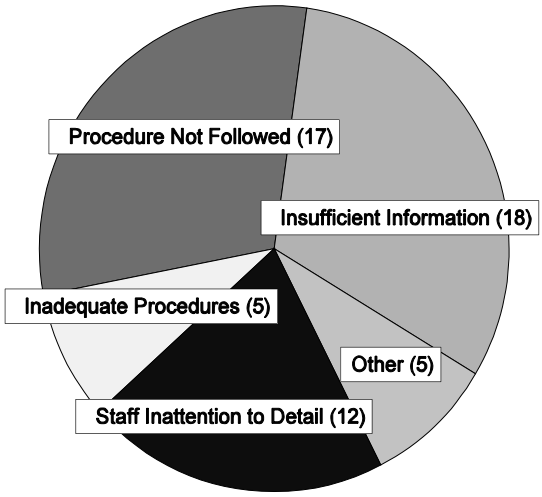


Figure 27. TRS Event Causes (18-months)

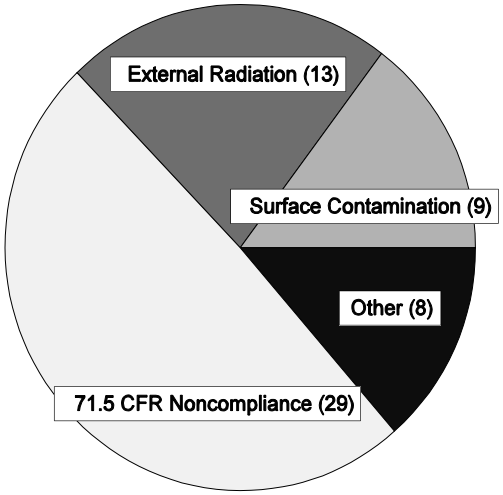


Figure 28. TRS Event Reporting Requirements (18-months)

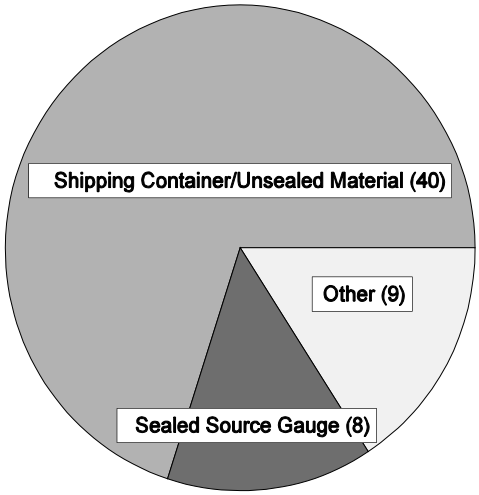


Figure 29. TRS Event Materials (18-months)

Figures 26 through 29 display the number per quarter and breakdown of reportable EQP events occurring for the 18-month period. The following observations were noted:

- Fifty-seven TRS events occurred in the 18-month period.

1.36 Events averaged 10 per quarter, with six events in Fiscal Quarter 02-4.

1.37 Procedure non-compliance and staff inattention to detail were the largest specified causal categories.

1.38 Over half of the events involved 10 CFR 71.5 non-compliance (an event can be associated with more than one reporting requirement).

1.39 Most of the events involved shipping containers or unsealed material during transportation.

2.9 Other (OTH)

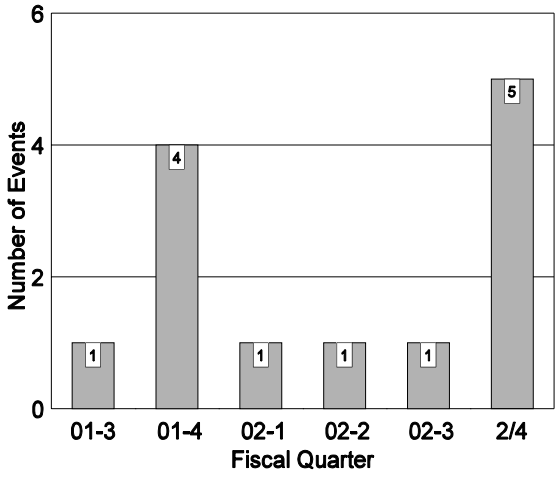


Figure 30. OTH Events (18-months)

Figure 30 display the number per quarter and breakdown of reportable OTH events occurring for the 18-month period. The following observations were noted:

- Thirteen OTH events occurred in the 18-month period.

1.41 Events averaged two per quarter, with five events in Fiscal Quarter 02-4.

Appendix A

Event Type Descriptions and Criteria

Appendix A

Event Type Descriptions and Criteria

The NMED events covered by this report are divided into the following categories based on the event reporting requirements defined in 10 CFR.

Medical Events (MD2)

Medical events (formerly referred to as medical misadministrations) are defined in 10 CFR Part 35 as follows:

1. A radiopharmaceutical dosage greater than 30 microcuries of either sodium iodide I - 125 or I - 131:
   - Involving the wrong individual, or wrong radiopharmaceutical; or
   - When both the administered dosage differs from the prescribed dosage by more than 20 percent of the prescribed dosage and the difference between the administered dosage and prescribed dosage exceeds 30 microcuries.

2. A therapeutic radiopharmaceutical dosage, other than sodium iodide I - 125 or I - 131:
   - Involving the wrong individual, wrong radiopharmaceutical, or wrong route of administration; or
   - When the administered dosage differs from the prescribed dosage by more than 20 percent of the prescribed dosage.

3. A gamma stereotactic radiosurgery radiation dose:
   - Involving the wrong individual, or wrong treatment site; or
   - When the calculated total administered dose differs from the total prescribed dose by more than 10 percent of the total prescribed dose.

4. A teletherapy radiation dose:
   - Involving the wrong individual, wrong mode of treatment, or wrong treatment site;
   - When the treatment consists of three or fewer fractions and the calculated total administered dose differs from the total prescribed dose by more than 10 percent of the total prescribed dose;
   - When the calculated weekly administered dose exceeds the weekly prescribed dose by 30 percent or more of the weekly prescribed dose; or
   - When the calculated total administered dose differs from the total prescribed dose by more than 20 percent of the total prescribed dose.

5. A brachytherapy radiation dose:
   - Involving the wrong individual, wrong radioisotope, or wrong treatment site (excluding, for permanent implants, seeds that were implanted in the correct site but migrated outside the treatment site);
   - Involving a sealed source that is leaking;
   - When, for a temporary implant, one or more sealed sources are not removed upon completion of the procedure; or
   - When the calculated administered dose differs from the prescribed dose by more than 20 percent of the prescribed dose.

6. A diagnostic radiopharmaceutical dosage, other than quantities greater than 30 microcuries of either sodium iodide I - 125 or I - 131, both:
   - Involving the wrong individual, wrong radiopharmaceutical, wrong route of administration, or

when the administered dosage differs from the prescribed dosage; and
- When the dose to the individual exceeds 5 rems effective dose equivalent or 50 rems dose equivalent to any individual organ.

Events are not considered MD2 events if they involve:

1. Only accelerator produced radiopharmaceuticals.
2. Only a linear accelerator.
3. A dose calculation error made by the prescribing physician that was administered as (incorrectly) prescribed.
4. Patient intervention.

Events are considered MD2 events if they involve:

1. A radiopharmaceutical containing by-product material was prescribed, but a radiopharmaceutical containing accelerator produced material was administered.
2. A radiopharmaceutical containing accelerator produced material was prescribed, but a radiopharmaceutical containing by-product material was administered.
3. A linear accelerator is used for therapy by mistake instead of a teletherapy unit or a teletherapy unit instead of a linear accelerator.

MD2 events occur to patients only. Hospital patients are always considered to be patients, rather than members of the general public, for purposes of determining whether to categorize an event as an MD2 or EXP event. For example, if a patient was administered a radiopharmaceutical that was prescribed for another patient, the event would be categorized as an MD2 event (radiopharmaceutical given to the wrong patient) rather than an EXP event.

Radiation Overexposures (EXP)

The EXP event category includes all regulatory overexposures of radiation workers or exposures of members of the public to radiation. The overexposure can be external or internal and can be whole body, extremity, skin, lens of the eye, or internal dose. When the overexposure involves multiple individuals or an individual with multiple overexposure types (such as whole body and extremity), the different types of overexposures are classified into the NMED Event Table separately. Note that dosimeters record exposure if improperly stored near a radiation source and, depending on the type of dosimeter, may react as though they are in a radiation field when exposed to heat or humidity. It is NRC policy to classify only those events that positively involve a personnel overexposure, and not just a dosimeter exposure, as reportable EXP events. For example, either the licensee does not contest the personnel overexposure, or in cases where the licensee does contest the overexposure, the State or NRC determines the event to be personnel overexposure. EXP events are categorized as follows:

1. A total effective dose equivalent of 0.25 Sv (25 rem) or more.

2. A total effective dose equivalent exceeding 0.05 Sv (5 rem) in a period of 24 hours.

3. An eye dose equivalent of 0.75 Sv (75 rem) or more.

4. An eye dose equivalent exceeding 0.15 Sv (15 rem) in a period of 24 hours.

5. A shallow-dose equivalent to the skin or extremities of 2.5 Gy (250 rads) or more.

6. A shallow-dose equivalent to the skin or extremities exceeding 0.5 Sv (50 rem) in a period of 24

hours.

7. A dose in excess of the occupational dose rate for adults in 20.1201.

8. A dose in excess of the occupational dose limits for a minor in 20.1207.

9. A dose in excess of the limits for an embryo/fetus of a declared pregnant woman in 20.1208.

10. A dose in excess of the limits for an individual member of the public in 20.1301

11. A dose in excess of any applicable limit in the license.

Release of Licensed Material or Contamination (RLM)

The RLM event category includes two types of events. The first type is a radioactive release to air or water exceeding the old 10 CFR Part 20 appendix governing maximum permissible concentrations (MPCs) or the new 10 CFR Part 20 appendix containing annual limit on intakes (ALIs). The second type of RLM event involves contamination events such as a radioactive spill outside of work areas, removable contamination found on equipment, or material tracked around a laboratory such that additional radiological control measures had to be implemented. This category does not include spills inside of laboratory hoods, radiopharmaceutical dose preparation areas, or hot cells where radioactive work routinely requires cleanup or changing of absorbent paper after the performance of a task. Should there be multiple release types (e.g., surface, or air, or water) or areas of contamination associated with the release, this information is classified individually into the NMED Event Table. RLM events are categorized as follows:

1. An unplanned contamination event that requires access to the contaminated area, by workers or the public, to be restricted for more than 24 hours by imposing additional radiological controls or by prohibiting entry into the area.

2. An unplanned contamination event that involves a quantity of material greater than five times the lowest ALI specified in Appendix B of 10 CFR 20.

3. An unplanned contamination event that has access to the area restricted for a reason other than to allow isotopes with a half-life of less than 24 hours to decay prior to decontamination.

4. The release of radioactive material, inside or outside of a restricted area, such that had an individual been present for 24 hours, the individual could have received an intake five times the ALI (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

5. The release of radioactive material, inside or outside of a restricted area, such that had an individual been present for 24 hours, the individual could have received an intake in excess of one ALI (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

6. Levels of radiation or concentrations of radioactive material in a restricted area in excess of any applicable limit in the license.

7. Levels of radiation or concentrations of radioactive material in an unrestricted area in excess of 10 times any applicable limit set forth in 10 CFR 20 or in the license (whether or not involving exposures of any individual in excess of the limits in 10 CFR 20.1301).

8. For licensees subject to the provisions of the Environmental Protection Agency's (EPA's) generally applicable environmental radiation standards in 40 CFR 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

9. An event that requires unplanned medical treatment at a medical facility of an individual with spreadable radioactive contamination on the individual's clothing or body.

10. An unplanned fire or explosion damaging any licensed material or any device, container, or equipment containing licensed material when the quantity of material involved is greater than five times the lowest ALI specified in Appendix B of 10 CFR 20.

Loss of Control (LAS)

The LAS event category includes those events where licensed radioactive material is lost or found, abandoned or discovered, and stolen or recovered. The radioactive material involved can be sealed or unsealed material, specifically or generally licensed, exempt or non-exempt quantities, involve a licensee or a non-licensee, and can be found anywhere. Abandoned well logging sources are included in this category. LAS events are categorized as follows:

1. Any lost, stolen, or missing licensed material in an aggregate quantity greater than or equal to 1,000 times the quantity specified in Appendix C to 10 CFR 20 under such circumstances that it appears to the licensee that an exposure could result to persons in unrestricted areas.

2. Any lost, stolen, or missing licensed material in a quantity greater than 10 times the quantity specified in Appendix C to 10 CFR 20.

3. An irretrievable well logging source.

4. An attempt made, or believed to have been made, to commit a theft or unlawful diversion of more than 10 Ci of H-3 at any one time or more than 100 Ci in any one calendar year.

5. An attempt made, or believed to have been made, to commit a theft or unlawful diversion of more than 15 pounds of source material at any one time or more than 150 pounds of source material in any one calendar year.

6. An attempt made, or believed to have been made, to commit a theft or unlawful diversion of special nuclear material.

7. Any loss (other than normal operating loss), theft, or unlawful diversion of special nuclear material.

Leaking Sealed Sources (LKS)

The LKS event category includes events involving leaking sealed sources. The NRC requires that most sealed sources be periodically leak tested to verify that the material is still sealed and that the source is still considered safe to use without protective clothing such as gloves. A source is considered leaking if a leak test can detect greater than 0.005 µCi of removable radioactive material. The leaking source is then removed from service, disposed of or returned to the manufacturer for repair, and a report is sent to the NRC or Agreement State with the details of the leaking source. For regulatory reporting purposes, a leaking source is generally considered a failed device under 10 CFR 30. Some specific reporting criteria are also listed in 10 CFR 31 (generally licensed material), 10 CFR 34 (radiography), and 10 CFR 35 (medical use of byproduct material).

Equipment Problems (EQP)

The EQP event category includes all types of radiological equipment problems, including generally licensed device problems covered in 10 CFR 31; radiography equipment problems covered in 10 CFR 34; irradiator problems covered in 10 CFR 36; well logging problems covered in 10 CFR 39, and other types of equipment covered in 10 CFR 30, 40, 70, and 76. EQP events are defined as the failure of, or a defect in, any piece of equipment that either contains licensed radioactive materials as an integral part, or whose function is to interact with such materials.

Examples of these problems include such things as a radiography source disconnect, a moisture density gauge being run over by a bulldozer, an irradiator source rack drive cable breaking, a well logging source being ruptured during a source recovery attempt, a fan motor failure in an exhaust hood used to store radioiodine, failure of a glove box connector gasket, or a damaged Type B shipping container. The radioactive material or source need not be damaged or leaking for the event to be considered an EQP event. Damage to a device housing, shutter, operation controls, or even a version of a software containing an error are covered in this category.

1. A defect or non-compliance involving the construction or operation of a facility or an activity that is subject to the licensing requirements under 10 CFR Parts 30, 40, 50, 60, 61, 70, 71, or 72.

2. A defect or non-compliance involving a basic component that is supplied for a facility or an activity that is subject to the licensing requirements under 10 CFR Parts 30, 40, 50, 60, 61, 70, 71, 72 or 76.

3. A piece of equipment that is disabled or fails to function as designed when the equipment is required by regulation or license condition to prevent releases exceeding regulatory limits, to prevent exposures to radiation and radioactive materials exceeding regulatory limits, or to mitigate the consequences of an accident.

4. A piece of equipment that is disabled or fails to function as designed when the equipment is required to be available and operable.

5. A piece of equipment that is disabled or fails to function as designed when no redundant equipment is available and operable to perform the required safety function.

6. An unplanned fire or explosion damaging any licensed material or any device, container, or equipment containing licensed material when the damage affects the integrity of the licensed material or its container.

7. The actual or possible failure of, or damage to, the shielding of radioactive material or the on-off mechanism or indicator on a generally licensed device.

8. An unintentional disconnection of a radiography source assembly from the control cable.

9. The inability to retract a radiography source assembly to its fully shielded position and secure it in this position.

10. The failure of any radiography component (critical to safe operation of the device) to properly perform its intended function.

11. An irradiator source stuck in an unshielded position.

12. Damage to an irradiator’s source racks.

13. Failure of the cable or drive mechanism used to move an irradiator's source racks.

14. Inoperability of an irradiator's access control system.

15. Structural damage to an irradiator's pool liner or walls.

16. Abnormal water loss or leakage from an irradiator's source storage pool.

17. Irradiator pool water conductivity exceeding 100 microsiemens per centimeter.

18. A licensee knows, or has reason to believe, that a well logging sealed source has been ruptured.

Transportation (TRS)

The TRS category includes a variety of transportation related events as follows:

1. The presence of removable surface contamination that exceeds the limits of Section 71.87(I).

2. The presence of external radiation levels that exceed the limits of Section 71.47.

3. Any significant reduction in the effectiveness of any approved Type B or fissile packaging during use.

4. Any defects with safety significance in Type B or fissile packaging after first use with the means employed to repair the defects and prevent their recurrence.

5. The conditions of approval in the certificate of compliance were not observed in making a shipment.

6. An accident involving a vehicle carrying licensed material regardless of whether the licensed material is damaged or spilled as a result of the accident.

7. Fire, breakage, spillage, or suspected contamination involving shipment of radioactive material.

Other (OTH)

The OTH event category includes a broad range of reportable events that do not specifically fit into one of the previous categories. This event type may also include events not reportable to the NRC but are included in the NMED program for informational purposes.