DOE Performance Indicators

for Environment, Safety & Health

Report Period:
April - June 1995

Office of Environment,
Safety and Health

Foreword

This is the first of our re-engineered performance indicator reports. It represents another effort by the Office of Environment Safety and Health to provide tools and information that will help managers manage safety effectively and efficiently. The performance indicator report is a work in progress; we encourage your input and participation in improving it. Please use the survey form at the back of this document to signal how we might better respond to your needs and concerns.

We recognize that this report is imperfect. To begin with, the data analyzed cover the period of April through June 1995. Over the next three quarters, we will shorten the reporting lag to 90 days. This is still not "real time" information, but the analyses should be useful in illuminating trends and highlighting areas that need attention. Secondly, these data present a composite picture of DOE – the safety performance of individual sites must be developed by "drilling down" to levels of greater detail.

The purpose of these reports is to raise questions and possibilities that will stimulate program and field office managers to analyze their own site-specific data in more detail and in "real time". Safety is no accident. Effective health and safety programs result when the many "upstream" factors that contribute to unsafe acts and dangerous conditions are well understood and well managed.

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Assistant Secretary
Environment, Safety and Health

Introduction

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Aligning with Strategic ES&H goals

A critical success factor identified in the Department of Energy (DOE) Strategic Plan for environment, safety and health is "ensuring the safety and health of workers and the public and the protection and restoration of the environment". Therefore, the senior leadership of DOE has a continuing need to routinely access information that relates to the measurement of this critical success factor. This Performance Indicator Report is intended to support this need to measure these success factors across the DOE complex. A summary of the indicator definitions and their relationship to the DOE Strategic Plan is provided in Appendix A.

Selecting the Indicators

Selection of the indicators presented in this report involved both evaluation of the overall safety significance as well as tests of availability. A process was established where all potential indicators were evaluated with respect to significance to the ultimate goal of measuring performance in environment, safety and health. With respect to availability, a decision was made to select indicators from existing data streams to avoid, for now, levying a burden on field activities for additional data. Primarily, indicators are derived from data within four data systems and one annual report:

- *Occurrence Reporting and Processing System (ORPS)* - a system originally designed for notification of nuclear as well as non-nuclear occurrences in the field.
- *Computerized Accident/Incident Reporting System (CAIRS)* - a system for collecting data associated with occupational injury and illness events and statistics.
- *Radiation Exposure Monitoring System (REMS)* - a system for collecting data on individual radiation doses received by DOE complex workers.
- *Environmental Compliance Database* - a system maintained by the Office of Environmental Policy and Assistance.
- *Annual Site Environmental Reports.*

There are, of course, limitations resulting from using the data for other than the purpose for which it was collected. Further, the availability of data should not be confused with relevance to measuring performance. Indicators should be selected based on their impact on the operations being examined (worker safety & health and the environment in this case), not solely because the data exist. Although some of the selected indicators may be of interest to other audiences, it is likely that other valid indicators exist that should be analyzed and trended to provide the appropriate perspective (e.g., facility, contractor, program management) on performance.

Analyzing the Indicators

The indicators are analyzed in terms of change relative to the baseline performance where possible and/or comparison to a benchmark or goal. Highlights of the data analysis are also provided. Appendix B outlines the process of establishing, measuring and displaying the indicator information. It is important to note that the facilities that comprise the DOE complex are diverse in mission, funding, staffing, and activities. The data provided are intended to flag areas that may require further investigation (i.e., to

identify areas that may require intervention as well as good practices to share across DOE). Care should be exercised when drawing conclusions based solely on the data presented within this report.

General Factors Influencing the Data

Some factors which have had a broad impact on the indicators include:

- More aggressive ES&H policies: In 1989-1990 major changes were made to place an increased emphasis on safety, resulting in major resource commitments to safety programs.
- Changing missions: Influenced by the end of the Cold War, the Department's primary mission has transition from nuclear weapons production to environmental clean-up.
- Reduced workforce: In general, the trends observed are not changed significantly when normalized to the total hours worked. Although there has been a decrease in the hours worked by technical workers in the past several years, the rate of decrease is relatively slow. However, anticipated further reductions in workforce may affect future data.
- Changes to reporting criteria: In many cases, requirements which determine whether an event is reportable and/or what is reported change over time. For example, when the occurrence reporting Order (5000.3A) was revised in February 1993 (5000.3B), some events which previously would have resulted in an occurrence report were no longer reportable. In another example, in 1993, the way radiation dose per person is tracked was changed – 50 year committed dose from an uptake is applied in the year received versus amortized over 50 years. This must be considered when judging historical data trends.
- Limited data normalization: Much of the information needed to normalize data to opportunities for occurrences is not currently available. Efforts are underway to collect this data.

Continuously improving the process

This document represents a work in progress. This is the initial report, utilizing actual data, based on this concept. Since this Performance Indicator Report represents a management tool, it is expected that this document will change internally as management needs are redefined. Further, no data were requested from the field to produce this report; only existing data streams were used. It is expected that this document will evolve as additional needs for information are identified and as other sources of information are identified. To help gather feedback on this new approach, a survey form is included at the end of this report. The reader is encouraged to complete the form and return it as indicated to assist in the continuous improvement of the product.

Reader Survey Form

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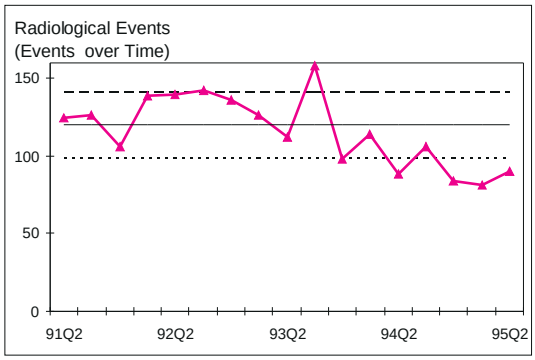
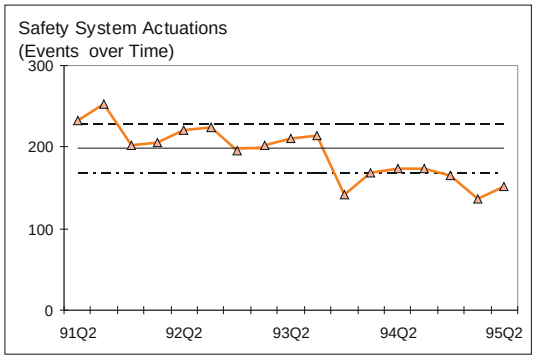
Management Summary

Key indicators selected from the set of DOE Environment, Safety and Health Performance Indicators are summarized below. The horizontal lines on the graphs represent the historical baseline ±1 standard deviation. Quarterly data is presented as calendar quarters.

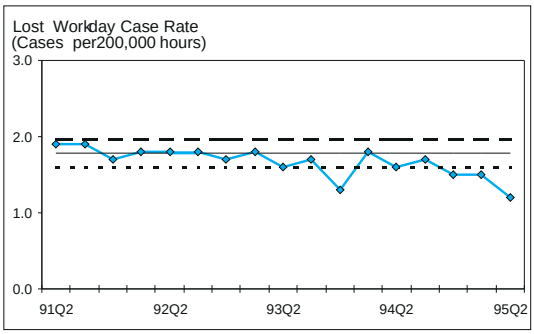
Worker and Facility Safety



Number of reportable radiological events as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.* These events are made up of both personnel contaminations and radiation exposures.

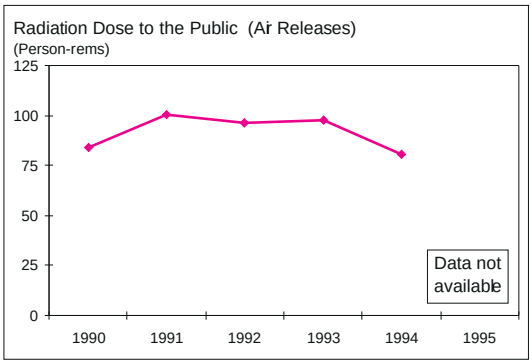


Number of operations-related events determined to be safety system actuations reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.*

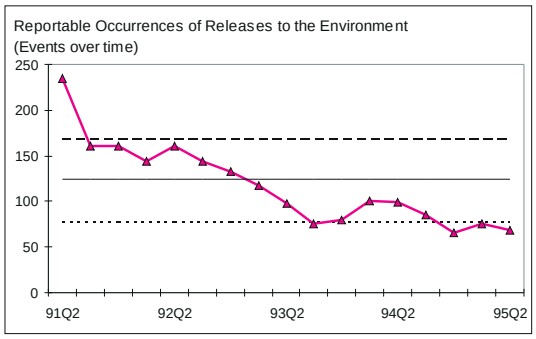


A lost workday case is a work related injury or illness that involves days away from work or days of restricted work activity, or both. Lost Workday case (LWC) rate is the number of lost workday cases per 200,000 hours worked.

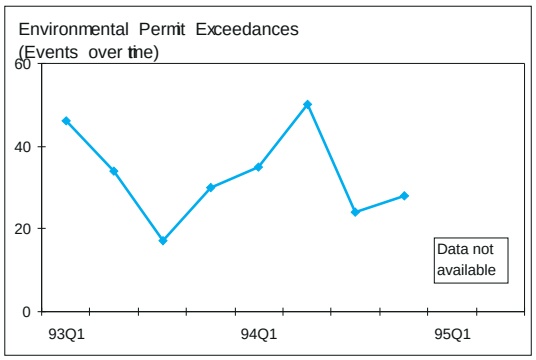
Environment



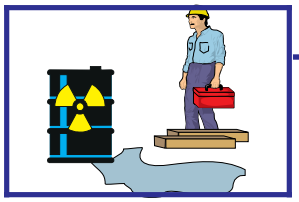
Total collective radiation dose (person-rem) to the public within 50 miles of DOE facilities due to radionuclide airborne releases. "Collective radiation dose" is the sum of the effective dose equivalent to all off-site people within a 50-mile radius of a DOE facility over a calendar year.



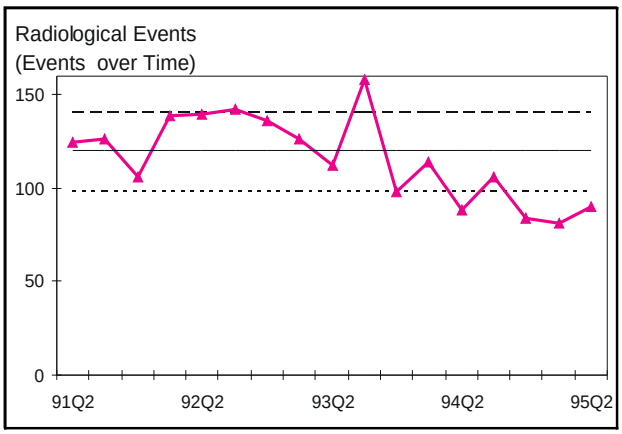
Releases of radionuclides or hazardous substances or regulated pollutants that are reportable to federal, state, or local agencies.



Exceedance of release levels specified in air or water permits during the quarter.

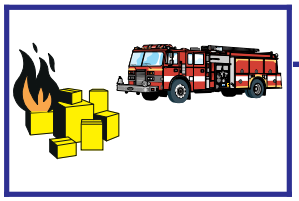


Radiological Events

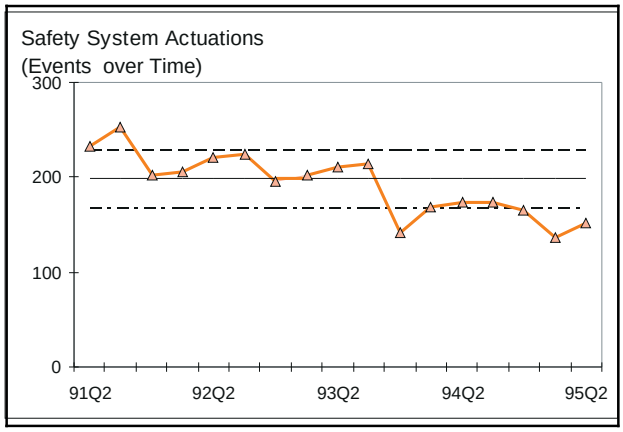


Number of reportable radiological events as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.* These events are made up of both personnel contaminations and radiation exposures.

- Since the first quarter of 1994, radiological events show a very probable decreasing trend.
- CY 1993 is a transition year where a significantly decreasing trend in the number of radiological events is observed. The 28% drop may be attributable to changes in the orrcuurence reporting Order's (5000.3B) contamination and reporting criteria, significantly reduced levels of DOE operations, and the implementation of the Radiological Control Manual. Each of these, coupled with increased worker awareness relative to radiological controls, helped to establish this positive trend.
- The spike exhibited in the 3rd quarter of 1993 resulted from a change in detection procedures and contamination definition at the Oak Ridge Y-12 Plant, which reported nearly half of the events. Subsequent changes implemented in radiation protection procedures resulted in a substantial reduction in radiation events as Y-12 dropped from being the largest contributor to this indicator to third at present.



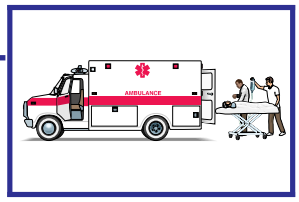
Safety System Actuations



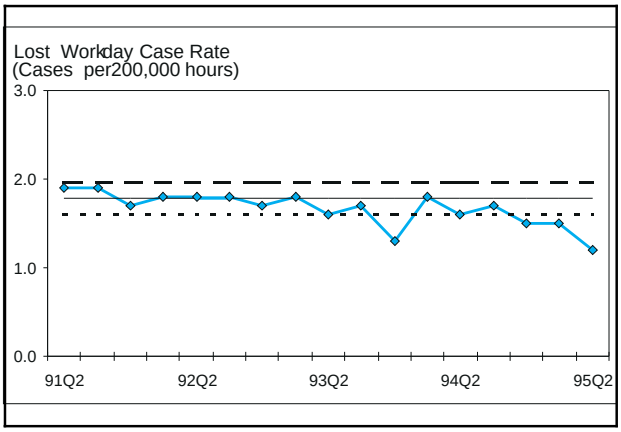
Number of operations-related events determined to be safety system actuations reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.* This includes actuation of any safety class equipment or alarm, unplanned electrical outages, unplanned outages of service systems, serious disruption of facility activity related to weather phenomenon, facility evacuations, or loss of process ventilation. These events have the potential to impact the safety and health of workers in the vicinity.

- There is a marked decrease in the number of safety system actuations reported two quarters following the implementation of version B to the occurrence reporting Order 5000.3B. The average of the last seven quarters is more than three standard deviations lower than the average of the first ten quarters. There is no trend evident over the last seven quarters following changes to the reporting criteria and reporting thresholds of DOE Order 5000.3B.
- Overall, approximately 70% of the safety system actuations reported were from false initiators.
- During the 2nd quarter of 1995, the six leading contractors reporting safety system actuations, reported 49% of the actuations from false initiators.
- Fire and smoke alarms were the leading cause of false alarms during the 2nd quarter of 1995. Of the false fire alarms, 20% were the result of improperly performed surveillances, and an additional 20% were the result of inadvertent actuation of hand-pull stations. The major false actuations for the quarter were: Fire/smoke alarm - 25%; Radiation alarm - 17%;Power outage/transient - 12%.

Lost Workday Case Rate

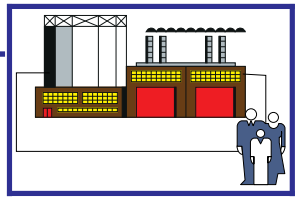


- The 1994 LWC rate has been relatively constant, even though all four quarters of 1994 and the first two quarters of 1995 fall below the 4-year average (1990-1993) LWC rate. Experience shows that 1994 and 1995 LWC rates will rise due to revisions and late reporting.
- Very general rate comparisons for some operation types can be made to the Department of Labor, Bureau of Labor Statistics private industry classifications. The 1994 DOE construction LWC rate is about one-half the 1993 private sector construction rate; the 1994 DOE production LWC rate is about one-fifth the 1993 private sector manufacturing rate; and the 1994 DOE services LWC rate is approximately four-fifths of the 1993 private sector rate.

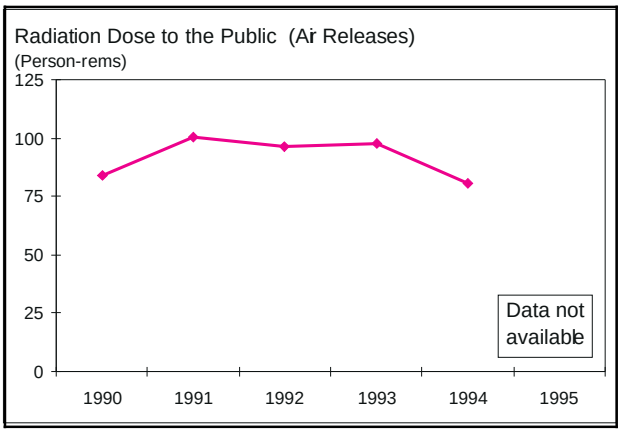


A lost workday case is a work related injury or illness that involves days away from work or days of restricted work activity, or both. Lost Workday case (LWC) rate is the number of lost workday cases per 200,000 hours worked.

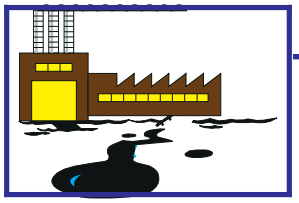
Radiation Dose to the Public



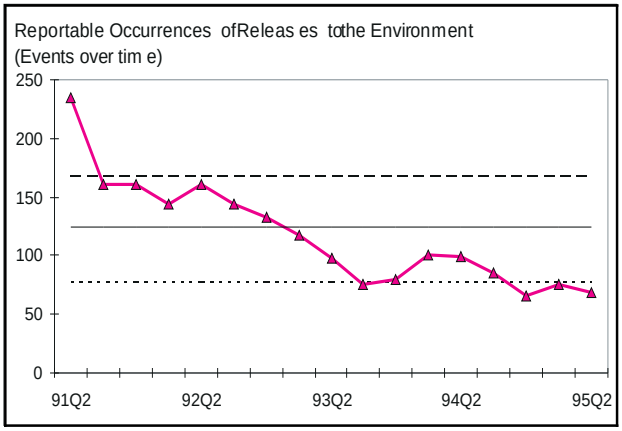
- Total collective radiation dose to the public from DOE sources is very low compared to the public dose from natural background radiation, which is approximately 10,000 times greater.
- Over the five years of available data, three sites [Oak Ridge Reservation, Argonne National Laboratory (ANL), and Savannah River Site] consistently account for about two-thirds of the estimated off-site collective radiation dose.
- The overall collective radiation dose decrease in 1994 is due to the lower off-site collective doses at these three sites. The decreases resulted primarily from the reduction in weapons production and development activities at Oak Ridge and Savannah River. ANL reductions resulted mostly from the decrease in Thorium-232 inventory in Building 200 which reduced Radon-220 emissions.
- In 1994, Lawrence Livermore Site 300 (LLNL-300) was also a significant contributor to the total collective radiation dose as a result of more comprehensive estimates of its diffuse emissions.



Total collective radiation dose (person-rem) to the public within 50 miles of DOE facilities due to radionuclide airborne releases. “Collective radiation dose” is the sum of the effective dose equivalent to all off-site people within a 50-mile radius of a DOE facility over a calendar year..



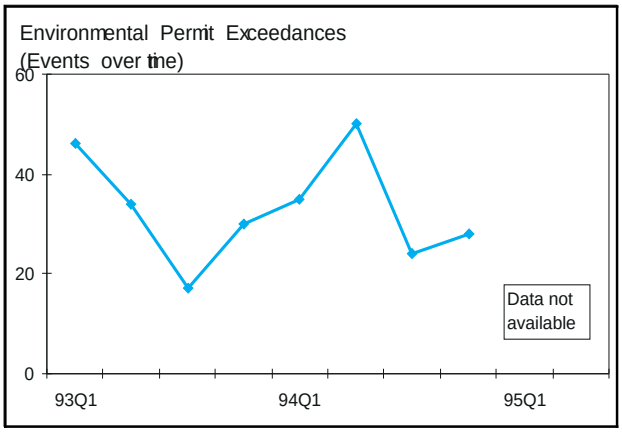
Reportable Occurrences of Releases to the Environment



Releases of radionuclides or hazardous substances or regulated pollutants that are reportable to federal, state, or local agencies.

- The number of reportable release incidents has generally decreased over the entire seventeen-quarter period displayed. The decline is also notable over the most recent ten-quarter period following the latest change to DOE's reporting criteria implemented by DOE Order 5000.3B, *Occurrence Reporting and Processing of Operations Information*. In general, there have been fewer opportunities for release incidents with the slow down in operations.

Environmental Permit Exceedances



Exceedance of release levels specified in air or water permits during the quarter.

- Approximately 95% of exceedances over this two year period were due to violations of water discharge permit conditions under the Clean Water Act, and 5% were attributed to Clean Air Act permit violations.
- Four facilities (ANL-East, Los Alamos, Portsmouth, and West Valley) consistently account for almost 70% of the total number of exceedances.
- The high number of exceedances that occurred in the first and second quarters of 1993 and 1994 are attributable to several influences. Based on telephone inquiries to high contributing sites, the high number of exceedances are due to the influence of significant variations in temperature, sunlight, precipitation, and biological activity occurring over these quarters. This directly led to increases of violations of several National or State Pollutant Discharge Elimination System (NPDES/SPDES) permit parameters; primarily total suspended solids, BOD, pH, and temperature.

Performance Indicator Definitions

The following indicators have been selected as DOE performance indicators for worker and facility safety and the environment. Key indicators (identified with *) are also summarized in a companion management summary handout and brochure.

Worker and Facility Safety

1. Radiological Events *
2. Worker Radiation Dose
3. Investigations of Serious Events
4. Chemical Hazard Events
5. Safety System Actuations *
6. Procedure Violations
7. Safety Equipment Degradation
8. Near Misses and Safety Concerns
9. Lost Workday Case Rate *
10. Lost Workday Incident Rate
11. Total Recordable Case Rate
12. Occupational Safety & Health Cost Index
13. Worker Health
14. Spent Nuclear Fuel and Plutonium Vulnerabilities Resolved
15. Open DNFSB Recommendations

Environment

16. Radiation Dose to the Public *
17. Reportable Occurrences of Releases to the Environment *
18. Toxic Chemical Releases
19. Environmental Permit Exceedances *
20. Cited Environmental Violations
21. Environmental Fines and Penalties
22. Environmental Compliance Milestones Met
23. Waste Minimization/Pollution Prevention

The horizontal lines on the graphs represent the historical baseline ±1 standard deviation. Quarterly data are presented as calendar quarters. DOE workers, contractors and subcontractors are included in data obtained from Occurrence Reports and the Computerized Accident/Injury Reporting System.

Worker & Facility Safety

1. Radiological Events

Number of reportable radiological events as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information*. These events are made up of both personnel contaminations and radiation exposures.

2. Worker Radiation Dose

The average measurable dose to DOE workers, determined by dividing the collective total effective dose equivalent (TEDE) by the number of individuals with measurable dose.

TEDE is determined by combining both internal and external contributions to an individual's occupational exposure. The number of individuals receiving measurable dose is used as an indicator of the exposed workforce size. It includes any individual (federal employees, contractors, subcontractors, and visitors) with reported doses greater than the minimum detectable dose.

3. Investigations of Serious Events

Investigation of accidents with significant human effects, environmental effects, or property damage.

Type A investigations include accidents which involve: a fatality, hospitalization or permanent disability of at least 3 people, significant radiation dose (>25 rem), releases more than 5 times that reportable under 40 CFR 302, and property damage in excess of $2.5 million.

Type B investigations include accidents which involve: at least 1 person hospitalized for more than 5 days, 5 related lost workday cases within 1 year, accidents involving 5 or more people, radiation exposures (10-25 rem), releases 2-5 times that reportable under 40 CFR 302, and property damage of $1-2.5 million

4. Chemical Hazard Events

The number of events reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information*, that are gathered by a word search for specific chemical names. The selected events are reviewed and screened for events meeting one of the following categories:

- Class 1 - An injury or exposure requiring hospital treatment, or confirmed, severe environmental effect.
- Class 2 - Minor injury (first aid) or exposure, or minor environmental damage.
- Class 3 - Potential precursors to the occurrences in Class 1 or 2.
- Class 4 - Minor occurrences such as leaks, spills, or releases which are significant by the frequency, but not by the consequences.

5. Safety System Actuations

Number of operations-related events determined to be safety system actuations reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.* This includes actuation of any safety class equipment or alarm, unplanned electrical outages, unplanned outages of service systems, serious disruption of facility activity related to weather phenomenon, facility evacuations, or loss of process ventilation. These events have the potential to impact the safety and health of workers in the vicinity.

6. Procedure Violations

Number of reportable events, as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information,* which are either categorized as procedure violations or problems or are reported as being caused by a procedure violation or problem.

7. Safety Equipment Degradation

Number of reportable events categorized as "vital system/component degradation" as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information*.

Safety equipment degradation includes: (1) any unplanned occurrence that results in the safety status or the authorization basis of a facility or process being seriously degraded; or (2) a deficiency such that a structure, system or component (SSC) vital to safety or program performance does not conform to stated criteria and cannot perform its intended function; or (3) unsatisfactory surveillance/inspections and appraisal findings of any safety class SSC.

8. Near Misses and Safety Concerns

Number of events related to near misses or safety concerns reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.* A near miss occurs when all barriers to an event initiation are compromised or if only one barrier remains to an event initiation, after other barriers have been compromised. A safety concern exists if the unauthorized use of hazardous products or processes occurs, or if work is shut down as the result of an Occupational Safety and Health Administration violation.

9. Lost Workday Case Rate

A lost workday case is a work related injury or illness that involves days away from work or days of restricted work activity, or both.

Lost workday case (LWC) rate is the number of lost workday cases per 200,000 hours worked.

10. Lost Workday Incident Rate

The Lost Workday (LWD) Incident Rate is the number of lost workdays per 200,000 hours worked.

11. Total Recordable Case Rate

Total recordable cases (TRC) are all work-related deaths and illnesses, and those work-related injuries which result in loss of consciousness, restriction of work or motion, transfer to another job, or require medical treatment beyond first aid.

Total recordable cases include all occupational injuries and illnesses that result in either death, a lost workday case, or a non-fatal case without lost workdays. Therefore, TRCs will always be either equal to or greater than the number of lost workday cases. Total recordable case rate is the number of TRCs per 200,000 hours worked.

12. Occupational Safety and Health Cost Index

In general terms, the DOE Occupational Safety and Health Cost Index represents the amount of money lost to injuries/illnesses for every hour worked by the total workforce. The Index is a coefficient calculated from the direct and indirect dollar costs of injuries. It is not a direct dollar value and is not commonly used in private industry. DOE sites use this index to measure their progress in worker safety and health. The index is computed as follows:

Cost Index = 100 (1,000,000 D + 500,000 T + 2,000 LWC +1,000 WDL + 400 WDLR +2,000 NFC) divided by the total hours worked, where

D = the number of deaths,

T = the number of permanent transfers or terminations due to occupational illness or injury,

LWC= the number of lost workday cases,

WDL = the number of days away from work,

WDLR = the number of restricted workdays, and
NFC = the number of non-fatal cases without days away from work or restricted workdays.

The coefficients are weighting factors, which were derived from a study of the direct and indirect dollar costs of injuries. As a result, the index is approximately equal to cents lost per hour worked.

13. Worker Health

Performance measures focusing on worker health are under development.

14. Spent Nuclear Fuel and Plutonium Vulnerabilities Resolved

The number of resolved plutonium and spent fuel vulnerabilities divided by the total number of vulnerabilities as defined in *Spent Fuel Working Group Report on Inventory and Storage of the Department's Spent Nuclear Fuel...and Their Environmental, Safety, and Health Vulnerabilities,* Volume 1, November 1993, and *Plutonium Working Group Report on Environmental, Safety, and Health Vulnerabilities*, Volume 1, November 1994 (DOE/EH-0415).

An ES&H vulnerability is defined in the plutonium and spent fuel vulnerability reports as "conditions or weaknesses that could lead to unnecessary or increased radiation exposure of workers, release of radioactive material to the environment or radiation exposure of the public". A resolved vulnerability implies that the cited condition no longer exists. Vulnerabilities can be characterized as material/packaging (e.g., storage of unstable and corrosive solutions), facility condition (e.g., facility weaknesses), or institutional vulnerabilities (e.g., loss of experienced personnel). The vulnerabilities were ranked by significance based on the likelihood of an accident and the perceived consequences.

15. Open DNFSB Recommendations

The cumulative number of open Defense Nuclear Facilities Safety Board (DNFSB) recommendations. DNFSB recommendations only apply to DOE defense nuclear facilities and, therefore, are representative only of DOE defense facilities involved in nuclear safety issues.

Each DNFSB recommendation leads to a set of commitments which, when fully implemented, will close a recommendation. A commitment is any documented obligation by the Secretary, or designee, that describes products to be delivered on a specified schedule. Commitments resulting from DNFSB recommendations are tracked by the Office of the Departmental Representative to the DNFSB (S-3.1) as completed (fulfilled), not yet due, and overdue.

16. Radiation Dose to the Public

Environment

Total collective radiation dose (person-rem) to the public within 50 miles of DOE facilities due to radionuclide airborne releases. "Collective radiation dose" is the sum of the effective dose equivalent to all off-site people within a 50-mile radius of a DOE facility over a calendar year.

17. Reportable Occurrences of Releases to the Environment

Releases of radionuclides or hazardous substances or regulated pollutants that are reportable to federal, state, or local agencies.

18. Toxic Chemical Releases

Toxic Release Inventory (TRI) chemicals released or transferred off-site for treatment or disposal (pounds).

19. Environmental Permit Exceedances

Exceedance of release levels specified in air or water permits during the quarter.

20. Cited Environmental Violations

Number of environmental violations cited by regulators in enforcement actions at DOE facilities.

21. Environmental Fines and Penalties

Fines and penalties assessed by regulators at DOE facilities related to violations of environmental laws and regulations.

22. Environmental Compliance Milestones Met

Enforceable requirements in environmental agreements, met on or before the milestone date (percent).

23. Waste Minimization/Pollution Prevention (future indicators)

The draft Pollution Prevention Cross-Cut Plan developed by the Office of Environmental Management proposes several “global” pollution prevention performance measures:

- Volume of radioactive waste reduced.
- Volume of mixed waste reduced.
- Weight of toxic chemical releases and off-site transfers reduced.
- Percentage of solid, non-hazardous waste recycled.
- Percentage of affirmative procurement guideline materials purchased by category.

These five measures represent Secretarial goals and are scheduled to be reported in 1996.

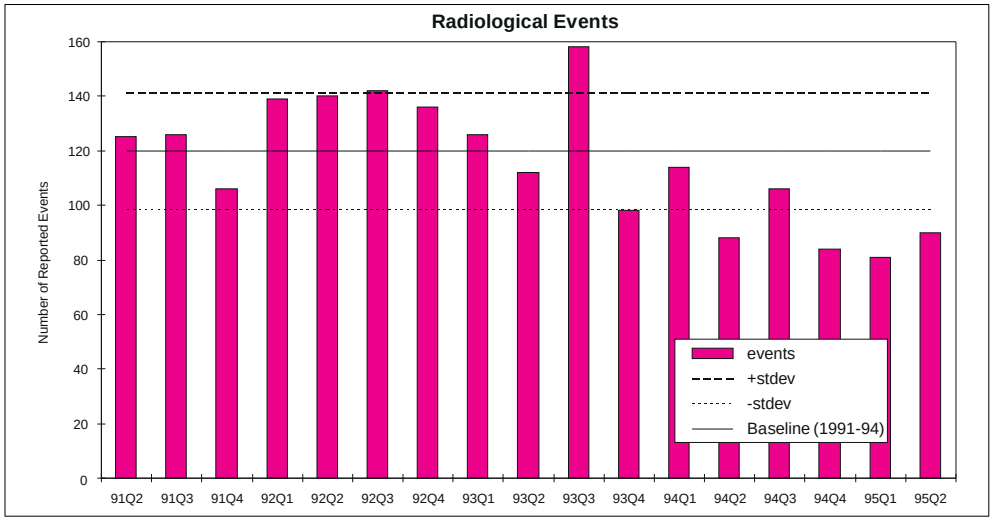
Worker and Facility Safety

Indicator

1. Radiological Events

Definition

Number of reportable radiological events as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information*. These events are made up of both personnel contaminations and radiation exposures.



Source: Occurrence Reports.

Key Observations

- Since the first quarter of 1994, radiological events show a very probable decreasing trend.
- CY 1993 is a transition year where a significantly decreasing trend in the number of radiological events is observed. The 28% drop may be attributable to changes in the occurrence reporting Order's (5000.3B) contamination and reporting criteria, significantly reduced levels of DOE operations, and the implementation of the Radiological Control Manual. Each of these, coupled with increased worker awareness relative to radiological controls, helped to establish this positive trend.
- The spike exhibited in the 3rd quarter of 1993 resulted from a change in detection procedures and contamination definition at the Oak Ridge Y-12 plant, which reported nearly half of the events. Subsequent changes implemented in radiation protection procedures resulted in a substantial reduction in radiation events as Y-12 dropped from being the largest contributor to this indicator to third at present.

Additional Analysis

- A DOE-wide average of 130 radiological events is observed for CY 1991 and 1992. This seems to be the typical or baseline level of performance for the DOE complex prior to the mission changes effected, in part, by the end of the Cold War and the implementation of more aggressive ES&H policies.
- Data from the 3rd quarter of each calendar year (i.e., July, August, and September) is generally higher because, historically, more contamination events occur in the summer months. Based on discussions with the field, it is postulated that the hot/humid conditions during the 3rd quarter can lead to a more difficult working

environment and increase migration of contamination through perspiration-soaked protective clothing.

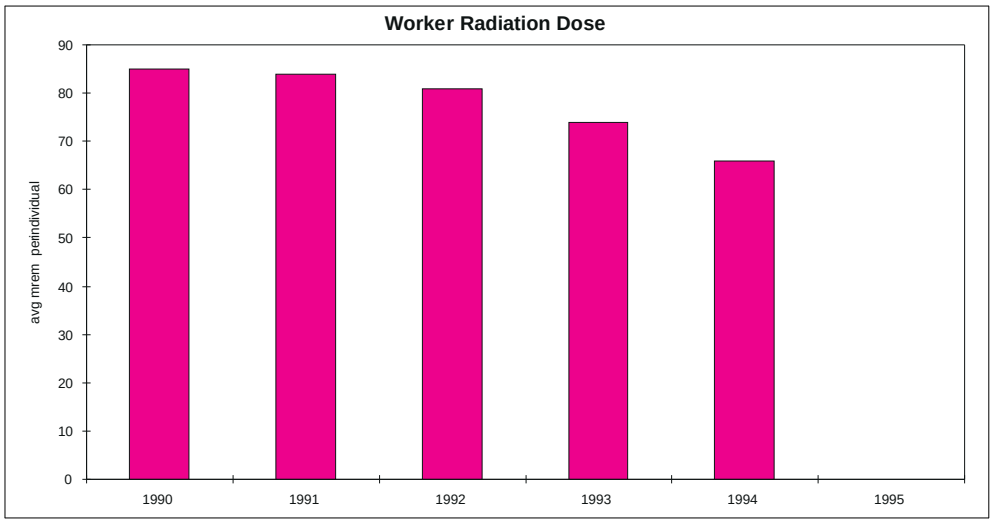
Indicator

2. Worker Radiation Dose

Definition

The average measurable dose to DOE workers, determined by dividing the collective total effective dose equivalent (TEDE) by the number of individuals with measurable dose.

TEDE is determined by combining both internal and external contributions to an individual's occupational exposure. The number of individuals receiving measurable dose is used as an indicator of the exposed workforce size. It includes any individual (federal employees, contractors, subcontractors, and visitors) with reported doses greater than the minimum detectable dose.



Source: DOE Radiation Exposure Monitoring System (REMS) printed from Safety Performance Measurement System (SPMS) on 10/18/95.

Key Observations

- The average TEDE per individual with measurable exposure decreased from 85 mrem in 1990 to 65 mrem in 1994 (for comparison, a typical chest x-ray yields a dose of approximately 65 mrem). This decrease in dose may be attributed to:
  - a change in the scope and nature of work being performed throughout the DOE complex from more to less radiation work, and/or
  - an increased awareness and emphasis on good radiation control practices, e.g., implementation of the Radiological Control Manual in June of 1992, increased radiation control training, and continuing ALARA practices, and/or
  - a change in the methodology used in calculating the TEDE in CY-1993 (see Glossary in Appendix A for further explanation).
- As a basis of comparison, the average Occupational Radiation Exposure received by personnel assigned to the tenders, bases, and nuclear-powered ships associated with the Naval nuclear propulsion program was 40 mrem per individuals with measurable doses for 1994 versus 65 mrem for DOE. The following table provides information on average occupational exposures for workers with measurable dose for other industries.

Occupational category	Mean annual dose equivalent in mrem (for workers that received a rad dose)
Nuclear power reactors	440
Nuclear fuel fabrication	130
Dentistry	20
Hospital worker	160
Education	80
All radiation workers	190

Source of table: U.S. EPA Summary of National Occupational Exposures for 1985.

Additional Analysis

- In 1994:
  - 66% of the 184,073 DOE workers and contractors were monitored; of those monitored, 23% received a measurable dose.
  - No individuals exceeded the DOE limit of 5 rem, one individual exceed the administrative limit of 2 rem.
  - The 5 locations with highest average dose per worker contributed 22% of the DOE TEDE while representing 10% of the workers with measurable dose. These locations and average dose (mrem) are: Argonne Natl. Laboratory - East (144), Idaho Natl. Engineering Laboratory (143), Lawrence Livermore Natl. Laboratory (129), Brookhaven Natl. Laboratory (107), and Nevada Test Site (100).
- The average radiation worker dose received from DOE operations in 1994 was 65 mrem per individual. This should be contrasted to background radiation levels of 30 mrem per individual from cosmic radiation, 30 mrem per individual from terrestrial sources, 40 mrem per individual from food, and 200 mrem from naturally occurring Radon sources.

Indicator

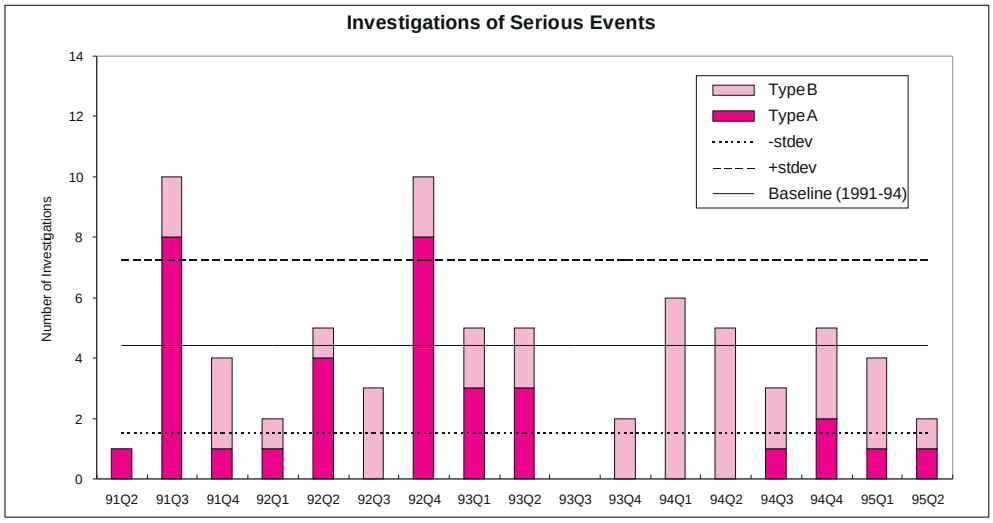
3. Investigations of Serious Events

Definition

Investigation of accidents with significant human effects, environmental effects, or property damage.

Type A investigations include accidents which involve: a fatality, hospitalization or permanent disability of at least 3 people, significant radiation dose (>25 rem), releases more than 5 times that reportable under 40 CFR 302, and property damage in excess of $2.5 million.

Type B investigations include accidents which involve: at least 1 person hospitalized for more than 5 days, 5 related lost workday cases within 1 year, accidents involving 5 or more people, radiation exposures (10-25 rem), releases 2-5 times that reportable under 40 CFR 302, and property damage of $1-2.5 million.



Source: Computerized Accident/Incident Reporting System.

Key Observations

- The data spikes in 3rd quarter 1991 and 4th quarter 1992 are attributable to aircraft accidents, both with multiple fatalities. A USAir crash in 3rd quarter 1994 that involved 9 DOE fatalities was not included with the data.
- There were 5 Hoisting and Rigging related incidents (4 of the 5 were Type A investigations); 3 of which resulted in fatalities.
- No statistically significant trends are observed.

Additional Analysis

Addressing the two peaks on the graph:

- In July 1991, an Airborne Response team helicopter using night vision goggles crashed at the Nevada Test Site after the helicopter struck the power lines. All five people on board were killed.
- In December 1992, a Western Area Power aircraft crashed into a warehouse in Billings Montana. All eight people on board were killed.

- Of the 5 hoisting and rigging incidents, 4 were directly attributable to rigging (e.g., equipment failure).

- Other activities which impacted the number of investigations included:
  - Pressurized vessel (6)
  - Vehicle accidents (3)
  - Natural phenomena (3)
  - Explosions (3)
  - Electrical (3)
  - Water hammer (2)
- Of the 34 Type “A” investigations, 29 involved fatalities.
- Of the 29 fatalities, 7 were attributable to security training operations involving 3 separate incidents. Corrective actions taken include placing an enhanced emphasis on the Aviation Safety Committee. Also, a guide was issued for the conduct of security exercises. The guide requires DOE approval prior to participating in security force related competitions.

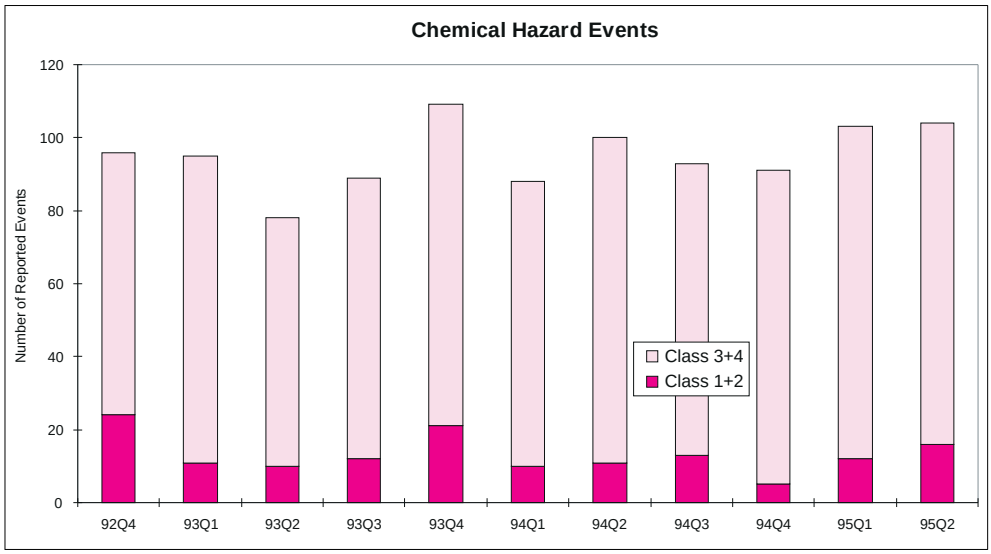
Indicator

4. Chemical Hazard Events

Definition

The number of events reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information*, that are gathered by a word search for specific chemical names. The selected events are reviewed and screened for events meeting one of the following categories:

- Class 1 - An injury or exposure requiring hospital treatment, or confirmed, severe environmental effect.
- Class 2 - Minor injury (first aid) or exposure, or minor environmental damage.
- Class 3 - Potential precursors to the occurrences in Class 1 or 2.
- Class 4 - Minor occurrences such as leaks, spills, or releases which are significant by the frequency, but not by the consequences.



Source: Chemical Safety Concerns: A Quarterly Review of ORPS April 1995–June 1995. U.S. Department of Energy, Office of Field Support, EH-53.

Chemical Safety Concerns: An Annual Review of ORPS January 1994–December 1994. U.S. Department of Energy, Office of Field Support, EH-53.

Management Response Plan for the Chemical Safety Vulnerability Working Group Report, Volumes 1, 2, and 3, U.S .Department of Energy, DOE EH-0396P, 1994.

Key Observations

- An average of 98 Class 1-4 chemical incidents are reported quarterly from across the DOE complex. Most (i.e., 70 to 80%) of these reported events are of the less severe Class 3 and 4 type. There is no identifiable trend in any Class type.
- During the 2nd quarter of 1995, there were a total of 16 Class 1 or Class 2 incidents. Only two previous quarters of the last 11 exceeded this number of serious incidents. The combined Class 1 and 2 incidents from the 2nd quarter of 1995 are predominantly worker exposure incidents involving spills, leaks, releases, and inadequate work control problems.
- The five chemicals most frequently involved in incidents for the current quarter were uranium hexafluoride, hydrogen, nitric acid, other acids, and ethylene glycol. Combined, these accounted for about one third of the total recorded incidents.

- Uranium hexafluoride and hydrogen were involved in the most reported incidents for the previous quarter and in the entire 1994 reporting period.

Additional Analysis

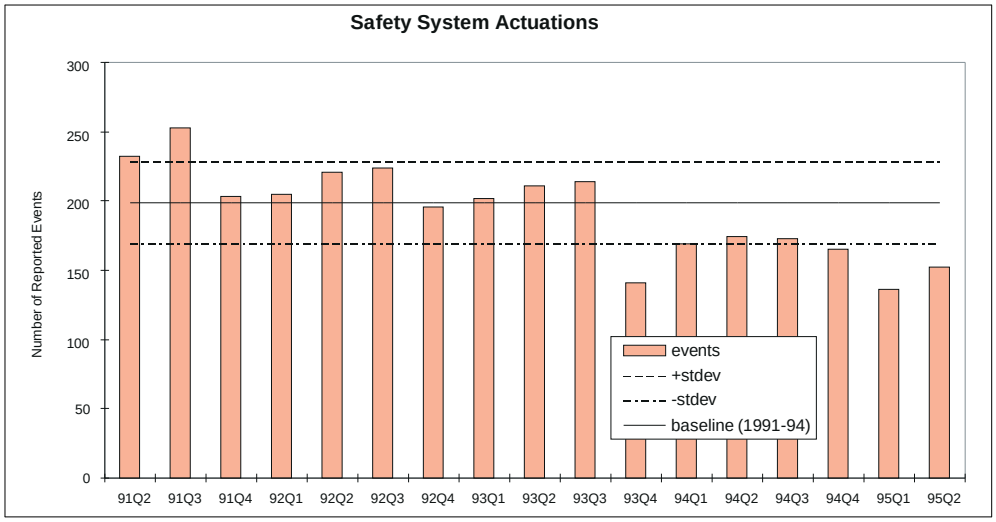
- Analysis of the Department of Energy's available information indicates a relatively consistent pattern of chemical safety incidents since data collection began in the latter part of 1992. However, for the first two quarters of 1995, there have been 28 combined Class 1 or 2 events compared to 18 reported events in the previous 6 months. No trend over the 11-quarter period is evident.
- Both of the Class 1 events during the 2nd quarter of 1995 occurred at Los Alamos National Laboratory (LANL). The Class 1 events involved a leaking chemical shipment and an acid drain line backup in an occupied area. Combined, the two events impacted a total of 14 people. The 14 Class 2 events involved 7 inhalation events, 4 spills, 2 leaks, and 1 splash event. Albuquerque facilities reported 5 of the 16 events, while Richland facilities reported 4. DOE-AL personnel indicated that LANL maintains a lower reporting threshold than required by ORPS, which may account for their higher total. No programmatic concerns were identified by the field as a result of these events.
- The event data can be normalized by events per 200,000 hours worked. This is not directly shown on the graph; however, when compared to the chemical industry (using 1993 data), DOE's total recordable case rate (TRC) of 3.7 represents a rate higher than the best-in-class chemical manufacturers TRC rate of 2.98 (based on 1993 data provided by the Chemical Manufacturers Association). On the other hand, the DOE TRC rate is below that of the average chemical company TRC rate of 5.9 (based on Bureau of Labor Statistics 1993 data).

Indicator

5. Safety System Actuations

Definition

Number of operations-related events determined to be safety system actuations reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.* This includes actuation of any safety class equipment or alarm, unplanned electrical outages, unplanned outages of service systems, serious disruption of facility activity related to weather phenomenon, facility evacuations, or loss of process ventilation. These events have the potential to impact the safety and health of workers in the vicinity.



Source: Occurrence Reports.

Key Observations

- There is a marked decrease in the number of safety system actuations reported two quarters following the implementation of version B to the occurrence reporting Order (5000.3B). The average of the last seven quarters is more than three standard deviations lower than the average of the first ten quarters. There is no trend evident over the last seven quarters following changes to the reporting criteria and reporting thresholds of DOE Order 5000.3B.
- Overall, approximately 70% of the safety system actuations reported were from false initiators (based on sampling the six leading contractors).
- During the 2nd quarter of 1995, the six leading contractors reporting safety system actuations, reported 49% of the actuations from false initiators.
- Fire and smoke alarms were the leading cause of false alarms during the 2nd quarter of 1995. Of the false fire alarms, 20% were the result of improperly performed surveillances, and an additional 20% were the result of inadvertent actuation of hand-pull stations. The major false actuations for the quarter were:
  - Fire/smoke alarm - 25%
  - Radiation alarm - 17%
  - Power outage/transient - 12%

- A sampling of 1,422 false alarms dating to the 2nd quarter of 1991 indicates the following distribution:
  - Power outage/transient - 26%
  - Fire/smoke alarm - 14%
  - Radiation alarm - 3%

Additional Analysis

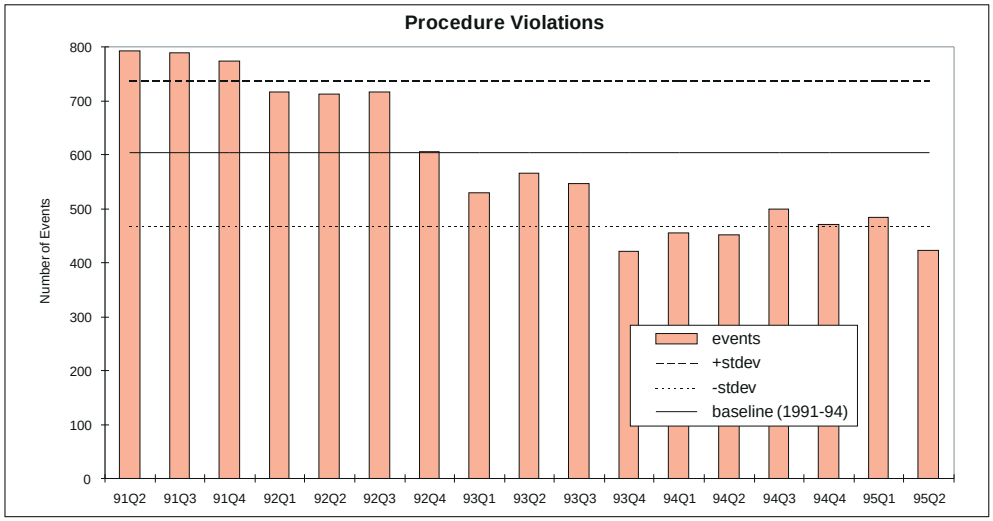
- During the 2nd quarter of 1995, six contractors reported a notable number of safety system actuations: Westinghouse Savannah River Company (WSRC-29); Lockheed Martin Utility Systems (LMUS-24); Westinghouse Hanford Company (WHC-20); Lockheed Martin Energy Systems (LMES-11); EG&G Rocky Flats (EGGR-10); and Lockheed Idaho Technologies Company (LITC-10). These contractor totals represent 68% of the reported safety system actuations during the second quarter. The total safety system actuations reported by these six contractors were considered the result of false alarms, disrupted power supplies, or malfunctioning equipment 72% of the time. Some 44% of the false alarms were attributed to defective or failed parts.
  - The WSRC true actuations were predominantly radioactivity alarms. No single facility dominated, and no trends are evident.
  - The LMUS true actuations were divided between Paducah and Portsmouth. The actuations involved uranium hexaflouride (UF6) steam wisps and autoclave shutdowns. No trend in actuations at either facility was noted.
  - The true actuations reported by the remaining leading contractors include several small fires, smoke or haze actuating fire alarms, and ventilation shutdowns. No single facility showed any domination in contributing to the quarter total.
- During the 2nd quarter of 1995, four events were classified as unusual events in accordance with the occurrence reporting order (232.1). These involved three separate facilities. An air reversal occurred at building 371 in Rocky Flats. A supply fan shutdown occurred at building 771 in Rocky Flats due to operator inexperience. Two UF6 wisp releases occurred at Portsmouth. One occurred during a sampling evolution, and the second occurred during a loop startup. None of these appear to be part of any long-term trend.
- An interesting phenomenon is not shown on the quarterly graph. In July 1991 and in each subsequent June, there is a pronounced peak in the number of reported safety system actuations. The increases are notable among the balance of plant facilities and the nuclear waste operations/disposal facilities. The leading root causes during these months include defective materials, drawing errors, and insufficient training or practice. Many of these events are construction related. The nature of the construction activities tends to result in more safety system actuations (e.g., cut power lines, fire alarms, etc.). Field inputs indicate that this may represent the large-scale resumption of outdoor activities at many facilities at the start of the summer. No single facility or location shows any dominance in contributing to the total monthly values; rather, numerous facilities show small increases during these months.

Indicator

6. Procedure Violations

Definition

Number of reportable events as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information* which are either categorized as procedure violations or problems, or which are reported as being caused by a procedure violation or problem.



Source: Occurrence Reports

Key Observations

- Procedure violation problems influence about 35% of all occurrence reports.
- Most (85%) of the procedure problems are minor (i.e., events classified as off-normal), which is slightly higher than in the total population of occurrence reports, where the percentage of off-normal reports is 81%.
- Procedure problems have been significantly less frequent than the historical baseline for five of the last seven quarters (at least 1 standard deviation below the 1991-1994 historical average). That is, recent performance is consistently better than the historical baseline. The trend may be attributable to implementation of procedure reduction programs and changes to the event reporting criteria and/or reporting thresholds.

Additional Analysis

- The Balance of Plant (BOP) facility type (e.g., machine shops, site/outside utilities, safeguards/security, transportation, and offices) dominates, contributing 38% of the total in 2nd quarter of 1995. BOP has experienced a significant downward trend since 1991, while other facility types have remained relatively constant. No single facility or site dominates the data.
- Fifteen percent (15%) of the procedure violations in 2nd quarter of 1995 were major (i.e., events classified as unusual or emergency). Twenty-six percent (26%) of these were related to overdue or improperly performed surveillances. The decreasing trend for procedure problems seen since 1991 is driven by a corresponding decreasing trend in the minor procedure problems; major procedure violations have remained relatively constant.
- The most frequent root causes associated with procedure problems are: Personnel errors (44% in 2nd quarter of 1995) and Management problems (30% in 2nd quarter of 1995). The most frequent root causes for all occurrence reports are Management

problems (26%) and Equipment/Materials problems (23%), with Personnel errors making up 18%.

- Although they have remained relatively constant over the last seven quarters, there has been a significant decreasing trend in procedure problems since 1991. This mirrors a similar decreasing trend for all occurrence reports. The trend may be attributable to implementation of procedure reduction programs and changes to the occurrence reporting criteria and/or reporting thresholds.

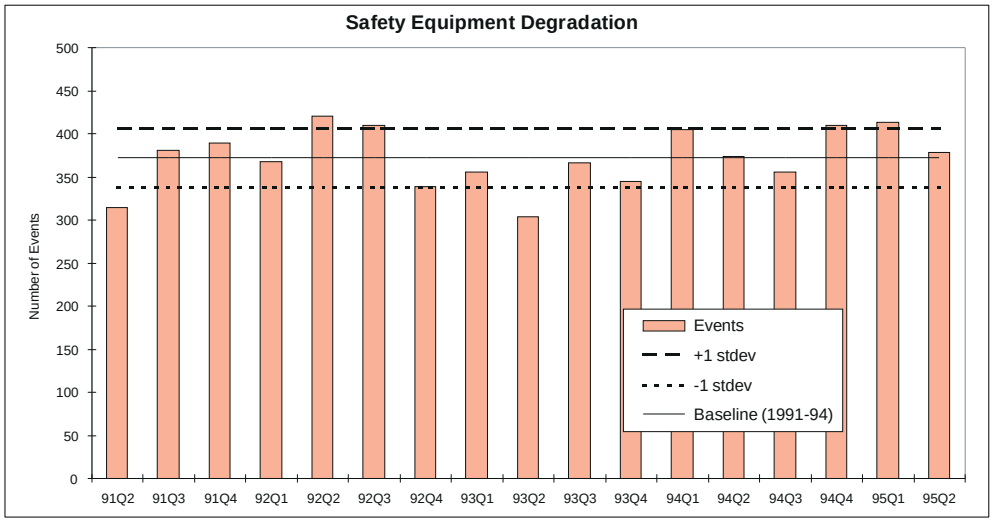
Indicator

7. Safety Equipment Degradation

Definition

Number of reportable events categorized as "vital system/component degradation" as defined in DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information*.

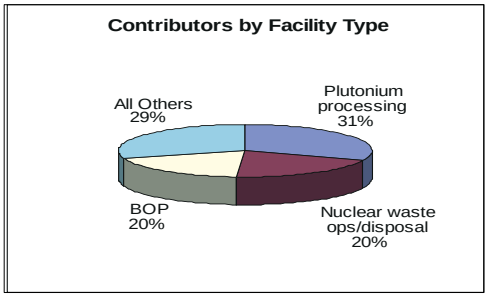
Safety equipment degradation includes: (1) any unplanned occurrence that results in the safety status or the authorization basis of a facility or process being seriously degraded; or (2) a deficiency such that a structure, system or component (SSC) vital to safety or program performance does not conform to stated criteria and cannot perform its intended function; or (3) unsatisfactory surveillance/inspections and appraisal findings of any safety class SSC.



Source: Occurrence Reports.

Key Observations

- The frequency of safety equipment degradation events is constant during the first six months of 1995.
- During the 2nd quarter 1995, defective or failed parts was the root cause of 38% of safety equipment degradation events. The next highest contributor was inadequate or defective design, which caused 7% of the events.
- In the 2nd quarter 1995, 36% of safety equipment degradation events were categorized as 'unusual' occurrences, the higher of the two significance categories. In contrast, only 19% of all other occurrence reports were categorized as unusual events defined in Order 232.1. This suggests that safety equipment degradation events are generally more safety-significant than other types of events reported to ORPS.
- In the 2nd quarter 1995, plutonium processing and handling facilities were the leading contributors to safety equipment degradation events (31%), followed by Balance of Plant (20%) and nuclear waste operations and disposal (20%).



- In the 2nd quarter 1995, the two locations with the highest contributions to safety equipment degradation were Savannah River (36%) and Rocky Flats (31%). The next highest contributors were U.S. Enrichment Corp. (7%) and Idaho (5%). Both Savannah River and Rocky Flats show highly probable increasing trends since 1991.

Additional Analysis

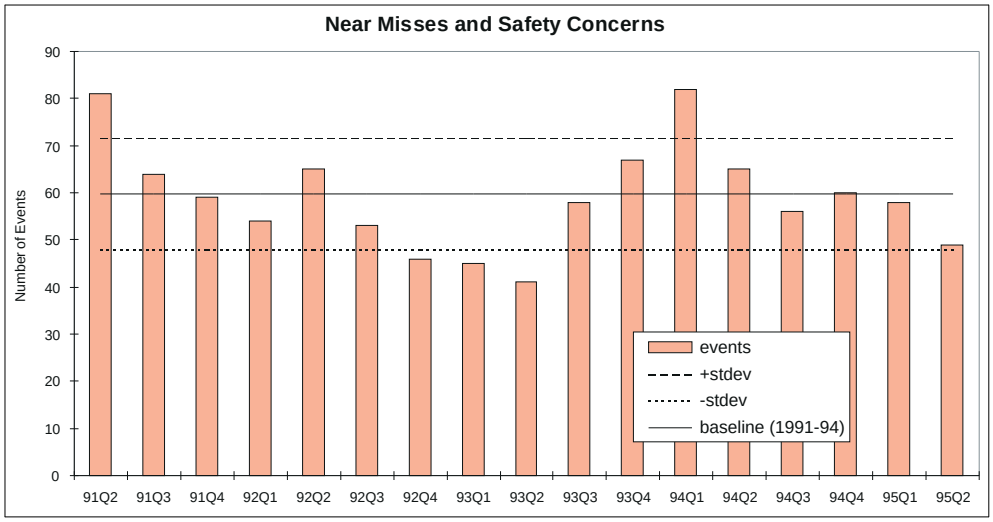
- Defective or failed parts are becoming an increasingly greater contributor to safety equipment degradation events. Since 1991, this root cause shows a highly probable increasing trend. Although further analysis is required, these data indicate that equipment-related problems (such as plant aging or inadequate maintenance) and surveillance and inspection programs may be a primary contributor to increases in the number of safety equipment degradation events reported.
- Since 1991, safety equipment degradation events in plutonium processing facilities and nuclear waste operations and disposal facilities show highly probable increasing trends. These events show a moderately increasing trend in Balance of Plant facilities during the same time period.

Indicator

8. Near Misses and Safety Concerns

Definition

Number of events related to near misses or safety concerns reportable under DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.* A near miss occurs when all barriers to an event initiation are compromised or if only one barrier remains to an event initiation, after other barriers have been compromised. A safety concern exists if the unauthorized use of hazardous products or processes occurs, or if work is shutdown as the result of an Occupational Safety and Health Administration violation.



Source: Occurrence Reports.

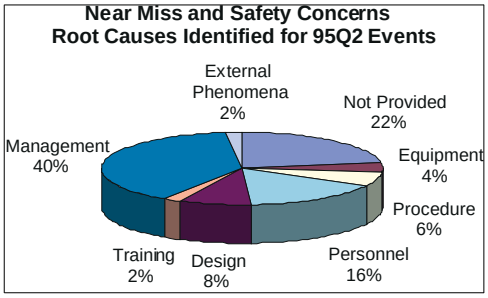
Key Observations

- A declining trend exists through the 2nd quarter of 1993; however, no discernible trend exists after this point. DOE Order 5000.3B was released in February 1993 which increased the number of events reported as a near miss or a safety concern after the 2nd quarter of 1993. The definitions of the applicable ORPS categories changed from what they were per DOE Order 5000.3A prior to February 1993.
- Electrical safety, radiation protection, and inadequate work controls are the main drivers of near misses and safety concerns. For the second quarter 1995:
  - Electrical Safety Events-16 (33%)
  - Radiation Protection Events-10 (20%)
  - Inadequate Work Controls/Procedure Violation Events-6 (12%)

Additional Analysis

- During the 2nd quarter of 1995, a total of 49 events were reported. The majority (47) were categorized as off-normal events. The remaining two events were classified as unusual events. One of the unusual events included cutting energized cables after tracing the incorrect conduit. The second unusual event involved an administrative loss of work control over a lockout-tagout while work was being performed which resulted in improperly opening a boundary valve.

- An in-depth review of 9 months of ORPS data between July 1994 and June 1995, included 157 near miss and safety concern events and yielded results similar to data from the 2nd quarter of 1995:
  - Electrical Safety Events-39 (25%)
  - Radiation Protection Events-17 (11%)
  - Procedures Violations Events-15 (10%)
- During the 2nd quarter of 1995, facilities involved in environmental restoration activities (7) and nuclear waste operations (6) contributed the most to the quarterly total by facility type. No single facility from either of these facility types was a dominant contributor to the quarterly total.
- During the 2nd quarter of 1995, the leading contractors contributing to the quarterly total were Westinghouse Hanford Company (12) and Westinghouse Savannah River Company (8). This is not unexpected as these contractors represent two of the largest and most active sites in the DOE complex. The types of events were varied, and no single facility from either of these contractors was a dominant contributor to the quarterly total.
- During the 2nd quarter of 1995, the most frequently cited root cause was management problems (approximately 40% of the total).



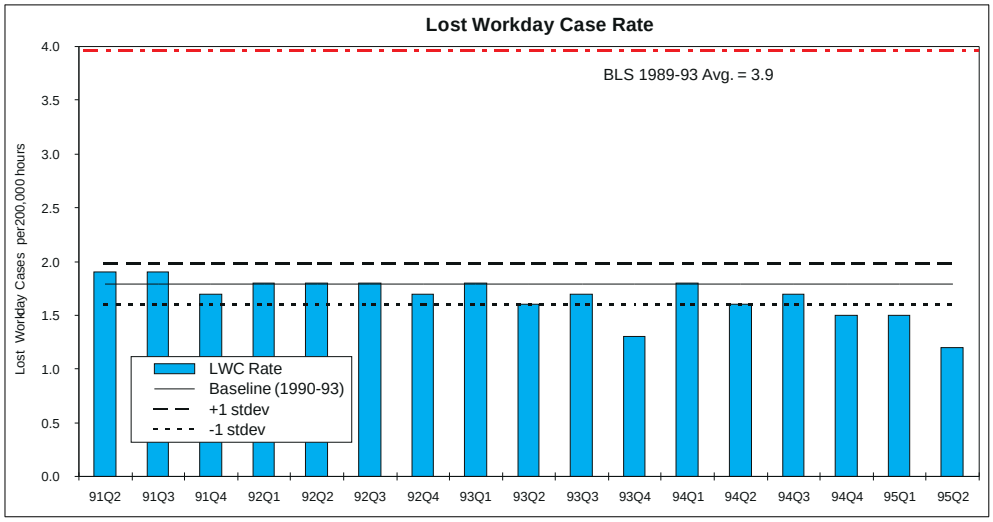
Indicator

9. Lost Workday Case Rate

Definition

A lost workday case is a work related injury or illness that involves days away from work or days of restricted work activity, or both.

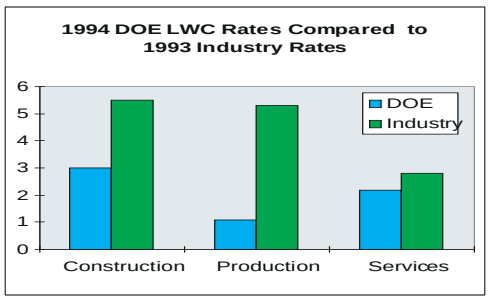
Lost workday case (LWC) rate is the number of lost workday cases per 200,000 hours worked.



Source: Computerized Accident/Incident Reporting System

Key Observations

- The 1994 LWC rate has been relatively constant, even though all four quarters of 1994 and the first two quarters of 1995 fall below the 4-year average (1990-1993) LWC rate. Experience shows that 1994 and 1995 LWC rates will rise due to revisions and late reporting.
- Very general rate comparisons for some operation types can be made to the Department of Labor, Bureau of Labor Statistics private industry classifications. The 1994 DOE construction LWC rate is about one-half the 1993 private sector construction rate; the 1994 DOE production LWC rate is about one-fifth the 1993 private sector manufacturing rate; and the 1994 DOE services LWC rate is approximately four-fifths of the 1993 private sector rate.



Additional Analysis

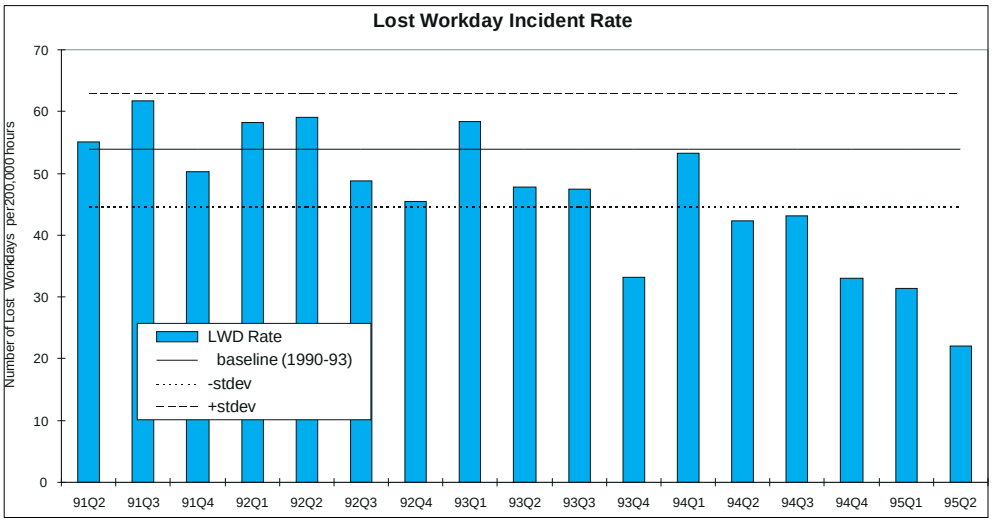
- Disabling falls account for 20% of the cases involving days away from work for both the construction industry and DOE construction operations. However, DOE workers suffering from disabling falls lose an average of 24 days away from work per case, compared to private industry workers with 14 days. The difference between the average days away from work at DOE, compared to private industry, may be due to one or more of a combination of factors, including the availability of return-to-work programs and the severity of accidents.

10. Lost Workday Incident Rate

Indicator

Definition

The Lost Workday (LWD) Incident Rate is the number of lost workdays per 200,000 hours worked.



Source: Computerized Accident/Incident Reporting System

Key Observations

- The LWD Incident Rate has declined slightly since 1991. The highest percentage of lost workdays has shifted from workdays lost to workdays lost restricted, indicating a possible tendency to reassign injured workers rather than give them the day off. (Note that the LWD incident rate for 1994 and 1995 is expected to increase due to revisions and late reporting.)

Additional Analysis

The days lost are assigned to the quarter in which the case occurred as opposed to the quarter that the time is taken off. This results in frequent updates to the historical information, since the number of days associated with a case can increase as the individual remains off the job.

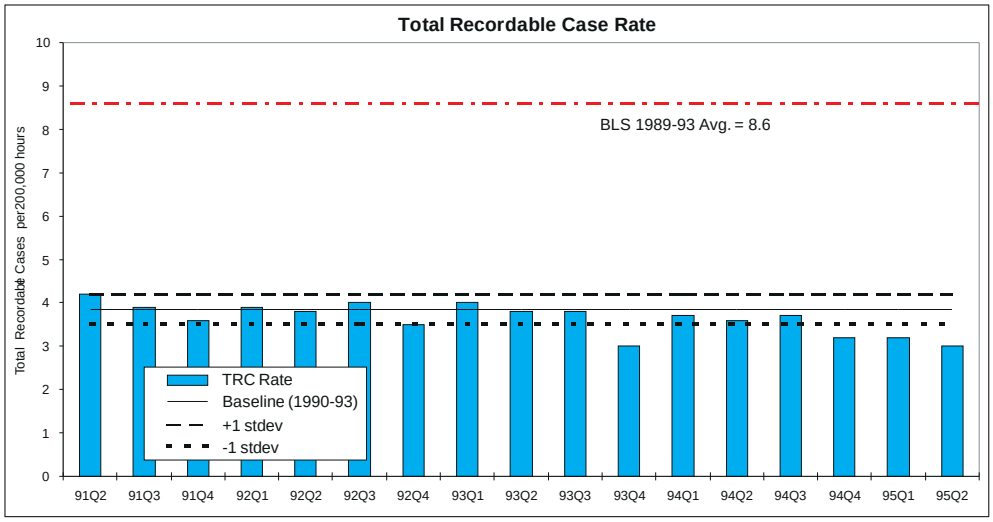
Indicator

11. Total Recordable Case Rate

Definition

Total recordable cases (TRC) are all work-related deaths and illnesses, and those work-related injuries which result in loss of consciousness, restriction of work or motion, transfer to another job, or require medical treatment beyond first aid.

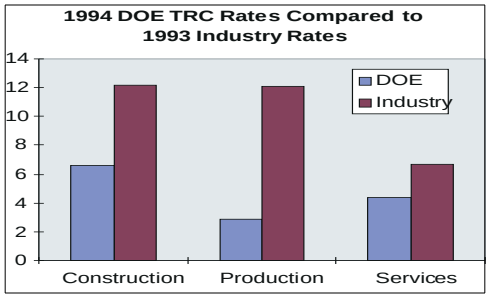
Total recordable cases include all occupational injuries and illnesses that result in either death, a lost workday case, or a non-fatal case without lost workdays. Therefore, TRCs will always be either equal to or greater than the number of lost workday cases. Total recordable case rate is the number of TRCs per 200,000 hours worked.



Source: Computerized Accident/Incident Reporting System

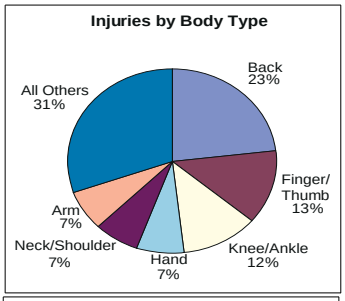
Key Observations

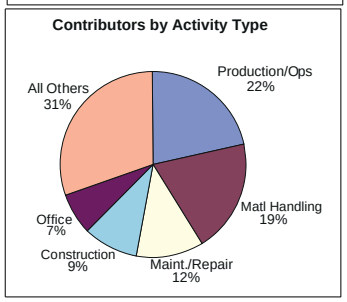
- The 1994 TRC rate has been relatively constant, although all four quarters of 1994 and the first two quarters of 1995 fall below the 4-year average (1990-1993) TRC rate. Experience shows that 1994 and 1995 TRC rates will rise due to revisions and late reporting.
- Very general rate comparisons for some operation types can be made to the Department of Labor, Bureau of Labor Statistics private industry classifications. The 1994 DOE construction TRC rate is approximately one-half the 1993 private sector construction rate; the 1994 DOE production TRC rate is about one-fourth the 1993 private sector manufacturing rate; and the 1994 DOE services TRC rate is about two-thirds the 1993 private sector services rate.



Additional Analysis

- A total of 6,204 injury or illness cases have been reported as of October 1995 for the 1994 12-month period. Forty-seven percent of these cases resulted in a lost workday case (a total of 72,899 lost workdays). In 1993, 44% of injury/illness cases resulted in a lost workday case (a total of 84,331 lost workdays).





- In 1994 strains and sprains account for one-third of all injuries and one-half of all lost workdays associated with DOE injuries. Back and knee injuries occurred frequently (one-fifth of all injuries were back injuries, while one-tenth were knee injuries) and were relatively severe (accounting for 30% and 13%, respectively, of lost workdays associated with DOE injuries in 1994).
- Production/operation and material handling activities emerge as high-risk activities. In addition, several generic occupation categories show a high risk: handler, laborer, or helper; security guard; plant, system or utility operator; and mechanic or repairer.
- Falls account for 11% of construction contractor total recordable cases, 16% of their lost workday cases, and 18% of their lost workdays reported in 1994. Handlers, laborers, helpers, carpenters, and electricians experience the greatest number of falls. Sprains, strains, and unspecified injuries occurred with high frequency and severity; however, fracture shows the highest severity (38 lost workdays per injury). The back was the most frequently injured body part, and the injury was also relatively severe (27 lost workdays per case).
- According to the most recent survey estimates provided by the U.S. Department of Labor, Bureau of Labor Statistics, seven percent (7%) of the total injuries and illnesses reported by private industry during 1993 were classified as work-related illnesses. As a comparison, 22% of the total injuries and illnesses reported by the DOE during 1994 were classified as work-related illnesses.
- About 60% of total occupational illnesses were reported by private industry as disorders associated with repeated trauma (also known as cumulative trauma disorders) in 1993, the most recent survey estimates provided by the U.S. Department of Labor, Bureau of Labor Statistics. In 1994, the DOE also reported approximately 60% of total occupational illnesses as repeated trauma disorders; however, private industry averages 20 lost workdays per case compared to the DOE with 10 lost workdays per case.

Indicator

12. Occupational Safety and Health Cost Index

Definition

In general terms, the DOE Occupational Safety and Health Cost Index represents the amount of money lost to injuries/illnesses for every hour worked by the total workforce. The Index is a coefficient calculated from the direct and indirect dollar costs of injuries. It is not a direct dollar value and is not commonly used in private industry. DOE sites use this index to measure their progress in worker safety and health. The index is computed as follows:

Cost Index = 100 (1,000,000 D + 500,000 T + 2,000 LWC +1,000 WDL + 400 WDLR +2,000 NFC) divided by the total hours worked, where

D = the number of deaths,

T = the number of permanent transfers or terminations due to occupational illness or injury,

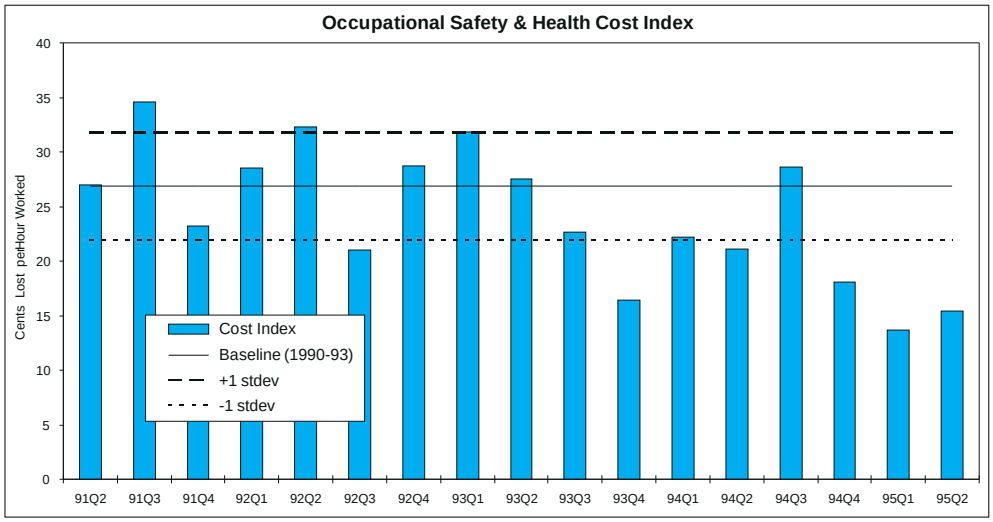
LWC= the number of lost workday cases,

WDL = the number of days away from work,

WDLR = the number of restricted workdays, and

NFC = the number of non-fatal cases without days away from work or restricted workdays.

The coefficients are weighting factors which were derived from a study of the direct and indirect dollar costs of injuries.



Source: Computerized Accident/Incident Reporting System

Key Observations

- With the exception of the 3rd quarter 1994, the Cost Index for each quarter in 1994 and the first two quarters of 1995 fall below the 4-year average (1990-1993) Cost Index. (Note that experience shows that the Cost Index will rise for 1994 and 1995 due to revisions and late reporting.)

- The Cost Index has turned downward slightly since 1991. This is most likely due to the overall decrease in lost workdays, with declines in both workdays lost (WDL) and workdays lost restricted (WDLR).
- Work-related fatalities resulted in 6.5 deaths per 100,000 workers in 1994. The highest number of accidental fatalities (12) occurred in 1994. Ten of the 12 fatalities occurred in the 3rd quarter of 1994. Of these, 9 DOE employees were killed in September 1994 when a commercial aircraft (USAir) crashed in Pittsburgh.

Indicator

13. Worker Health

Performance measures focusing on worker health are under development. The following discussion provides a summary of these efforts.

Future

Background

The need for performance measures for health is well recognized within the Department of Energy. Appropriate measurements of health oriented programs and their impact on worker health facilitate one of the most effective uses of limited resources and assist in focusing programs toward the core mission of protecting and enhancing worker health. The health of the individual reflects not only occupational factors but lifestyle choices, genetics, and other nonoccupational factors as well. To assess worker health to the extent that occupational factors affect it, performance measurements should reflect occupational factors. The Office of Health Studies is focusing its initial development efforts on measurements that assess worker health rather than measuring health program development and implementation.

To date, OSHA recordable injury and illness data are the only DOE complex-wide data addressing issues of worker health. The Epidemiologic Studies Program of the Office of Health Studies collects a broader array of health outcome data. The program now involves 10 sites. While this program is not yet complex wide, it can contribute standardized health data for participating sites in a format that facilitates analysis. These data are collected on a nearly real time basis and are part of an established, ongoing system.

Future developments in the evolution of performance measurements for health will be facilitated by the implementation of medical (clinical) surveillance, which will provide additional, clinically oriented data helpful in detecting diseases and conditions that are not yet symptomatic, identifying occupational exposures, and in providing related data useful for measuring performance at the preventive or leading end of the performance measurement spectrum.

Current Activities

The concept of “sentinel health events,” those believed to be strongly associated with occupational exposures, is being examined for the development of potentially useful measures of occupational health.

An examination of key corporate worker health programs is being conducted to identify performance measures of health that others have found effective. As in government, private industry reflects a range of developments in this area. The Chemical Manufacturers Association has also developed guidelines which may have relevance to some aspects of worker health measurement at DOE.

A recent survey of DOE Occupational Physicians, conducted by the Office of Health Studies, identified performance measurement activities at the field level in various occupational medicine clinics throughout the complex. With almost three fourths of the sites contributing responses to the survey we have developed a data base of information on potential performance measurements and the availability of automated data to support their use at the Headquarters level.

Potential Performance Measurements

Initially, EH is considering the following three performance measurements related to health.

Blood Lead concentration: The measurement of blood lead concentration is being considered because the potential for exposure is believed to be relatively pervasive, monitoring of workers at potential risk for exposure to lead is prevalent at most sites, and reliable data are available to assess DOE workers' exposure.

Noise induced hearing loss: Noise induced hearing loss can exist in varying degree and can be detected in its early stages, providing a mechanism for prevention of further loss as well as an potential indication of workplace conditions that may require remediation to reduce or eliminate exposure. Again, the potential for exposure is relatively common, the capability to measure hearing loss is well developed and widely available, and many sites already have audiometry data available in automated form.

Carpal Tunnel Syndrome: Carpal tunnel syndrome is a repetitive motion injury of interest as a potential performance measurement because it is frequently diagnosed among workers whose tasks involve sedentary work at desks or computer stations rather than more traditional tasks involving greater physical exertion. Rates of diagnosis or absence related to this syndrome would focus on a group of workers who are not commonly exposed to a variety of more traditional chemical, radiation, and other exposures. Data pertaining to carpal tunnel syndrome are readily available for epidemiologic surveillance sites and the availability will expand further with the implementation of the Medical Surveillance Information System.

Other Potential Indicators

Our initial efforts have identified potential performance measurements outlined above. Stakeholders have also offered a variety of other suggestions regarding potential measurements of use in assessing the health of the DOE workforce. These suggestions and alternative measurements are also under consideration.

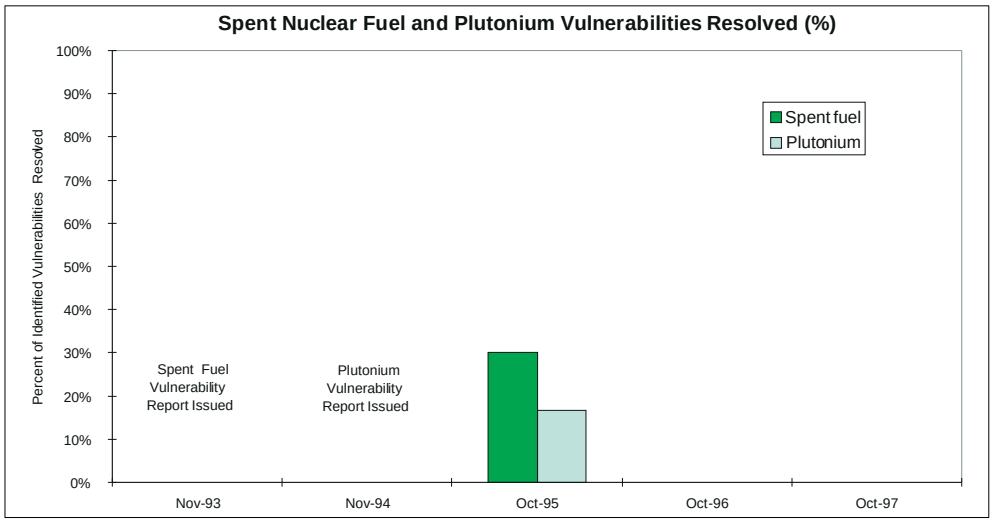
Indicator

14. Spent Nuclear Fuel and Plutonium Vulnerabilities Resolved

Definition

The number of resolved plutonium and spent fuel vulnerabilities divided by the total number of vulnerabilities as defined in *Spent Fuel Working Group Report on Inventory and Storage of the Department's Spent Nuclear Fuel...and Their Environmental, Safety, and Health Vulnerabilities,* Volume 1, November 1993, and *Plutonium Working Group Report on Environmental, Safety, and Health Vulnerabilities*, Volume 1, November 1994 (DOE/EH-0415).

An ES&H vulnerability is defined in the plutonium and spent fuel vulnerability reports as "conditions or weaknesses that could lead to unnecessary or increased radiation exposure of workers, release of radioactive material to the environment or radiation exposure of the public." A resolved vulnerability implies that the cited condition no longer exists. Vulnerabilities can be characterized as material/packaging (e.g., storage of unstable and corrosive solutions), facility condition (e.g., facility weaknesses), or institutional vulnerabilities (e.g., loss of experienced personnel). The vulnerabilities were ranked by significance based on the likelihood of an accident and the perceived consequences.



Source: Draft Plutonium Vulnerability Management Summary Report (EM-60),
Reports on Status of Corrective Actions to Resolve Spent Nuclear Fuel Vulnerabilities, 10/5/95 (EM-37).
Plutonium Vulnerability Management Plan, DOE/EM-0199.

Key Observations

- There are 299 plutonium vulnerabilities at 13 sites and 106 spent fuel vulnerabilities at 11 sites.

<u>Spent Fuel Vulnerabilities</u>

- Hanford, Idaho National Engineering Laboratory (INEL), and Savannah River account for 85% of the spent fuel vulnerabilities (36, 33, and 21 vulnerabilities, respectively). The Spent Fuel Working Group Report indicates that approximately 80%, by weight, of the spent fuel total at DOE facilities is stored at Hanford, 8% at INEL, and 8% at Savannah River.
- Thirty-two percent of the spent fuel vulnerabilities noted by the spent fuel study have been satisfactorily resolved. Hanford has resolved 25% of its vulnerabilities (9 of 36), Idaho 15% (5 of 33), and Savannah River 52% (11 of 21).

Plutonium Vulnerabilities

- Rocky Flats, Los Alamos, Savannah River, and Hanford account for 73% of the plutonium vulnerabilities (87, 60, 39, and 33 vulnerabilities, respectively). Pantex has only 4% (11) of the plutonium vulnerabilities. The Plutonium Working Group Report indicates that, excluding plutonium in intact weapons or at facilities actively undergoing decontamination and decommissioning, approximately 49%, by weight, of the plutonium at DOE facilities is stored at Rocky Flats, 17% at Hanford, 10% at Los Alamos, and 8% at Savannah River.
- Seventeen percent of the plutonium vulnerabilities noted by the plutonium study have been satisfactorily resolved. Los Alamos has resolved 12% (7 of 60) of its vulnerabilities, Hanford 9% (3 of 33) and Savannah River and Rocky Flats have each resolved 5% (2 of 39 and 4 of 87, respectively).

Additional Analysis

Plutonium Vulnerabilities: 46 of the 299 plutonium vulnerabilities considered to be *most significant* are characterized in the Plutonium Working Group Report as follows.

- Workers - 15 vulnerabilities have both the highest consequences and the highest likelihood to workers. These vulnerabilities do not affect the public or the environment because they involve relatively small releases of plutonium into work areas, which could cause high localized exposures but would have negligible consequences outside of facilities. The 15 vulnerability locations include:
  - 10 at Rocky Flats (5 characterized as facility condition and 5 characterized as material/packaging)
  - 4 at Hanford (characterized as material/packaging)
  - 1 at Lawrence Livermore National Laboratory Hanford (characterized as material/packaging)
- Public and Environment - 22 vulnerabilities have potentially high or medium consequences to the public, high consequences to the environment, and medium or low likelihood of occurrence. These vulnerabilities also impact workers, but are not categorized as worker vulnerabilities because they do not fall into the associated high consequence and high likelihood group. The 22 vulnerability locations include:
  - 17 at Rocky Flats (characterized as facility condition)
  - 2 at Savannah River (characterized as material/packaging)
  - 2 at Mound (characterized as material/packaging)
  - 1 at Hanford (characterized as facility condition)
- Environment - 9 vulnerabilities pose high environmental consequences but pose low to negligible public consequences because, in most cases, distances to site boundaries allow for dilution of released plutonium before it can reach the public. The 9 vulnerability locations include:
  - 4 at Savannah River (2 characterized as facility condition and 2 characterized as material/packaging)
  - 2 at Oak Ridge (characterized as material/packaging)
  - 1 at Rocky Flats (characterized as facility condition)
  - 1 at Los Alamos (characterized as material/packaging)

- 1 at Hanford (characterized as facility condition)

Three of the 46 most significant plutonium vulnerabilities have been resolved. An additional 37 are covered by site plans in response to DNFSB recommendation 94-1 concerning the remediation of shutdown production facilities.

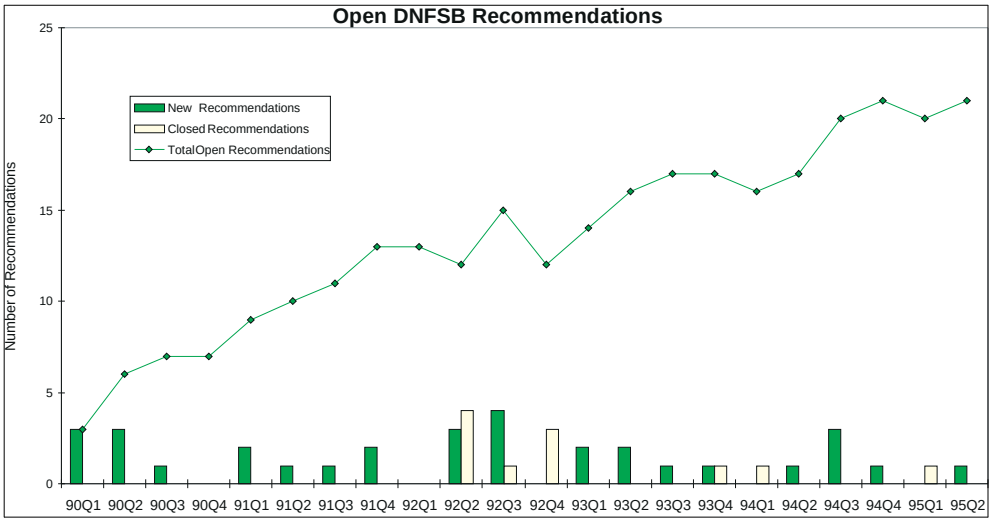
15. Open DNFSB Recommendations

Indicator

Definition

The cumulative number of open Defense Nuclear Facilities Safety Board (DNFSB) recommendations. DNFSB recommendations only apply to DOE defense nuclear facilities and, therefore, are representative only of DOE defense facilities involved in nuclear safety issues.

Each DNFSB recommendation leads to a set of commitments which, when fully implemented, will close a recommendation. A commitment is any documented obligation by the Secretary, or designee, that describes products to be delivered on a specified schedule. Commitments resulting from DNFSB recommendations are tracked by the Office of the Departmental Representative to the DNFSB (S-3.1) as completed (fulfilled), not yet due, and overdue.



Source: Safety Issues Management System.

Key Observations

- There are 21 open DNFSB recommendations representing 996 DOE commitments. Of these commitments, 418 (42%) are considered to be satisfied or fulfilled, 373 (37%) are not yet due, and 205 (21%) are considered overdue based on a projected schedule of completion.

Additional Analysis

- Environmental Management (EM) and Defense Programs (DP) are responsible for implementing most of the recommendations. The cumulative subtotals are represented in the following table:

Office	DNFSB Recommendations	Commitments	Fulfilled	Not Yet Due	Overdue
EM	10	455	187 (41%)	189 (42%)	79 (17%)
DP	7	389	139 (36%)	144 (37%)	106 (27%)
EH/HR/NE	4	152	92 (61%)	40 (26%)	20 (13%)
Total	21	996	418 (42%)	373 (37%)	205 (21%)

- Of the 205 overdue commitments, 100 are overdue by less than 3 months (1 quarter). This is 49% of the total commitments considered overdue.

- The largest DNFSB recommendation, based on the number of commitments generated, which EM is responsible for is Recommendation 94-01. This represents 100 commitments, of which only 5% are completely fulfilled; however, only 2% are considered overdue. This recommendation deals with the slow pace of remediation scheduled for F-Canyon at Savannah River, K-Basin at Hanford, 603 Basin at INEL, and plutonium bearing liquids and solids at Rocky Flats, Savannah River, Hanford, and Los Alamos. The DNFSB recommends establishing a high priority on conversion of plutonium materials at these facilities into a form that is safe for interim storage, within two to three years. All but two of the commitments are considered to be on schedule. The missed milestones include inspecting plutonium proximity to plastic at Rocky Flats, which was delayed due to ventilation system repairs, and resolution of EH concerns over the environmental impact statement at Savannah River.
- The largest DNFSB recommendation, based on the number of commitments generated, which DP is responsible for is Recommendation 90-02. This represents 260 commitments, of which 25% are completely fulfilled and 33% are considered to be overdue. This recommendation stems from a review and evaluation of the content and implementation of standards relating to the design, construction, operation, and decommissioning of defense nuclear facilities within the DOE complex. Subsequent to this report, recommendation 95-02 was issued by the DNFSB combining Recommendation 90-02, Recommendation 92-05, and Recommendation 94-5 under one recommendation since they were all similar in nature.

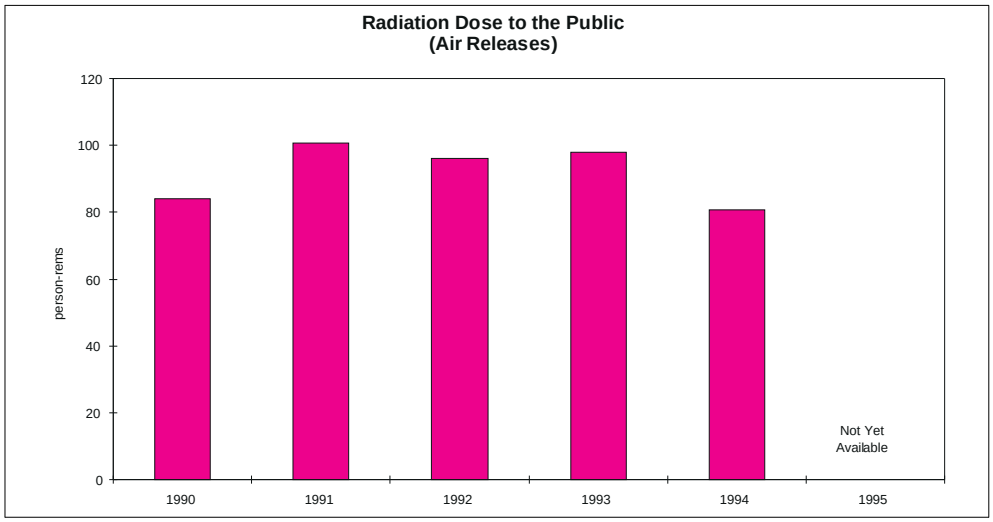
Environment

Indicator

16. Radiation Dose to the Public

Definition

Total collective radiation dose (person-rem) to the public within 50 miles of DOE facilities due to radionuclide airborne releases. “Collective radiation dose” is the sum of the effective dose equivalent to all off-site people within a 50-mile radius of a DOE facility over a calendar year.



Source: Annual reports to EPA, EH-41 data.

Key Observations

- Total collective radiation dose to the public from DOE sources is very low compared to the public dose from natural background radiation, which is approximately 10,000 times greater.
- Over the five years of available data, three sites [Oak Ridge Reservation, Argonne National Laboratory (ANL), and Savannah River Site] consistently account for about two-thirds of the estimated off-site collective radiation dose.
- The overall collective radiation dose decrease in 1994 is due to the lower off-site collective doses at these three sites. The decreases resulted primarily from the reduction in weapons production and development activities at Oak Ridge and Savannah River. ANL reductions resulted mostly from the decrease in Thorium-232 inventory in Building 200 which reduced Radon-220 emissions.
- In 1994, Lawrence Livermore Site 300 (LLNL-300) was also a significant contributor to the total collective radiation dose as a result of more comprehensive estimates of its diffuse emissions.

Additional Analysis

- In 1994, Oak Ridge and Savannah River reported the largest air releases, and were significant contributors to the total collective radiation dose to the public. ANL and LLNL-300 reported smaller air releases during 1994, but these sites are surrounded by higher population densities. Therefore, these sites were also significant contributors to the total collective radiation dose to the public from DOE sources during 1994.

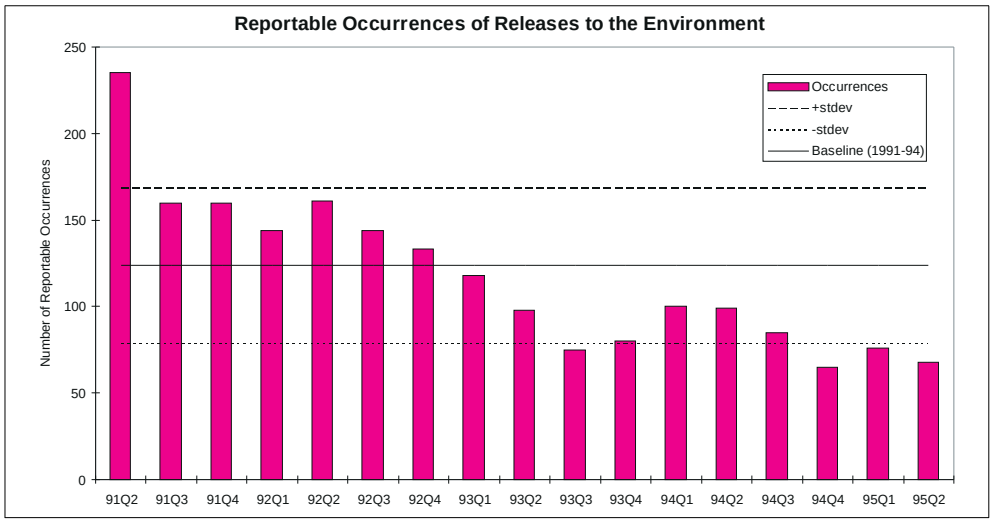
- The increase in collective radiation dose from 1990 to 1991 results from a doubling of the reported collective dose at Savannah River. The results between 1991 and 1992 appear nearly unchanged or show a slight dip in emissions. A 30% increase in the collective dose at Oak Ridge is more than balanced by a 60% decrease in reported collective dose by Savannah River. Between 1992 and 1993, the situation is reversed where the Oak Ridge collective dose is reduced by nearly 50%, but is compensated for by a 60% increase at Savannah River along with a significant increased contribution from LLNL-300.
- In 1994, Lawrence Livermore Site 300 (LLNL-300) was also a significant contributor to the total collective radiation dose as a result of more comprehensive estimates of its diffuse source emissions. This results from a change in EPA policy in which EPA began to pay closer attention to diffuse source emissions. Site 300, therefore, began reporting emissions under National Emission Standards for Hazardous Air Pollutants (NESHAP) using more comprehensive analysis and estimates of the diffuse source emissions. These results are also considered to be based on fairly conservative assumptions. All sites performed similar reviews of diffuse source emissions, but this did not result in any significant change in the total releases reported by other sites.
- Comparisons: The total collective radiation dose to the public around DOE sites from air releases is 0.00013 of the dose received to the same population from natural background radiation.

Indicator

17. Reportable Occurrences of Releases to the Environment

Definition

Releases of radionuclides, hazardous substances or regulated pollutants that are reportable to federal, state, or local agencies.



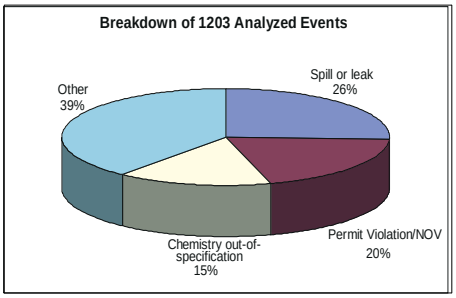
Source: Occurrence Reports

Key Observations

- The number of reportable release incidents has generally decreased over the entire seventeen-quarter period displayed. The decline is also notable over the most recent ten-quarter period following the latest change to DOE's reporting criteria implemented by DOE Order 5000.3B, *Occurrence Reporting and Processing of Operations Information*. In general, there have been fewer opportunities for release incidents with the slow down in operations.

Additional Analysis

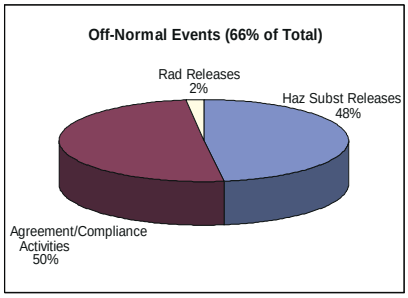
- Two thousand and one (2001) release incidents were reported during the seventeen-quarter period reflected in the above chart. Agreement/compliance activities (ORPS "unusual" or "off-normal" category) and the release of hazard substances, regulated pollutants, or oil (ORPS "unusual" category) comprise 60% (1203 of 2001) of the total. Of these 1203 events:



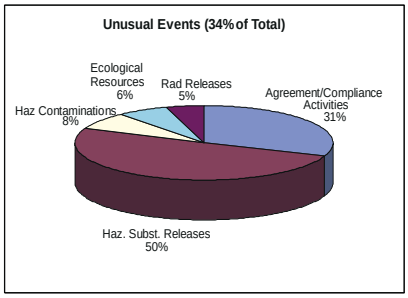
  - 26% (312 of 1203) involved a spill or leak of a hazardous substance, regulated pollutants, or oil,
  - 20% (237 of 1203) involved a permit violation or a Notice of Violation,
  - 15% (184 of 1203) involved out of specification chemistry or sewage in treatment water or waste water streams/outfalls,
  - the most common facility functions cited were balance-of-plant (58%), uranium enrichment (10%), environmental restoration (8%), and fossil/petroleum reserves(8%),

- the majority of the events were reported by Martin Marietta Energy Systems (20%), EG&G Rocky Flats (14%), Los Alamos National Laboratory (11%), and Westinghouse Savannah River Company (9%), and
- the most common root causes cited were management problems, followed by defective parts/materials or defective design.

- Over the seventeen-quarter period depicted in the chart, reportable releases to the environment were categorized as "off-normal" 66% (1330 of 2001) of the time. Of these:
  - 657 involved agreement/compliance activities
  - 649 involved hazardous substance releases
  - 24 involved radiation releases



- Over the seventeen-quarter period depicted in the chart, reportable releases to the environment were categorized as "unusual" 34% (671 of 2001) of the time. Of these:
  - 339 involved hazardous substance releases
  - 207 involved agreement/compliance activities
  - 51 involved hazardous contaminations
  - 42 involved ecological resources
  - 32 involved radiation releases

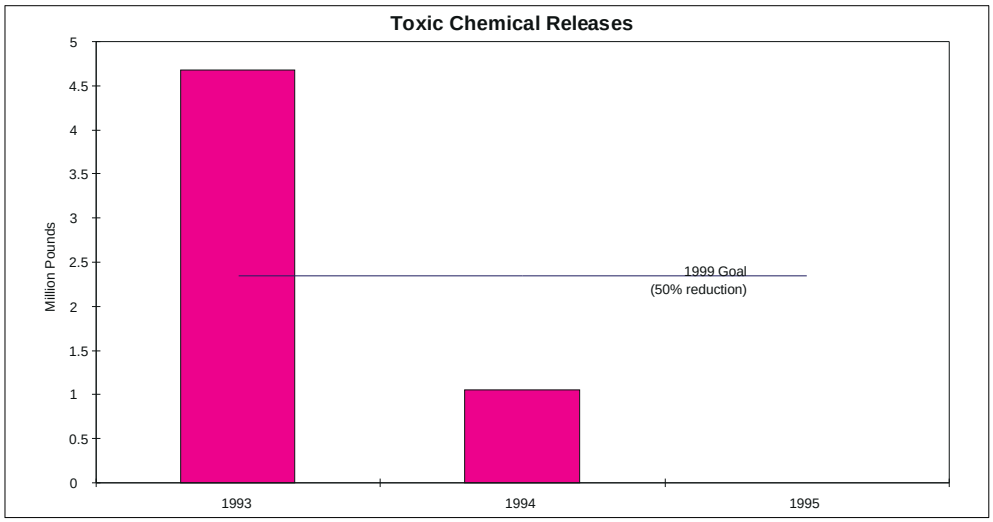


Indicator

18. Toxic Chemical Releases

Definition

Toxic Release Inventory (TRI) chemicals released or transferred off-site for treatment or disposal (pounds).



Source: EPA Toxnet database; individual site Section 313 Form R reports

Key Observations

- Executive Order 12856 requires Federal agencies to reduce by 50 percent their toxic chemical releases and off-site transfers by December 31, 1999. Using a pre-established baseline year of 1993, DOE has already met the stated goal of the executive order.
- Through an earlier cooperative effort with the Environmental Protection Agency, DOE met its goal of reducing releases of 17 hazardous chemicals by 50 percent before 1995.

Additional Analysis

Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, signed August 2, 1993, directed all Federal agencies to reduce releases and off-site transfers of toxic chemicals [as reported in the Emergency Planning and Community Right-to-Know Act's Toxic Chemical Release Inventory (TRI)] by 50 percent as of December 31, 1999.

Prior to the executive order being issued, DOE had participated in the Environmental Protection Agency's 33/50 pollution prevention program, which included voluntary TRI reporting. Through this cooperative effort with EPA, DOE met its earlier goal of reducing inventories of 17 hazardous chemicals by 50 percent before 1995. Therefore, by establishing a 1993 baseline year, DOE effectively "jumped" one year ahead of other Federal agencies in working toward achieving the inventory/transfer reductions directed in Executive Order 12856.

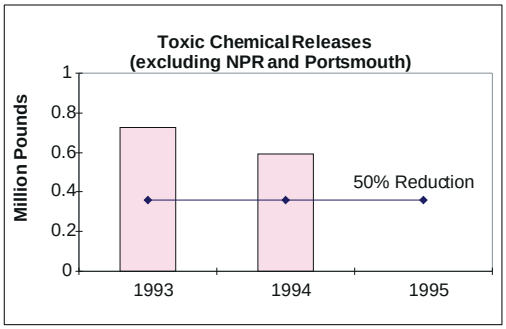
The new goal is for all TRI-reported chemicals. DOE's 1993 baseline total is 4,677,000 pounds. This is 0.1 percent of the 1993 industry-wide total.

In 1993, 3,666,000 pounds of methanol accounted for 79 percent of all of the toxic chemicals reported by DOE as released or transferred for treatment or disposal. Naval Petroleum Reserve #1 (NPR#1) reported 81 percent of the DOE TRI baseline

(3,783,000 pounds). In 1994, reported methanol releases at NPR#1 were reduced by more than 90 percent below releases reported for 1993 by improving estimates based on sampling and monitoring.

Another major decrease was at Portsmouth Gaseous Diffusion Plant, which reported 171,638 pounds in 1993, and 2,781 pounds in 1994. The decrease is entirely due to approximately 170,000 pounds of dichlorotetrafluoroethane reported in 1993 (and none in 1994). The reason for this decrease is the transfer of Portsmouth operations to the U.S. Enrichment Corporation in mid-1993; these releases continue and are now reported by USEC.

When the reported releases are adjusted for these two anomalies, the modified data still indicate that DOE is achieving significant reduction in reported chemical releases.

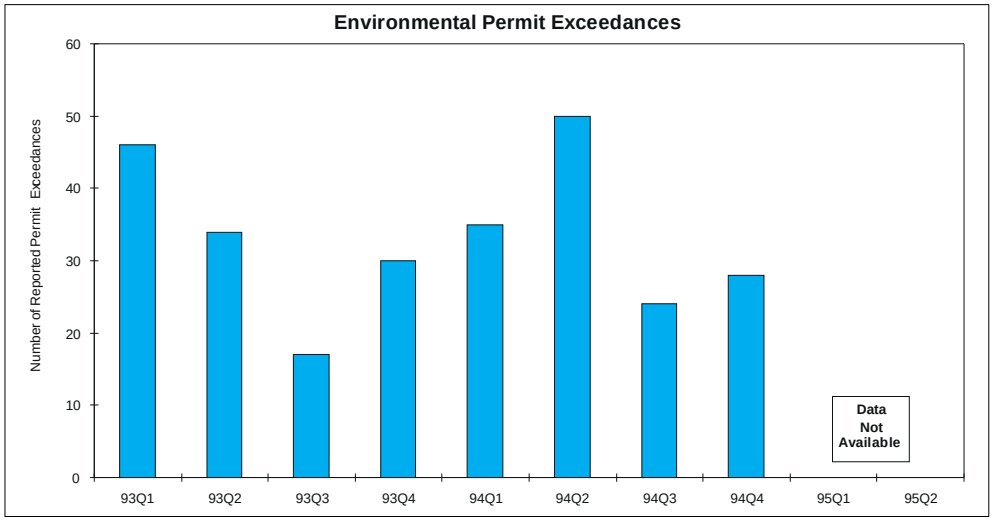


Indicator

19. Environmental Permit Exceedances

Definition

Exceedance of release levels specified in air and water permits during the quarter.



Source: Annual Site Environmental Reports, additional site data

Key Observations

- Approximately 95% of exceedances over this two year periodwere due to violations of water discharge permit conditions under the Clean Water Act, and 5% were attributed to Clean Air Act permit violations.
- Four facilities (ANL-East, Los Alamos, Portsmouth, and West Valley) consistently account for almost 70% of the total number of exceedances.
- The high number of exceedances that occurred in the first and second quarters of 1993 and 1994 are attributable to several influences. Based on telephone inquiries to high contributing sites, the high number of exceedances are due to the influence of significant variations in temperature, sunlight, precipitation, and biological activity occurring over these quarters. This directly led to increases of violations of several National or State Pollutant Discharge Elimination System (NPDES/SPDES) permit parameters; primarily total suspended solids, BOD, pH, and temperature.

Additional Analysis

- Most exceedances occurred under NPDES/SPDES permits mandated by the Clean Water Act to protect surface waters by limiting effluent discharges to receiving streams, reservoirs, ponds, etc. These permits specify discharge standards for various parameters and constituents as well as monitoring and reporting requirements. Industrial and sanitary wastewater discharges as well as stormwater runoff discharges are regulated under NPDES/SPDES permits.
- The second largest type of permit violations occurred under Clean Air Act permits for on-site emission sources from industrial operations, chemical process systems, waste processing systems that discharge to the ambient air through stacks, ventilators, air ducts, etc. (i.e., Air Quality Permits, etc.).
- Four of the 54 DOE facilities from which the data were compiled contribute almost 70% of the total number of permit exceedances across the DOE complex. These are ANL-East, Los Alamos, Portsmouth, and West Valley. All routinely discharge into receiving waters from significant ongoing on-site processes, industrial operations and sanitary wastewater operations, and all are affected by variations

in precipitation and storm events. The facilities are, therefore, sensitive to stormwater runoff related exceedances. Some large sites such as INEL, Hanford, and the Nevada Test Site contributed no permit exceedances mainly because of low annual precipitation and less likelihood of stormwater runoff related exceedances.

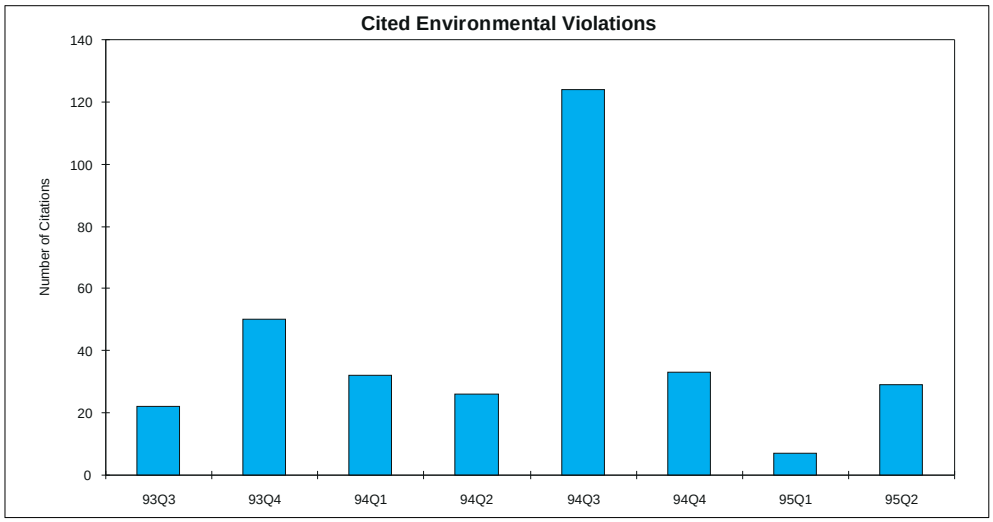
- The number of exceedances is also a function of the permit-specific parameters, number of outfalls, reporting frequency requirements, or the timing of the NPDES/SPDES permit renewal. In addition, changes in temperature, sunlight, and increased rainfall events all contribute to permit exceedances of non-toxic parameters such as BOD, pH, and Total Suspended Solids (TSS). For example, in the first quarter of 1994, West Valley renewed their SPDES permit which required additional chemical monitoring requirements and more stringent effluent limitations. This, along with the increased precipitation and temperature, resulted in a higher number of exceedances in the second quarter of 1994. This appears to be true of other sites as well. Portsmouth contributed 13 exceedances in the second quarter of 1994 with most exceedances attributed to TSS, pH, and daily temperature violations due to precipitation and temperature influences. These factors appear to influence the high number of exceedances recorded in the first two quarters of 1993 and 1994 and the overall pattern of the data in both years.
- Not enough data have been collected to confidently identify a trend. Exceedances are significantly more frequent during the first two quarters of the year. This is due primarily to increased precipitation, temperature, sunlight, and biological activity in on-site retention lagoons/ponds at the high-contributing sites, resulting in significant exceedances of the TSS, pH, BOD, and temperature permit parameters at these sites. If West Valley and Portsmouth data are excluded, there appears to be a slight downward trend in exceedances over the two years. Compiling additional data from 1991, 1992, and 1995 would serve to validate this apparent trend.

Indicator

20. Cited Environmental Violations

Definition

Number of environmental violations cited by regulators in enforcement actions at DOE facilities.



Source: EH-41 Compliance Database

Key Observations

- In the third quarter of 1994, two enforcement actions against Los Alamos National Laboratory accounted for 85% of the citations.
- Except for the third quarter of 1994, the number of violations per quarter appears to be generally declining since the fourth quarter of 1993. However, additional data validation is required to confirm that a declining trend exists.

Additional Analysis

Because the citations involve the full gamut of statutes, regulations, and compliance agreements to which DOE is subject, they have a number of origins. Over 55% of the total citations are the result of inspections.

In addition to the "true" level of compliance, many factors, such as those identified below, may lead to increases or decreases in the number of violations cited.

- Timing. The dates used in this data set are the dates when DOE received notification of the alleged violations, not the dates the alleged violations occurred or were discovered. Enforcement actions may lag the dates of the violations cited by weeks or months, depending on the enforcing agency. Violations may occur before the date of an inspection. Issuance of citations for a violation may lag an inspection by days, weeks, or months. For this reason, one must be cautious in drawing any conclusions regarding timing of the violations.
- Enforcement philosophy. This indicator is subject to variations due to the vigor of enforcement. Regulatory agencies, whether they be states, EPA Regions, or local jurisdictions, vary in the vigor with which they enforce environmental requirements. While some regulators tend to cite only major violations, other regulators issue citations for many smaller "administrative" violations.
- Number of violations cited. This indicator is influenced by the number of violations cited from a single inspection, or in a single notice. An intensive

multi-media inspection at a single site can either skew or obscure the "real" trend. For example, one such inspection resulted in an enforcement action citing 77 violations at one DOE site.

- Number of inspections. The number of violations cited is tied to the number of inspections performed by regulatory agencies. Increases or decreases in the number of violations cited may be a direct result of increases and decreases in inspections performed, or increases and decreases in agency emphasis on certain types of violations. However, not all inspections yield a cited violation. The number of inspections could be used to normalize the number of citations. However, DOE sites are not required to keep a record of the data on the number of regulatory inspections. Although some sites do keep such records, it is unlikely that all sites would keep such records in an accessible form.

Because no attempt has been made to normalize data among sites, no site-to-site comparison is appropriate, or attempted, using this indicator.

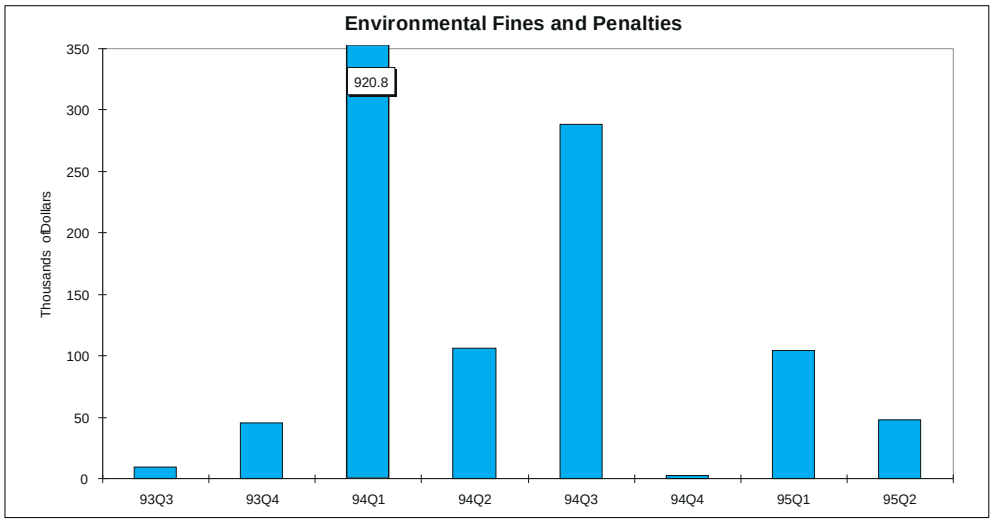
The Office of Environmental Policy and Assistance (EH-41) has extensively cross-checked (by corroboration of the data with other sources, telephone inquiries to the field, and follow-up of discrepancies) the data for all of fiscal year (FY) 1994 and the first quarter of FY 1995. Data outside this range have not been validated. Data quality for the last quarter of FY 1993 is not on par with that for FY 1994 because reporting of citations of environmental violations was not mandatory prior to FY 1994. Data quality for the second, third, and fourth quarters of FY 1995 has not been tested.

Indicator

21. Environmental Fines and Penalties

Definition

Fines and penalties assessed by regulators at DOE facilities related to violations of environmental laws and regulations.



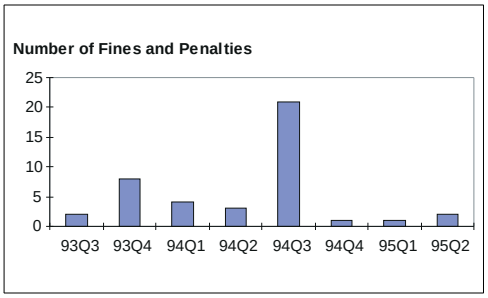
Source: EH-41 Compliance Database

Key Observations

- This performance indicator roughly shows a trend of declining dollar amount of fines and penalties. This trend can be interpreted as either a decreasing severity in the environmental violations attributed to DOE, an improving relationship between DOE and regulatory agencies, or a combination of both.
- This performance indicator can be skewed or otherwise dominated by single large assessments, either for a single violation or multiple violations, against a facility. A $900,000 fine was assessed for a single violation in the first quarter of 1994. $247,000 in fines were assessed for 28 violations at a single site in the third quarter of 1994.

Additional Analysis

The dollar amount of fines and penalties assessed per quarter is highly variable. The volatility of the dollar amount is demonstrated by the fact that the trend in the dollar amount of fines and penalties does not follow the trend shown for the "Cited Environmental Violations" performance indicator. On the other hand, the trend in the number of fines and penalties roughly follows the trend for the number of cited violations, quarter by quarter.



There are six quarters with large total dollar amounts (i.e., amounts greater than $10,000). All of these six are dominated by large assessments at single sites.

- Only two of the six are large assessments for single violations: one is a $900,000 fine assessed in first quarter of 1994, and the other is a $100,000 fine assessed in second quarter of 1994 (both fines were at Oak Ridge K-25 Plant).

- The remaining four of the six are for multiple violations addressed at a single site. For example, fines totaling $247,000 for 28 hazardous waste violations were assessed at Los Alamos National Laboratory in third quarter of 1994. Fines totaling about $104,000 for a different set of 28 violations were assessed at the same site in first quarter of 1995.

The dollar value of fines and penalties provides an indication of the degree of importance the regulators attach to a violation (i.e., the more serious the violation the higher the assessed fine or penalty). The highest assessment for a single violation ($900,000) mentioned above was for failure to properly store drums of hazardous waste. The second highest assessment for a single violation ($100,000) alluded to above was for an administrative violation, i.e., failure to obey a Compliance Order for correcting violations dating from 1990.

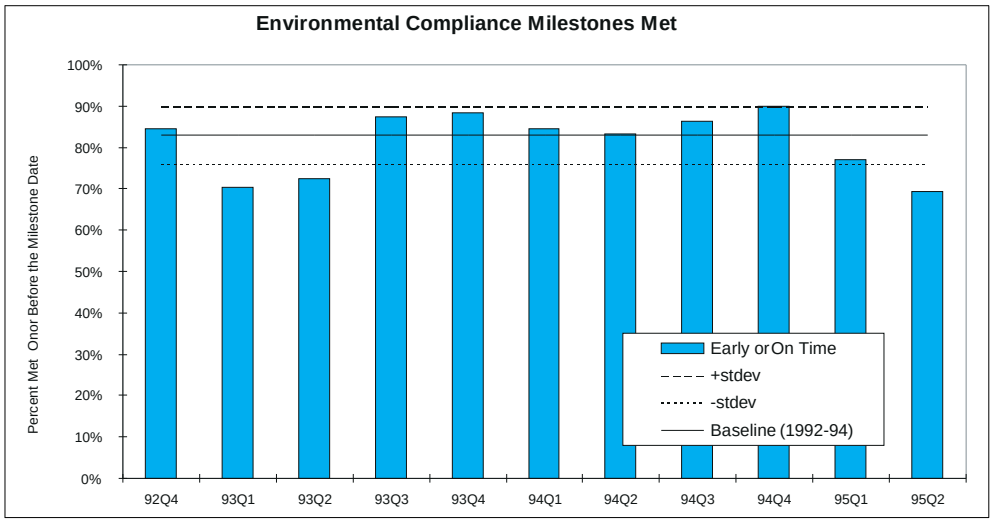
In 1994, the average fine per administrative violation, potential release, and actual release was $9846, $7337, and $1828, respectively. Thus, if actual releases are a reflection of actual impact on the environment, the dollar amount of fines and penalties is not measuring the severity of impact to the environment. It may instead reflect potential impact to the environment, and it certainly reflects what the regulators view as serious compliance deficiencies.

Indicator

22. Environmental Compliance Milestones Met

Definition

Enforceable requirements in environmental agreements, met on or before the milestone date (percent).



Source: Progress Tracking System Data, Office of Environmental Management.

Key Observations

- A significant number of enforceable milestones are not being met on time. Over 11 quarters, the fraction of milestones met early or on-time has ranged from 90% down to 69%.
- The number of milestones per quarter varies from 71 to 127. There is an increasing trend: the first four quarters reported average 81 milestones per quarter; the most recent four quarters average 104 milestones per quarter.

Additional Analysis

- Percentage of milestones met on time (including “early”) has decreased. In the first two quarters of 1995, 73% were completed on time. In the previous six quarters, 87% were completed on time. Data from the third quarter of 1995 are consistent with this trend.
- On a fiscal year basis, on-time completion for FY 1995 (three quarters) was 77%. On-time completion for FY 1994 was 86%.
- These data do not capture all enforceable milestones; they reflect those milestones under the purview of the Office of Environmental Management. EM’s Progress Tracking System is believed to capture 85–90% of all DOE enforceable environmental milestones.

23. Waste Minimization / Pollution Prevention

Indicator

Definition

The draft Pollution Prevention Cross-Cut Plan developed by the Office of Environmental Management proposes several "global" pollution prevention performance measures:

- Volume of radioactive waste reduced.
- Volume of mixed waste reduced.
- Weight of toxic chemical releases and off-site transfers reduced.
- Percentage of solid, non-hazardous waste recycled.
- Percentage of affirmative procurement guideline materials purchased by category.

These five measures represent Secretarial goals and are scheduled to be reported in 1996.

Future

Key Observations

- Current data are provided in this report for one measure: "Toxic Chemical Releases."
- The most recent DOE-wide data for waste generation (radioactive, mixed, solid non-hazardous) are for 1991, 1992, and 1993. As such, they are not presented in this report.
- Additional indicators related to waste minimization and pollution prevention may be provided in the future as the data are developed by the Office of Environmental Management.

A1. Relationship to DOE Strategic Plan Goals

	DOE STRATEGIC PLAN (April 1994)	PERFORMANCE INDICATORS
Eliminate Hazards and Releases	**Environment, Safety, & Health Goal 1** *Empower workers and take other necessary actions to prevent all serious injuries and all fatalities, and to eliminate all worker exposures and environmental releases in excess of established limits. By eliminating these exposures and releases, reduce the incidence of illness among workers and the public, and prevent damage to the environment.*	1. Radiological Events 2. Worker Radiation Dose 3. Investigations of Serious Events 5. Safety System Actuations 6. Procedure Violations 7. Safety Equipment Degradation 8. Near Misses and Safety Concerns 9–12. OSH (Lost Workday Case Rate, Total Recordable Cases, Cost Index, Lost Workday Incident Rate) 15. Radiation Dose to the Public 16. Reportable Occurrences of Releases to the Environment 18. Environmental Permit Exceedances
Performance Requirements	**Environment, Safety, & Health Goal 2** *Ensure there are specific environmental, safety, and health performance requirements for DOE activities which are the basis for measuring progress toward continuous improvement.*	1. Radiological Events 2. Worker Radiation Dose 9–12. OSH (Lost Workday Case Rate, Total Recordable Cases, Cost Index, Lost Workday Incident Rate) 17. Toxic Chemical Releases
Establish Priorities	**Environment, Safety, & Health Goal 3** *Establish clear environmental, safety, and health priorities and manage all activities in proactive ways that effectively and significantly increase protection to the environment and to public and worker safety and health.*	13. Spent Nuclear Fuel and Plutonium Vulnerabilities
Demonstrate Performance	**Environment, Safety, & Health Goal 4** *Demonstrate respectable performance related to environmental protection and worker/public safety and health...,*	All

(Numbers refer to corresponding Sections in this report.)

A2. Glossary

Baselines

Baselines provide an historical reference point used to show how the current period compares to past experience. For the graphs in this report, the baseline is calculated by taking the average of 15 quarters of historical Performance Indicator data (91Q2-94Q4). In addition, the graphs show the historical baseline ± 1 standard deviation to give the reader a feel for the variation associated with the data. For Performance Indicators where there are insufficient data to calculate a meaningful baseline, no baseline is shown on the graph.

Multinomial Likelihood Ratio Test (MLRT)

MLRT is used to determine statistical significance of trends. MLRT performs separate tests for increasing and decreasing trends in a sequence of 2 to 30 counts of an event. The tests are based on a multinomial distribution assumption for the counts. Therefore, the sequence must be counting discrete events that are independent over time. An event is a physically indivisible quantity, such as an incident. These tests are also useful for performing trend analysis of rare events. MLRT computes a ratio of constant trend likelihood to increasing (or decreasing) trend likelihood from the observed sequence of counts. Therefore, small values of the ratio favor an increasing (or decreasing) trends. Consider the following question: "If the data are generated by a constant trend multinomial model, what is the probability of observing a smaller ratio than that computed from the observed sequence?" This probability is called the significance level of the test and is interpreted as follows:

Significance Level	Conclusion
> 0.1 to 1.0	no departures from constant trend detected
> 0.05 to 0.1	possible increasing (or decreasing) trend
> 0.01 to 0.05	probable increasing (or decreasing) trend
> 0.001 to 0.01	very probable increasing (or decreasing) trend
0 to 0.001	highly probable increasing (or decreasing) trend

The significance level is analogous to precision of measurement. As always, the importance of any precisely measured (i.e., statistically significant) quantity depends on the subject matter and context.

Total Effective Dose Equivalent (TEDE)

TEDE = External Dose Contribution + Internal Dose Contribution. Prior to 1993, the method for calculating the internal dose contribution changed from an annual internal dose to a dose committed over 50 years. Although one may expect this change would result in higher reported doses, the elimination of the "legacy" doses from previous years' exposures resulted in lower reported doses.

The following terms are related to occurrence reporting, as required by DOE Order 232.1, *Occurrence Reporting and Processing of Operations Information.*

Occurrence Categories (types of occurrences)

Occurrences are arranged into 10 generic groups related to DOE operations and include the following:

1. Facility Condition
2. Environmental
3. Personnel Safety
4. Personnel Radiation Protection

5. Safeguards and Security
6. Transportation
7. Value Basis Reporting
8. Facility Status
9. Nuclear Explosive Safety
10. Cross-Category Items

Severity of Occurrence

Identification scheme used to categorize occurrences to indicate degree of significance associated with the different types of occurrences.

Emergency Occurrence: The most serious occurrence and requires an increased alert status for on-site personnel and, in specified cases, for off-site authorities.

Unusual Occurrence: A non-emergency occurrence that exceeds the Off-Normal Occurrence threshold criteria; is related to safety, environment, health, security, or operations; and requires immediate notification to DOE.

Off-Normal Occurrence: Abnormal or unplanned event or condition that adversely affects, potentially affects, or is indicative of degradation in the safety, safeguards and security, environmental or health protection, performance or operation of a facility.

Facility Function

The type of facility or the activity/function performed by the facility. Possible facility functions are listed below.

Plutonium Processing and Handling
Special Nuclear Materials Storage
Explosive
Uranium Enrichment
Uranium Conversion/Processing and Handling
Irradiated Fissile Material Storage
Reprocessing
Nuclear Waste Operations
Tritium Activities
Fusion Activities
Environmental Restoration Operations
Category “A” Reactors
Category “B” Reactors
Solar Activities
Fossil and Petroleum Reserves
Accelerators
Balance-of-Plant (e.g., offices, machine shops, site/outside utilities, safeguards/security, and transportation)

Causes of Occurrences

Causes of occurrences are determined by performing event investigations and may be identified as direct, contributing, or root causes.

Direct Cause: The cause that directly resulted in the occurrence.

Contributing Causes: The cause(s) that contributed to the occurrence but, that by itself, would not have caused the occurrence.

Root Cause: The cause that, if corrected, would prevent recurrence of this and similar occurrences.

Cause categories are selected from the following:

1. ***Equipment/material problem:*** An event or condition resulting from the failure, malfunction, or deterioration of equipment or parts, including instruments or material.
2. ***Procedure problem:*** An event or condition that can be traced to the lack of a procedure, an error in a procedure, or procedural deficiency or inadequacy.
3. ***Personnel error:*** An event or condition due to an error, mistake or oversight. Personnel errors include inattention to details of the task, procedures not used or used incorrectly, communication problems, and other human errors.
4. ***Design problem:*** An event or condition that can be traced to a defect in design or other factors related to configuration, engineering, layout, tolerances, calculations, etc.
5. ***Training deficiency:*** An event or condition that can be traced to a lack of training or insufficient training to enable a person to perform a desired task adequately.
6. ***Management problem:*** An event or condition that can be directly traced to managerial actions or methods. Management problems include inadequate administrative control, work organization/planning deficiency, inadequate supervision, improper resource allocation, policies not adequately defined, disseminated or enforced, and other management problems.
7. ***External phenomenon:*** An event or condition caused by factors that are not under the control of the reporting organization or the suppliers of the failed equipment or service.
8. ***Radiation/hazardous material problem:*** An event related to radiological or hazardous material contamination that cannot be attributed to any other causes.

Summary of Process

B1. Overview

Summary of Process

1. Overview

1.1 Initial Performance Measures

2. Data Analysis

2.1 Analyses Performed

2.2 Determining Statistical Significance of Trends

3. Future Plans

One of the critical success factors identified in the Department of Energy (DOE) Strategic Plan for environment, safety and health is “ensuring the safety and health of workers and the public and the protection and restoration of the environment”. This report describes a new approach for measuring the performance of DOE operations in these areas and thereby supporting management decisions aimed at “ensuring the safety”. The general concept is to focus on key factors with the most impact on worker and facility safety and the environment.

This report is the product of a multi-disciplinary team from the Offices of Environment, Safety and Health (EH) and Defense Programs (DP) with expertise in nuclear and facility safety, environment, worker safety and health, health studies, and planning/administration. The team is identified in Table B1.

This first report is intended to serve as a prototype or pilot. Data collection was limited to available data (e.g., ORPS, CAIRS, Site Environmental Reports). The process was non-intrusive and did not expend site resources. As such, the performance indicator components may not sufficiently measure all facets of environment, safety and health. Experience from this report, along with customer feedback from the attached survey form, will be evaluated. Subsequent reports may evolve to include incorporating the components into an index to represent the combined effect that the activities have on the envelope of safety that protects the worker and the environment, as experience is gained and data sources improve.

B1.1 Initial Performance Measures

The initial performance measures are identified in the table below. The six key indicators selected for the management summary are identified with an asterisk.

PI Component	Data Source
Worker and Facility Safety	
1 Radiological Events *	Occurrence Reports, EH-33
2 Worker Radiation Dose	Radiation Exposure Monitoring System (REMS), EH-52
3 Investigations of Serious Events	Computerized Accident/Incident Reporting System (CAIRS), EH-51
4 Chemical Hazard Events	Quarterly Review of Chemical Safety Concerns/Occurrence Reporting and Processing System, EH-52/EH-53
5 Safety System Actuations *	Occurrence Reports, EH-33
6 Procedure Violations	Occurrence Reports, EH-33
7 Safety Equipment Degradation	Occurrence Reports, EH-33
8 Near Misses & Safety Concerns	Occurrence Reports, EH-33
9 Lost Workday Case Rate *	Computerized Accident/Incident Reporting System, EH-51
10 Lost Workday Incident Rate	Computerized Accident/Incident Reporting System, EH-51
11 Total Recordable Case Rate	Computerized Accident/Incident Reporting System, EH-51
12 Occupational Safety and Health Cost Index	Computerized Accident/Incident Reporting System, EH-51
13 Worker Health	TBD - Under Development
14 Spent Nuclear Fuel and Plutonium Vulnerabilities Resolved	Plutonium Vulnerability Management Summary Report, EM-60; Reports on Status of Corrective Actions to Resolve Spent Nuclear Fuel Vulnerabilities, EM-37
15 Open DNFSB Recommendations	Safety Issues Management System (SIMS), S-3.1
Environment	
16 Radiation Dose to the Public *	Annual Reports to Environmental Protection Agency (EPA) by Each Site, EH-41
17 Reportable Occurrences of Releases to the Environment *	Occurrence Reports, EH-33
18 Toxic Chemical Releases	Annual DOE 3350 Pollution Prevention Report to EPA
19 Environmental Permit Exceedances *	Annual Site Environmental Reports
20 Cited Environmental Violations	Environmental Compliance Tracking Database, EH-41
21 Environmental Fines and Penalties	Environmental Compliance Tracking Database, EH-41
22 Environmental Compliance Milestones Met	EM Progress Tracking System (PTS)
23 Waste Minimization/Pollution Prevention	TBD - Under Development

B2. Data Analysis

B2.1 Analyses Performed

The data analysis results are summarized in the new DOE Performance Indicator Report. They are intended to identify areas which should be further investigated (to identify areas that may require intervention as well as good practices to share across DOE); they do not provide absolute answers in themselves. Data analyses include:

- looking for statistically significant trends over time,
- comparison to historical averages or benchmarks (e.g., Bureau of Labor Statistics for similar industries),
- normalization of events to opportunities (e.g., construction related events divided by construction hours worked or construction dollars spent),
- examination for statistically significant trends in types of operations, severity or type of events, and causes.

Typically, the historical baseline is established using existing data excluding the 2 most recent quarters (95Q1 and 95Q2).

Where possible, data were analyzed by quarter. In some cases, data were also viewed monthly to reveal any interesting seasonal effects not evident in the quarterly data grouping. Where appropriate, sites were contacted to provide perspective for unusual data values or trends. Data sources for several of these measures are annual; the need for more frequent data must be evaluated for future reports. Although some of the sources contain more data, analyses start with the second calendar quarter of 1991, which corresponds to establishment of the ORPS database

The data can also be used to perform other special analyses and reports (such as trends in causes and types of events). These analyses and reports could support special needs, such as oversight preparation and programmatic reviews.

The same approach can be used to perform more detailed functional or programmatic analyses by identifying subsets (peer groups) of DOE facilities for further examination. Examples of peer groups might include: reactors, accelerators, major clean-up sites, waste storage areas, defense chemical facilities, fossil energy sites, laboratories and spent fuel storage facilities.

B2.2 Determining Statistical Significance of Trends

The Multinomial Likelihood Ratio Test (MLRT) is used to determine statistical significance of trends. MLRT performs separate tests for increasing and decreasing trends in a sequence of 2 to 30 counts of an event. The tests are based on a multinomial distribution assumption for the counts. Therefore, the sequence must be counting discrete events that are independent over time. An event is a physically indivisible quantity, such as an incident. These tests are also useful for performing trend analysis of rare events.

MLRT computes a ratio of constant trend likelihood to increasing (or decreasing) trend likelihood from the observed sequence of counts. Therefore, small values of the ratio favor an increasing (or decreasing) trends. Consider the following question: “If the data are generated by a constant trend multinomial model, what is the probability of observing

a smaller ratio than that computed from the observed sequence?" This probability is called the significance level of the test and is interpreted as follows:

Significance Level	Conclusion
> 0.1 to 1.0	no departures from constant trend detected
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> 0.01 to 0.05	probable increasing (or decreasing) trend
> 0.001 to 0.01	very probable increasing (or decreasing) trend
0 to 0.001	highly probable increasing (or decreasing) trend

The significance level is analogous to precision of measurement. As always, the importance of any precisely measured (i.e., statistically significant) quantity depends on the subject matter and context.

B3. Future Plans

This first report is considered a "work in progress". Future activities are focused on obtaining feedback on the approach and improving the effectiveness of the product, including:

- Establishing feedback mechanisms to obtain and incorporate customer and supplier input.
- Incorporate more detailed analysis showing selected site specific trends where certain sites dominate the current quarter for an indicator.
- Improving the process and products based on feedback from the data, customers, and suppliers.
- Developing indexes which consider the composite influence of the indicators on the overall worker safety and the environment.

Future reports will be refined as data are gathered and customer input is received. Over time, new knowledge and changing missions will be reflected in the process.

Table B1

Report Contributors

US DOE, Office of Environment, Safety and Health

Randy Belles, Office of Operating Experience Analysis and Feedback/Oak Ridge National Laboratory
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Janet Macon, Office of Occupational Safety and Health Policy
Nirmala Rao, Office of Worker Protection Programs and Hazards Management
Rama Sastry, Office of Field Support

Product Improvement Survey Form

Purpose of the Product - The Office of Operating Experience Analysis and Feedback, EH-33, is developing a set of indicators for measuring the performance of DOE operations in the areas of Worker Safety and Health and the Environment. The indicators are intended to measure the Department's success in its strategic goal to manage and improve its environmental, safety, and health (ES&H) performance. The major customers for these indicators are expected to be the senior leadership of DOE.

In order to assess the effectiveness of this new performance indicator report, we would appreciate your assistance by providing responses to the following (check one):

1. Do you use indicators to measure performance? ❑ Yes ❑ No
2. Do you feel that improved methods for measuring performance are needed? ❑ Yes ❑ No
3. Would you make management decisions based on this kind of information? ❑ Yes ❑ No
4. Does DOE-wide ES&H performance matter to you? ❑ Yes ❑ No
5. What are your information needs with regard to measuring Department-wide ES&H success:
   - ❑ Quick pulse of the Department ES&H success
   - ❑ Light detail concerning the Department ES&H success
   - ❑ Moderate detail concerning the Department ES&H success
   - ❑ I have no need for this information on a regular basis

Report Evaluation - From your review of this report, ***and in consideration of the purpose stated above***, mark the number that most closely corresponds to your reaction to the following statements

		Strongly Agree			***Neutral***			***Strongly Disagree***
6.	The performance indicators are relevant to the measurement of overall DOE ES&H performance.	⑦	⑥	⑤	④	③	②	①
7.	The report layout (text and graphics) is logical and easy to understand.	⑦	⑥	⑤	④	③	②	①
8.	The data presented in this report are consistent with my impressions of DOE's ES&H performance.	⑦	⑥	⑤	④	③	②	①
9.	The performance indicators provide a "balanced" view (e.g., successes and problems) of DOE's ES&H performance.	⑦	⑥	⑤	④	③	②	①
10.	This report concept can help measure DOE's success in managing and improving its ES&H performance.	⑦	⑥	⑤	④	③	②	①
11.	This report concept can be useful in communicating information on DOE's ES&H performance to external customers.	⑦	⑥	⑤	④	③	②	①

12. Based on your stated needs, does this report meet your expectations? ❑ Yes ❑ No
13. Would you be willing to expend time/travel funds to participate in product improvement sessions? ❑ Yes ❑ No

Mail or FAX to:

Tom Rollow (FOR) / **Rich Day** (CXXI/GTN)
Office of Operating Experience Analysis and Feedback, EH-33
U.S. Department of Energy
Washington, DC 20585

FAX number: (301) 903-2329

Page 1 of _____

From:

Name _____

Organization _____

Phone _____

Comments: What additional parameter(s) should be monitored and where could the data be obtained? Consider changes required to make this report more useful for your needs and any general observations based on your review. Use additional pages as necessary.