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Operational Accidents and Radiation Exposures at ERDA Facilities 1975 — 1977

Published May 1980

U.S. Department of Energy
Assistant Secretary for Environment
Office of Environmental Compliance and Overview

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U.S. Department of Energy
Assistant Secretary for Environment
Office of Environmental Compliance and Overview
Washington, D.C. 20545

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ERDA SUMMARY

The Energy Research and Development Administration (ERDA) accident frequency and losses were similar to that of the Atomic Energy Commission (AEC) from 1970 - 1974.

INJURY EXPERIENCE

The ERDA incidence rates per 200,000 work hours were 1.05 for lost workday injuries and 17.8 for workdays lost. These rates are about one third of the national industrial averages reported by the National Safety Council (NSC).

Ten fatalities occurred at ERDA facilities resulting in an average annual rate of three deaths per 100,000 workers compared to the national rate of 14 deaths per 100,000 workers.

PROPERTY DAMAGE EXPERIENCE

ERDA's total property loss from 1975 to 1977 was \$11.9 million; \$1.8 million caused by fires. The average annual loss rates, in cents loss per \$100 valuation, were 1.15 for non-fire and 0.18 for fire. These rates are higher than the AEC post - Rocky Flats period (1970-1974) which were 0.60 non-fire and 0.10 fire; but are lower than the average annual rates which were 2.4 non-fire and 1.7 fire for the entire history of the AEC.

RADIATION EXPOSURES

ERDA continued to make a strong effort to eliminate unnecessary radiation exposures to workers. The number of employees exceeding 1 rem decreased from 2999 in 1975 to 2274 in 1977.

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INTRODUCTION

The Energy Research and Development Administration (ERDA) was established by the Non-Nuclear Energy Research and Development Act of 1974 (Public Law 93-577). Section 3 of the Act includes the following statement of policy:

(a) "...to develop on an urgent basis the technological capabilities to support the broadest range of energy policy options through conservation and use of domestic resources by socially and environmentally acceptable means..."

(b) (1) "...establish and vigorously conduct a comprehensive, national program of basic and applied research and development..."

(2) "...the policies and provisions of the Atomic Energy Act of 1954 shall continue to apply to the nuclear research, development, and demonstration program."

The Atomic Energy Commission (AEC) had been responsible for the administration of the policies and provisions of the Atomic Energy Act and the management of Government-owned contractor-operated nuclear energy facilities. Their design, construction, and operation were by contract with industrial, academic, and nonprofit organizations. The operations at these facilities included the production and processing of special nuclear and radioactive materials, the development of nuclear reactors, the development of nuclear explosives, and research in the physical and biological sciences.

The early operations of the atomic energy industry were performed without prior experience or a complete understanding of nuclear hazards and effects. Therefore, accident prevention programs were strongly promoted by management. Operating contracts were administered by field offices near the major facilities. Inspection and compliance activities were also conducted through these field offices.

One basic policy of the AEC was the protection of persons and property against potential hazards. Safety programs required the reporting and investigation of operational accidents, occupational injuries, and property loss.

The AEC reporting requirements were adopted by ERDA when it became operational on January 11, 1975. These requirements and policies remained in effect until ERDA was abolished on October 1, 1977 and its functions transferred to the Department of Energy. The following activities were administered by ERDA:

Nuclear research and development facilities including national laboratories formerly operated by the Atomic Energy Commission (AEC),

Energy research centers transferred from the Department of Interior,

Solar and geothermal power development programs previously administered by the National Science Foundation,

Alternative automotive power systems previously administered by the Environmental Protection Agency.

ERDA and its major contractors were required to comply with all regulations concerning environmental protection, safety and health protection. Compliance was mandatory with provisions of the Occupational Safety and Health Act, the Environmental Protection Agency, and other Federal, state, and local codes, standards, and regulations. The comprehensive environmental and safety effort at ERDA facilities was designed to ensure protection of the environment, the public and the employees.

ERDA continued the AEC policy to conduct formal investigations of accidents to identify causes and corrective actions for the prevention of similar occurrences.^[a] At least one member of an investigation board was a formally trained accident investigator.

[a] The ERDA criteria for accident investigations are given in Appendix A.

ERDA also continued to use the AEC requirements for reporting of personnel injuries, property losses, and any radiation exposure to personnel who might receive a significant radiation dose. These data are presented and reviewed for the period of ERDA responsibility in this report. The data concerning injury and property loss are for the calendar years 1975 and 1976 and for three quarters of 1977. However, because the radiation exposure data are reported only on a calendar year basis, the information provided is for calendar years 1975 through 1977.

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I. ORGANIZATION

ERDA was headed by an Administrator appointed by the President and confirmed by the U. S. Senate. The six major program areas were under the direction of six Assistant Administrators, who were also appointed by the President with Senate confirmation. The major program areas were:

- (1) Fossil energy
- (2) Nuclear energy
- (3) Environment and safety
- (4) Solar, geothermal and advanced energy systems
- (5) National security
- (6) Conservation

The functional assignments in ERDA are shown in Figure 1.

1. Fossil Energy

The increased production of coal and research on the technology of converting coal to gas and liquid fuel were important ERDA activities. Construction was begun on pilot plants for surface gasification of coal and for the conversion of coal to oil. Economical and acceptable ways to convert shale deposits into oil in Colorado, Wyoming, and Utah were also part of the fossil energy research program.

2. Solar, Geothermal, and Advanced Energy Systems

The ERDA solar energy program included six different approaches for the use of energy from the sun. Three of these approaches with short-range applications were solar energy for heating and cooling, conversion of wind energy, and bioconversion to fuels. The other long-range approaches included solar thermal conversion, photoelectric conversion, and ocean thermal conversion.

The research and development work on geothermal energy focused on means to extract the heat trapped inside the earth. One research project in the Raft River Valley of southern Idaho was built on a known geothermal reservoir. A pilot hot-dry-rock system was planned for the ERDA New Mexico test area to extract the heat energy from subterranean depths. Research was also carried out on the underground aquifers along the Texas and Louisiana Gulf coasts which contain brines and natural gas.

Research was devoted to fusion, which was one of the most advanced concepts in energy systems. ERDA further supported basic research in the physical sciences for a better understanding of the fundamental laws which govern the structure and behavior of matter and energy.

3. Nuclear Energy

The nuclear research activities of the AEC were continued as a part of ERDA at several national laboratories and three weapons development laboratories. Production facilities included nuclear feed material plants, three uranium gaseous diffusion plants for producing enriched uranium, and two plutonium production complexes. Research continued on the safety and efficiency of light-water and gas-cooled reactors. Nuclear technology also included development of compact, plutonium-fueled generators to assist spacecraft in outer space remote from solar power.

4. Energy Conservation

The energy conservation program was one of ERDA's most urgent responsibilities. It included ways to obtain a greater return from existing energy sources, to provide alternate and more efficient fuels, and to eliminate the waste of energy.

5. Environment and Safety

Research on environmental control technology was directed towards the control of emissions and discharges, the management of wastes, and the mitigation of environmental impacts associated with an energy

system. Biomedical and environmental research was performed on health effects, nuclear medicine, the applications of radioisotopes, and the development of instrumentation.

6. National Security

ERDA contributed to the national security through its responsibility for research, development, production, and testing of nuclear weapons. The goal was to advance the technology of design and production to ensure maximum effectiveness, reliability, and safety at the lowest practicable cost. The ERDA responsibility for safeguarding nuclear materials included plant protection, materials accountability, and transportation.

Fig. 1 Functional Assignments in Energy Research and Development Administration.

II. PERSONNEL SAFETY

Operational Accidents and Radiation Exposure Experience within the Atomic Energy Commission, 1943 - 1975 (WASH-1192) contains descriptions and statistics regarding disabling injuries, radiation exposures, and property loss. These data were reported according to the American National Standards Institute Standard (ANSI) Z16.1, which defines a disabling injury as an injury which results in death, permanent impairment, or prevents the employee from performing his or her regular work assignment for one or more days after the day upon which the injury occurred.

The ERDA requirements for injury reporting were based on the requirements of the Occupational Safety and Health Administration (OSHA). The OSHA requirements differ from the ANSI standards in the definition of reportable accidents and the criteria for charging days away from work due to injury. Therefore, the ERDA experience is not directly comparable to the AEC experience. However, comparisons indicate that the performance of ERDA was very similar to that of the AEC from 1970 to 1974.

1. Fatalities

From January 1, 1975, to October 1, 1977, ten fatalities were caused by eight accidents at ERDA facilities. These accidents are summarized in Table I. (One radiation exposure from a cabinet X-ray machine resulted in the permanent disability of a scientist.)

TABLE I. FATAL ACCIDENTS FROM JANUARY 1, 1975, TO OCTOBER 1, 1977

Accident	Number of Occurrences	Number of Fatalities
Explosion	1	3
Motor Vehicle Accident	3	3
Electrical Accident	1	1
Fall from Heights	<u>3</u>	<u>3</u>
	8	10

Three of the fatalities occurred during construction activities and seven during operations (production and research). Summary accounts of the fatal accidents and the radiation exposure are given in Appendix B.

The national industrial death rate expressed as the number of deaths per 100,000 workers is reported annually by the National Safety Council. The graphs shown in Figure 2 indicate that the ERDA death rates were lower than the national industrial average rates.

Fig. 2 Death rates for ERDA facilities and the national industrial averages from 1975 to 1977

2. Occupational Injuries and Illnesses

The reported data for lost workday cases (including restricted workdays) are input to incidence rates for disabling injuries. These rates are expressed in terms of 200,000 employee-hours. The ERDA lost workday case incidence rate was 1.0 and the lost workday incidence rate was 17.8 as compared to national industrial averages of 3.4 and 58.5. These rates are given in Figures 3 and 4 for different types of ERDA facilities and private industry.

The industrial hazards at ERDA facilities were similar to those in other industries. The primary causes of injuries were, therefore, falls and vehicles.

From January 1, 1975, to October 1, 1977, 431 cases of occupational illnesses were reported. The nature of these illnesses were as follows:

Skin Diseases or Disorders	158
Dust Diseases of the Lungs	5
Respiratory Conditions due to Toxic Agents	43
Poisoning (Systemic Effects of Toxic Materials)	6
Disorder due to Physical Agents	167
Disorder Associated with Repeated Trauma	31
Other Illnesses	<u>21</u>
	431

3. Radiation Safety

The official ERDA policy included routine monitoring of employees who might receive a significant radiation dose. The radiation exposures of ERDA and ERDA contractor employees for the calendar years 1975, 1976, and 1977 are given in Table II.

Fig. 3 Incidence rates for lost workday cases.

Fig. 4 Incidence rates for lost workdays.

TABLE II. DISTRIBUTION OF WHOLE BODY RADIATION
DOSES TO MONITORED ERDA & ERDA CONTRACTOR EMPLOYEES

Year	DOSE RANGE (rem)				
	0-1	1-5	5-10	10-15	>15
1975	144,372	2998	1		
1976	154,484	2258	1		[a]
1977	176,951	2269	3	1	1

[a] The radiation exposure of an employee after the explosion of an ion exchange column has not been released in accordance with provisions of the Privacy Act.

III. PROPERTY DAMAGE

The total reported ERDA property damage from 1975-1977 was \$11.1 million. Government offices reported losses of \$657,745, of which \$541,000 represented losses caused by acts of nature.

ERDA contractors reported property damage of \$10.4 million from 1975-1977. Two accidents each caused more than \$1 million of the total property loss. The largest single loss of \$3.25 million was the result of the accidental drop of a nuclear canister at the Nevada Test Site on October 23, 1975. This accident accounted for 82% of all reported loss from mechanical causes. Property damage of \$2.5 million occurred after an explosion and subsequent fire at the Pantex Plant on March 30, 1977. This accident represented 59% of the total loss due to explosions.

Accidents resulting in property loss greater than \$50,000 are listed in Table III. These accidents were investigated by ERDA investigation boards. (Summaries of these investigations are given in Appendix B.)

The ERDA property damage is grouped by cause and ranked by decreasing dollar loss in Table IV. The relation of the property loss to the total evaluation of all ERDA property is given by the property damage ratio. It is expressed in terms of cents per \$100 of total property evaluation.

The property damage ratio for each type of accident is also shown in Table IV. Mechanical causes and explosions had much larger property damage ratios than other types of accidents.

The annual ERDA property damage ratios are shown in Figure 5. The weighted average annual loss rate was 1.15 cents per \$100 of ERDA property evaluation. The annual ERDA fire loss ratios are shown in Figure 6. The weighted average fire loss ratio was 0.18 cents per \$100 evaluation. The ERDA experience was comparable to the AEC experience from 1970 to 1974 and was much less than the best protected class of insured properties.

TABLE III. ACCIDENTS CAUSING MORE THAN \$50,000 PROPERTY DAMAGE AT ERDA FACILITIES

Property Damage (dollars)	Date	Field Office and Contractor	Description
3,250,000	Oct. 23, 1975	San Francisco Operations ^[a] University of California Lawrence Livermore Laboratory Nevada Site	Nuclear canister fell 40 feet to bottom of 475-foot test hole
2,500,000	Mar. 30, 1977	Albuquerque Operations ^[a] Mason & Hanger - Silas Mason Company, Inc.	High explosive detonated during machining operation
500,000	Dec. 3, 1975	Savannah River Operations ^[a] E. I. du Pont de Nemours	Fire in electrostatic precipitator
500,000	Aug. 30, 1976	Richland Operations ^[a] Atlantic Richfield Hanford Company	Chemical explosion in ion exchange column
499,917	June 16, 1977	Albuquerque Operations Los Alamos Area Office	Fire in Santa Fe National Forest
285,000	June 13, 1976	Chicago Operations Argonne National Laboratory	Tornado damage to equipment and buildings
281,050	Mar. 10, 1976	Schenectady Naval Reactors Office General Electric Corporation Knolls Atomic Power Laboratory Kesselring Site	Leak of 30,000 gallons of oil from underground tank
230,000	Feb. 12, 1975	Savannah River Operations ^[a] E. I. du Pont de Nemours	Denitrate explosion damaged cell and equipment

[a] A summary of the accident investigation is given in Appendix B.

TABLE III. ACCIDENTS CAUSING MORE THAN \$50,000 PROPERTY DAMAGE AT ERDA FACILITIES (continued)

Property Damage (dollars)	Date	Field Office and Contractor	Description
174,000	June 13, 1977	Albuquerque Operations Mason & Hanger - Silas Mason Company, Inc.	Hail damage to vehicles and buildings
134,000	April 16, 1976	San Francisco Operations ^[a] University of California Lawrence Livermore Laboratory	Detonation of high explosives during remote operation
101,027	Nov. 10, 1976	Oak Ridge Operations ^[a] Goodyear Atomic Corporation	Release of UF ₆ caused by improper valve connection
100,000	Sept. 7, 1976	Laramie Energy Technology Center ^[a] Development Engineering Inc.	Welding sparks caused fire which destroyed crusher building
91,500	Feb. 21, 1976	Oak Ridge Operations ^[a] Union Carbide Corporation Nuclear Division Oak Ridge Y-12 Plant	Fire caused by evaporation of a cleaning solution in an electric immersion heater
86,046	Mar. 16, 1975	San Francisco Operations ^[a] Stanford Linear Accelerator Center	Fire caused by malfunction of thyratron destroyed equipment
76,030	Dec. 13, 1976	Oak Ridge Operations ^[a] Union Carbide Corporation Nuclear Division Paducah Gaseous Diffusion Plant	Damage to a 2000 hp motor during startup

[a] A summary of the accident investigation is given in Appendix B.

TABLE III. ACCIDENTS CAUSING MORE THAN \$50,000 PROPERTY DAMAGE TO ERDA FACILITIES (continued)

14	Property Damage (dollars)	Date	Field Office and Contractor	Description
	75,000	Jan. 26, 1976	Chicago Operations ^[a] Brookhaven National Laboratory	Fatigue cracks in bubble chamber delayed operations for 10 months
	70,760	Mar. 6, 1975	Richland Operations Westinghouse Hanford Company	Release of chain hoist caused component to fall on instrumentation
	70,000	May 28, 1976	Savannah River Operations E. I. du Pont de Nemours Company	Abnormal rainfall damaged railways and roads
	63,700	Oct. 15, 1975	Fast Flux Test Facility Project Office ^[a] Bechtel Power Company	Crane hook and assembly fell on the cover of the reactor
	57,000	June 18, 1977	Albuquerque Operations University of California Los Alamos Scientific Laboratory	Building housing photography laboratory destroyed by forest fire
	51,000	Nov. 15, 1975	Chicago Operations Argonne National Laboratory	Reactor experiment dropped during transfer
	50,000	Feb. 16, 1977	Oak Ridge Operations ^[a] Union Carbide Corporation Nuclear Division Paducah Gaseous Diffusion Plant	Electrical fault caused fatality and damage to switchgear

[a] A summary of the accident investigation is given in Appendix B.

TABLE IV

ERDA PROPERTY DAMAGE FROM JANUARY 1, 1975 TO OCTOBER 1, 1977

TYPE	LOSS	PROPERTY DAMAGE RATIO
	(Thousand \$)	(cents/\$100 Property Evaluation)
Mechanical Causes	3,962.9	0.41
Explosions	3,468.5	0.36
Fires	1,750.0	0.18
Acts of Nature	849.3	0.09
Miscellaneous	552.2	0.06
Nuclear Related	361.8	0.04
Electrical Causes	262.2	0.03
Transportation	<u>51.4</u>	0.005
	11,258.3	

Rate for all losses 1.15

Government Loss \$ 657.7
 Total ERDA Loss \$11,916.00

Fig. 5 ERDA property damage ratios.

Fig. 6 ERDA fire loss ratios.

APPENDIX A

ERDA CRITERIA FOR ACCIDENT INVESTIGATIONS

Events which require Types A or B investigations are defined in ERDA Manual Chapter 0502, "Notification, Investigation, and Reporting of Occurrences" and Appendix.

TYPE A

1. Incident (Accident)

- a. Any fatal or imminently fatal occupational injury or occupational illness involving an ERDA or ERDA contractor employee or a member of the public due to an occurrence associated with ERDA or ERDA contractor operation.
- b. Any lost work day case due to an occupational injury or illness of five or more persons as a result of one occurrence in an ERDA or ERDA contractor operation.
- c. Estimated loss or damage to ERDA or other property amounting to \$250,000 or more or estimated costs of \$250,000 or more required for cleaning (including decontamination), renovating, replacing or rehabilitating structures, equipment or property.
- d. Any occurrence involving a nuclear weapon or device (under jurisdiction of ERDA) where there is personal injury or damage to private property.

2. Loss of Material. Any apparent loss or theft of byproduct or other radioactive material in such quantities and under such circumstances that it could constitute a hazard to the health and safety of individuals. Where this involves the possible theft of Government property, the FBI shall be notified (for a decision as to acceptance of investigation jurisdiction).

3. Radiation Exposure

- a. A single or annual accumulated whole body exposure of an individual to 25 rem or more of radiation, a single exposure of the skin of the whole body of an individual to 75 rem or more of radiation, a single exposure of the forearms of an individual to 150 rem or more or a single exposure of the hands, or feet of any individual to 375 rem or more of radiation.
- b. Any internal uptake of radioactive material which on the basis of early assay data, will result in a dose commitment in excess of 5 times the annual standard set forth in Chapter 0524.

4. Other

- a. Any nuclear criticality in a system not intended to reach criticality.
- b. Any accidental release of pollutants which result or could result in significant effect on the public or offsite environment or which requires activation of the EPA or the U.S. Coast Guard National Contingency Plan.

TYPE B

1. Incident (Accident)

- a. Loss or damage to ERDA or other property of \$50,000 to \$250,000 where loss or costs are incurred for cleaning (including decontamination), renovating, replacing, repairing, or rehabilitating structures, equipment, or property.
- b. Occupational illness which requires hospitalization, involves 5 or more persons of which one is a LWC, or results in a greater than 5 days away from work.

2. Radiation Exposure

- a. Any radiation exposure to an individual which in one calendar quarter exceeds the following:
 - (1) 5 rem to the whole body
 - (2) 15 rem to skin of whole body or thyroid
 - (3) 30 rem to the forearms
 - (4) 75 rem to the hands or feet
- b. Any internal uptake of radioactive material which on the basis of a small number of early assay data will result in a dose or dose commitment in excess of the pertinent annual standard set forth in Chapter 0524.

3. Other

- a. Any unplanned nuclear excursion in a reactor which is clearly outside routine experience.
- b. Any release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5000 times the limits specified for such materials in Appendix 0524, II, A.
- c. Any release of radioactive material offsite where it is believed any member of the general population may have received an exposure greater than the annual standard set forth in Appendix 0524, II, A.

APPENDIX B

SUMMARIES OF ACCIDENT INVESTIGATION REPORTS

1. Fatalities and Permanent Disability

Fall from Scaffold - West Milton, New York

June 9, 1975 Cyclops Corporation, Elwin G. Smith Division

One Fatality

A construction worker on a scaffold was attempting to remove or bend a steel bar on the third floor roof of a training and support building at the K. A. Kesselring Site of the Knolls Atomic Power Laboratory. The bar broke, and the employee fell 40 feet to the ground. He was pronounced dead on arrival at a local hospital.

Topple of Core Drilling Rig - Richland, Washington

February 26, 1976 J. A. Jones Construction

One Fatality

A pneumatic core drilling rig toppled from an unstable position on a concrete coverblock at the 241A Tank Farm on the Hanford Reservation. One member of the operating crew was struck by the 1200-pound rig and died immediately.

Motor Vehicle Accident - West Milton, New York

May 11, 1976 Morrison-Knudsen Company

One Fatality

An employee lost control of his motorcycle in the main parking lot at the K. A. Kesselring Site of the Knolls Atomic Power Laboratory. He fell from the motorcycle and struck an automobile. The employee died from his injuries about two hours later in a local hospital.

Electrical Fire - Paducah, Kentucky
February 16, 1977 Union Carbide Corporation
Nuclear Division

Equipment Damage - \$50,000
One Fatality

An electrical mechanic trainee contacted an energized portion of a unit electrical substation with a metal tool at the Paducah Gaseous Diffusion Plant. He sustained third-degree burns from the resulting electrical fault and died eight hours later. The electrical fault and subsequent fire caused extensive damage to equipment.

Detonation of High Explosive - Amarillo, Texas
March 30, 1977 Mason & Hanger-
Silas Mason Company, Inc.

Property Loss - \$2,500,000
Three Fatalities

An experienced engineering technician was performing a roughing operation on a high-explosive billet by contact machining at the Pantex Plant when the explosion occurred. He was killed instantly. An employee in a hallway opposite the machining bay was fatally injured by parts of the falling wall. A third employee was seriously injured by debris and died five days afterwards. The building in which the accident took place was heavily damaged by the blast pressure from the explosion. Adjacent facilities and covered ramps were also damaged.

Radiation Exposure of Both Hands - Berkeley, California
April 6, 1977 University of California

Permanent Disability

A guest research scientist at the Lawrence Berkeley Laboratory exposed his hands to the primary beam of a cabinet X-ray machine during irradiation of yeast culture samples. The estimated dose to the hands was 2100 to 8100 rem. The resulting radiation injury required the amputation of both index fingers.

Motor Vehicle Accident - Livermore, California

May 29, 1977 University of California

Property Damage - \$4400

One Fatality

While conducting a routine patrol on site 300 of the Lawrence Livermore Laboratory, a security officer failed to negotiate a curve. The patrol vehicle overturned, and the officer sustained fatal injuries.

Fall from Roof - Pinellas County, Texas

September 9, 1977 General Electric Company

Neutron Devices Department

One Fatality

A maintenance craftsman was fatally injured at the Pinellas Plant after being catapulted 25 feet from the roof of a building to the ground. The accident occurred during the lowering of an air conditioning cooling coil from the roof using a mobile hoist.

2. Property Loss and Damage

Drop of Component on Instrumentation - Richland, Washington

February 6, 1975 Westinghouse Hanford Company

Property Loss - \$70,760

During testing of the identification and toe drive systems of the in-vessel handling machine at the Fast Flux Test Facility on the Hanford Reservation, the rising stem/grapple arm was being lowered with the chain hoist. Malfunction of the chain hoist drive coupling caused the rising stem to drop about 40 inches upon the foot assembly. The impact of the rising stem assembly on the foot assembly resulted in damage to the foot, arm jack, and associated instrumentation.

Fire and Explosion - Aiken, South Carolina

February 12, 1975 E. I. du Pont de Nemours

Property Loss - \$230,000

During the thermal decomposition of uranyl nitrate hexahydrate to uranium trioxide at the Chemical Separation Area of the Savannah River Plant, the contents of a denitrator pot calciner underwent an exothermic reaction. The contents of the calciner and combustible reaction products were ejected into the room. The resulting combustion and explosion caused damage to the building and equipment. Two operators received minor injuries and returned to work the same day. Although a small quantity of depleted uranium was released in the building, there was no detectable release outside the area.

Equipment Destroyed by Fire - Stanford, California

March 16, 1975 Stanford University

Property Loss - \$86,046

A fire occurred in the west interaction pit of the Stanford Positron-Electron Asymmetric Ring Facility of the Stanford Linear Accelerator Center. Four thyratron pulsers, their high voltage power supply, and related cables were destroyed or severely damaged. Significant damage was sustained by the muon chamber in the west pit experimental area and the west pit roof. Operation of the ring facility was interrupted for about eight days. Operation of the magnetic detector and muon chamber in the west pit was interrupted for approximately four weeks.

Release of Uranium Hexafluoride - Portsmouth, Ohio

April 10, 1975 Goodyear Atomic Corporation

Property Loss - \$29,000

A release of 12 kilograms of uranium containing 0.372 kilograms of enriched uranium occurred in the Extended Range Product Station at the Portsmouth Gaseous Diffusion Plant. The failure of a compressor was the cause of the release. There was neither a release to the environment outside the plant nor exposure to personnel.

Fall of Crane Hook and Assembly on Reactor Cover - Richland, Washington
October 15, 1975 Bechtel Power Company

Property Loss - \$63,700

The auxiliary hook and assembly of polar gantry crane fell at the Fast Flux Test Facility on the Hanford Reservation. The accident occurred after a temporary cover plate had been placed on a silo over the reactor cavity. Although no employees were injured, the property loss included damaged crane components and replacement materials. The direct programmatic impact was a delay of three days in setting the intermediate heat exchanger tube bundles.

Accidental Drop of Nuclear Canister - Mercury, Nevada

October 23, 1975 University of California

Lawrence Livermore Laboratory

Property Loss - \$3,250,000

A diagnostic canister containing a nuclear test device dropped 40 feet to the bottom of the 675-foot test hole at the Nevada Test Site. Twenty-four joints of emplacement pipe, diagnostic hardware and many downhole diagnostic and control cables also dropped down the hole. The result was a tangled mass of pipe, cables, diagnostic instruments, and earth to a depth of 240 feet below the surface. Eleven workers in the immediate vicinity were injured by a whipping action of the connecting cables during their rapid free fall down the hole. Ten workers received minor injuries. One worker suffered a fractured leg.

Release of Uranium Hexafluoride - Portsmouth, Ohio

November 10, 1975

Goodyear Atomic Corporation

Property Loss \$101,027

A release of 10,589 grams of enriched uranium hexafluoride occurred in the High Assay Sampling Area of the Portsmouth Gaseous Diffusion Plant. The leak appeared at a pigtail valve connection of a cylinder when the sample valve was opened. The exhaust fans failed to shut down immediately, and an extensive contamination of the building resulted.

The accident did not cause any significant exposures to personnel or environmental impact. The total cost of the release included lost material, decontamination of the building, and the reprocessing of recovered material.

Fire in Electrostatic Precipitator - Aiken, South Carolina

December 3, 1975 E. I. du Pont de Nemours Company

Property Damage - \$500,000

A fire occurred in the 400-D heavy water production area at the Savannah River Plant after a fuel-rich mixture of pulverized coal and oil was fired. Combustion was incomplete, and the unburned particles were carried by the flue gas through the boiler, air heater, dust collector, and precipitator to the stack. Combustion of these unburned particles took place in the precipitator collector section. The internals of the second and third fields of the precipitator were severely damaged. Although production loss was negligible, the repair of the precipitator required eight months, including a four-month shutdown of the boiler.

Building Fire - Oak Ridge, Tennessee

February 21, 1976 Union Carbide Corporation
Nuclear Division

Property Loss - \$91,500

A fire occurred in the parts cleaning facility at the Y-12 Plant. Plastic material was ignited after the evaporation of a cleaning solution in an electric immersion heater.

Chemical Explosion in Ion Exchange Column - Richland, Washington

August 30, 1976 Atlantic Richfield Hanford Company

One Severe Radiation Exposure

Seven Minor Radiation Exposures

Property Loss - \$500,000

A chemical explosion occurred in the Americium Processing Facility on the Hanford Reservation while americium-241 was being removed from a

waste stream by use of a cation exchange column contained in a glovebox. Americium-241 was released to the room through the shattered glass windows of the glovebox. A nuclear process operator standing near the glovebox received severe radiation exposure. Seven other employees received minor radiation exposure. The property loss included damaged equipment and the cost of decontamination and clean-up. The levels of a very small release from the stack of the building were within established guidelines.

Building Destroyed by Fire - Rifle, Colorado

September 7, 1976 Development Engineering, Inc.

Property Loss - \$100,000

A fire completely destroyed the crushing plant at the Anvil Points Oil Shale Research Facilities. Two crushers were heavily damaged. The probable cause of the fire was the ignition of shale dust by sparks from a cutting torch. Some undetected hot spots in the fine dust could have smoldered and expanded for several hours until the heat was sufficient to spontaneously ignite dust or other flammable material.

Electrical Fire - Paducah, Kentucky

December 13, 1976 Union Carbide Corporation Nuclear Division

Property Loss - \$76,030

A ground fault in a motor at the time of startup caused an electrical fire at the Paducah Gaseous Diffusion Plant. The damaged electrical equipment included the switchgear of a substation and cable. One of the four process motors was severely damaged, and rewinding was required.

Electrical Fire - Paducah, Kentucky

February 16, 1977 Union Carbide Corporation Nuclear Division

Property Damage - \$50,000

One Fatality

See summary on page B-2.

Detonation of High Explosive - Amarillo, Texas

March 30, 1977

Mason & Hanger-

Silas Mason Company Inc.

Property Loss - \$2,500,000

Three Fatalities

(See summary on page B-2).

3. Other Investigations

Fire in Plutonium Glovebox - Aiken, South Carolina

January 13, 1975

E. I. du Pont de Nemours Company

Property Loss - \$20,000

A fire occurred inside the feed preparation glovebox in the Isotopes Process Development Laboratory of the Savannah River Laboratory. The fire burned or melted a polyvinyl chloride bag covering a bag port in one end of the glovebox. The containment was therefore breached, and the atmosphere of the glovebox was opened to the room. No injuries or personnel contamination resulted from this accident. There was no release of radioactive materials to the environment.

Missing Calibration Standard - Argonne, Illinois

May 9, 1975

University of Chicago

Argonne Universities Association

A plutonium calibration standard was discovered to be missing from its storage container at Argonne National Laboratory. The standard was 0.50996 gram of high purity 239-Pu in metal form. It was last seen on May 2, 1975 in the Plutonium Analytical Chemistry Laboratory. Searches of the laboratory premises and associated areas produced negative results.

Inhalation of Plutonium - Golden, Colorado

July 30 and 31, 1975

Rockwell International

Two Radiation Exposures

Two separate, unrelated events resulted in the release of plutonium particulate radioactivity to work areas from gloveboxes at the Rocky Flats Plant. There was no release to the environment outside the plant. The first release was caused by a V-shaped cut in a glove on a glovebox. An operator sustained a total lung burden (plutonium plus americium) of 0.74 to 1.45 maximum permissible lung burden. A hole in the middle finger of a glove was the source of the second release from a glovebox in the calciner process line. The plutonium was confined to a small area in the process room and did not become airborne because of the wet nature of the calciner operation. An operator sustained a plutonium uptake of an unknown quantity. The plutonium was in a soluble form and most of it was not deposited in the lung.

Quarterly Dosimeter Reading of 5.80 rem

August 8, 1975

Western Electric Company

One Radiation Exposure

The dosimeter badge of a technician, who calibrated radiation survey instruments, indicated a quarterly dose of 5.80 rem, which was above the ERDAM quarterly limit of 5.0 rem. The Investigation Board determined that 5.8 rem was a valid exposure to the badge but could not establish the source of the exposure. Consequently, the exposure was assigned to the technician.

Leak of Xenon Gas from Shipping Container - Knoxville Airport, Tenn.
February 13, 1976

The leakage of xenon gas from a glass ampule occurred after shipment from Oak Ridge National Laboratory. Measurements of radiation levels prior to the time of dispatch indicated that they were within Department of Transportation limits. After monitoring at the airport indicated that the radiation levels exceeded the limits, the package was returned to Oak Ridge National Laboratory. It was opened and a hairline crack was discovered in the glass ampule. Personnel exposure was minimal, and the occurrence did not cause any adverse environmental effects.

Occupational Injury - Golden, Colorado

March 24, 1976

Rockwell International

Injury Involving Contaminated Equipment

A chemical operator at the Rocky Flats Plant was injured when his glove and left palm were punctured by a pair of contaminated tweezers. He was attempting to dislodge an improperly machined Teflon gasket from a fitting on a glovebox. No radioactive material was released from the glovebox to the environment.

Krypton Release - Oak Ridge, Tennessee

April 2, 1976 Union Carbide Corporation

Nuclear Division

Three radiation exposures

During the withdrawal of 85-Krypton from a thermal diffusion column at the Oak Ridge National Laboratory, a release of about 50 curies of krypton occurred. Estimates of the dose received by three employees were 4, 6, and 15 rem to the skin and 20, 30, and 100 mrem of penetrating radiation. The maximum concentration downwind was within the established limits.

Inhalation of Plutonium - Columbus, Ohio
July 13, 1976 Battelle Memorial Institute

Decontamination costs - \$5,000
Three radiation exposures

A glovebox containing residual plutonium contamination was accidentally breached during offloading from a forklift in the Plutonium Laboratory in the Columbus Laboratories. Plutonium-bearing particulate materials were released in the area through the opening. One employee received a first year dose commitment of less than 12 rem to the lungs. Two other employees received a first year dose commitment of less than 1.75 rem to the lungs. No release of radioactivity occurred to the environment outside the Plutonium Laboratory.

Radiation Exposures - Tonopah Test Range, Nevada
August 11 and 12, 1976 University of California

Two radiation exposures

A radiographer of the Lawrence Livermore Laboratory exposed his hands to a cobalt-60 source during operations to recover the source which had been disconnected from its drive cable in a transfer tube. The "most probable" dose to the left hand was estimated to be 40 rem. The dose to the right hand was estimated to be less than 2 rem. On the following day, the section leader was inadvertently exposed to the cobalt source as he attempted to retrieve a source tube for subsequent use in a planned recovery of the source. He did not know that the source tube contained the cobalt source. Estimates of his maximum exposure were 0.7 rem to his hands and 2.2 rem to his feet.

Chemical Explosion in Ion Exchange Column - Richland, Washington
August 30, 1976 Atlantic Richfield Hanford Company

One severe radiation exposure
Seven minor radiation exposures
Property Loss - \$500,000

See summary on Page B-6

Severe Electrical Burns - Oak Ridge, Tennessee
September 16, 1976 Union Carbide Corporation
Nuclear Division

One Case of Electrical Burns

An experienced lineman contacted an energized 13.8 KV power line and sustained severe electrical burns at the Oak Ridge National Laboratory. Other members of the four-man crew were not injured. The immediate cause of the accident was the failure of the lineman to wear prescribed protective clothing (insulating gloves) and to remove metal jewelry.

Electrical Shock - Livermore, California
November 2, 1976 University of California

One Case of Electrical Shock

An electronics technician received a severe electrical shock after contacting a surface at high voltage in the Lawrence Livermore Laboratory. He was working close to two exposed surfaces at high voltage in a cluttered and confined area. The technician was hospitalized for a brief period. No permanent disability was expected to result from the accident.

Explosion in Glovebox - Los Alamos, New Mexico
February 10, 1977 University of California

Five Radiation Exposures
Property Loss - \$30,000

An explosion in a reduction vessel glovebox caused two gloves to be torn from it and the subsequent release of plutonium into a room at the Los Alamos Scientific Laboratory. The direct cause of the accident was the failure of a metal gasket at the top of the reduction vessel during the reaction. Five employees received lung burdens of 0.3, 3.4, 6.3, 8.1, and 18.3 nCi. There was no release of plutonium to the environment outside the room. The property loss includes the costs of decontamination, programmatic interruption, and destroyed equipment.

Inhalation of Hazardous Fumes - Los Alamos, New Mexico

May 9, 1977 University of California

Occupational Illness

On May 5, 6, and 9, 1977 an employee used very large quantities of methyl chloroform and acetone to clean machines at the Los Alamos Scientific Laboratory. He became ill and was transported to the Los Alamos Scientific Laboratory Occupational Medicine Facility, where the medical examiners suspected a stroke and transferred him to the Los Alamos Medical Center. The exact nature of the illness is indeterminate because Safety and Industrial Hygiene Groups were not notified immediately to initiate toxicologic analyses and supportive investigations. Since positive proof cannot be established to the contrary, the Investigation Board believed that the incident should be classified as an occupational illness.

Radiation Exposure - Richland, Washington

June 22 - August 1, 1977 Rockwell Hanford Operations

A routine dosimetry analysis indicated that a dosimeter issued to a nuclear process operator had been exposed to 7.64 rem of penetrating radiation between June 22 and August 1, 1977. Although the potential for a dose of 7.64 rem exists in the Waste Encapsulation and Storage Facility, no specific source was identified. No other employee of the facility during the same period received a dose greater than the permissible limit. The operator was restricted from further radiation work for the remainder of the year.

Automobile-Pedestrian Accident - Golden, Colorado

August 26, 1977

One Fatality

(Non-occupational)

An automobile-pedestrian accident occurred on the east access road of the Rocky Flats Plant. The pedestrian was jogging toward oncoming traffic and was struck by an automobile which had left the road. The pedestrian was pronounced dead at the scene. The Investigation Board

determined that the weather, terrain, condition of the road, and mechanical condition of the automobile did not appear to be factors in this accident. The Investigation Board did not believe this accident to be a recordable occupational fatality.