

SUMMARY OF FIRE PROTECTION PROGRAMS FOR CALENDAR YEAR 1998



UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF WORKER HEALTH AND SAFETY
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FOREWORD

This edition of the Annual Fire Protection Program Summary for the Department of Energy (DOE) continues the series started in 1972.

Since May 1950, an Annual Fire Protection Program Summary (Annual Summary) has been submitted by DOE's fire protection engineering community under the requirements of DOE's predecessor agencies: the Atomic Energy Commission (AEC) and the Energy Research Development Administration (ERDA). Currently it is required by section 5a.(8) of DOE Order 231.1, "Environment, Safety and Health Reporting" which replaced DOE 5484.1, "Environmental Protection, Safety and Health Protection Information Reporting Requirements".

Beginning in 1981, all individual accident reports required by DOE Order 5484.1 have been compiled within the Computerized Accident Incident Reporting System (CAIRS) from different field organization sources than those submitting the Annual Summary. Each quarter, CAIRS issues the Occupational Injury and Property Damage Summary which statistically reports on DOE loss topics such as fatalities, injuries, illnesses, fire, and non-fire losses. The Annual Summary however, takes a more comprehensive look at the DOE fire protection program. Fire loss statistics are provided, as are reports on a broad range of fire protection activities including; automatic suppression system performance, fire department responses, and the recurring cost of fire protection at DOE. Fire loss statistics from the Annual Summary are also validated with the CAIRS fire loss reports, and trended against the CAIRS non-fire loss data. Discrepancies with either loss statistic are investigated and corrected as necessary.

The report for calendar year (CY) 1998 was summarized from information sent to Headquarters by 64 out of 82 sites, representing approximately 91 percent of DOE's holdings. For comparison purposes, field offices are arranged according to the CAIRS reporting format, with a total of 19 categories represented. Abbreviations are identified in the Glossary, as are the DOE site and management and operations (M&O) contractors and major definitions.

GLOSSARY

Field organization abbreviations:

AL	Albuquerque Operations
CH	Chicago Operations
ETC	Energy Technology Centers ¹
GFO	Golden Field Office
HQ	Headquarters (DOE)
ID	Idaho Operations
NPR	Naval Petroleum Reserves ²
NV	Nevada Operations
OK	Oakland Operations (San Francisco)
OFO	Ohio Field Office
ORO	Oak Ridge Operations
PA	Power Administrations ³
PNR	Pittsburgh Naval Reactors Office
RF	Rocky Flats Operations
RL	Richland Operations
SNR	Schenectady Naval Reactors Office
SPR	Strategic Petroleum Reserves
SR	Savannah River Operations
YM	Yucca Mountain Site Characterization Project Office

Site or M&O contractor abbreviations:

ALA	Ames Laboratory
ANLW	Argonne National Laboratory, West
ANLE	Argonne National Laboratory, East
BAPL	Bettis Atomic Power Laboratory
BM	Bryan Mound Crude Oil Storage Site
BNL	Brookhaven National Laboratory
ETEC	Energy Technology Engineering Center
ETTP	East Tennessee Technology Park
FA	Fermi National Accelerator Laboratory
FEN	Fernald Site
HAN	Hanford Site
INEEL	Idaho National Engineering & Environmental Laboratory
ITRI	Inhalation Toxicology Research Institute

1. Energy Technology Center organizations are comprised of: the Bartlesville Project Office (BPO); the Pittsburgh Energy Technology Center (PETC); and the Morgantown Energy Technology Center (METC).

2. Naval Petroleum Reserve organizations are comprised of: the Naval Petroleum Reserves in California (NPR-1), and the Naval Petroleum & Oil Shale Reserves in CO, UT, and WY (NPR-2,3).

3. Power Administration organizations are comprised of: the Alaska Power Administration (APA); the Bonneville Power Administration (BPA); Southeastern Power Administration (SEPA), Southwestern Power Administration (SWPA); and the Western Area Power Administration (WAPA).

KAPL	Knolls Atomic Power Laboratory
KCP	Kansas City Plant
KSO	Kesserling Site
LANL	Los Alamos National Laboratories
LLNL	Lawrence Livermore National Laboratories
MB	Mound Site
NRF	Naval Reactor Facilities
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratories
PAN	Pantex Site
PGDP	Paducah Gaseous Diffusion Plant ⁴
PI	Pinellas Site
PNL	Pacific Northwest Laboratory
POR	Portsmouth Gaseous Diffusion Plant ⁴
PPPL	Princeton Plasma Physics Laboratory
ROSS	Ross Aviation, Inc.
SLAC	Stanford Linear Accelerator Center
SNLA	Sandia National Laboratories, Albuquerque
SNLL	Sandia National Laboratories, Livermore
SRS	Savannah River Site
WH	West Hackenberry
WI	Weeks Island Site
WS	Windsor Site
Y-12	Oak Ridge's Y-12 Plant

The below reference is used throughout the report to identify various DOE elements:

DOE field organization (abr.)/site or M&O contractor (abr.)
 Example: AL/LANL

⁴. On July 1, 1993, a lease agreement took effect between the DOE and the United States Enrichment Corporation (USEC) essentially transferring all ownership responsibilities to USEC.

DEFINITIONS

The following terms are defined in the text of DOE Manual M 231.1-1, "Environment, Safety, and Health Reporting Manual." Major definitions not included in this manual have been extracted from the rescinded order DOE 5484.1 to clarify key concepts. Section references to these documents are given at the end of the definition.

- 1. Property Value:** The approximate replacement value of all DOE-owned buildings and equipment. Included are the cost of all DOE-owned supplies and average inventory of all source and special nuclear materials. Excluded are the cost of land, land improvements (such as sidewalks or roads), and below ground facilities not susceptible to damage by fire or explosion (such as major water mains and ponds). (APPENDIX C, DOE M 231.1)
- 2. Estimated Loss:** Monetary loss determination based on all estimated or actual costs to restore DOE property and equipment to preoccurrence conditions irrespective of whether this is in fact performed. The estimate includes: (1) any necessary nuclear decontamination; (2) restoration in areas that received water or smoke damage, (3) any reductions for salvage value, and (4) any lost revenue experienced as a result of the accident. The estimate excludes: (1) down time; and (2) any outside agency payments. Losses sustained on private property is not reportable, even if DOE is liable for damage and loss consequences resulting from the occurrence. Categorization of occurrences shall be by fire loss and non-fire loss events. (APPENDIX C, DOE M 231.1)
- 3. Fire Loss:** All damage or loss sustained as a consequence of (and following the outbreak of) fire shall be classified as a fire loss. Exceptions are as follows: (1) burnout of electric motors and other electrical equipment through overheating from electrical causes shall be considered a fire loss only if self-sustained combustion exists after power is shut off. (APPENDIX C, DOE M 231.1)
- 4. Non-fire Loss:** All damage or loss sustained as a consequence of the following events: (1) explosions; (2) natural cause events (such as earthquakes and hurricanes); (3) electrical malfunctions; (4) transportation (cargo) losses; (5) mechanical malfunctions; (6) radiation releases or other nuclear accidents; and (7) miscellaneous accidents (such as thermal, chemical or corrosion-related accidents). (CHAPTER 4.2.c, DOE 5484.1)
- 5. Loss Rate:** Unit of comparison in cents loss per \$100 of property value.

EXECUTIVE SUMMARY

DOE experienced no fatalities or major injuries from fire in CY 1998. This period was marked, however, with the inadvertent actuation of a fire suppression system that caused one fatality and several life threatening injuries at the INEEL. Lessons learned from the incident are currently being implemented throughout the complex. In addition, information sharing with the private sector on the event has been completed, with positive steps underway to prevent recurrence of the event.

In all, 84 fire occurrences during the period caused an estimated \$294,255 in property damage. These losses are approximately \$240,000 less than fire losses sustained in CY 1997, with 34 percent of costs distributed over 1 incident. Loss comparisons between the DOE and private industry are performed by normalizing data against total property value. In CY 1998, DOE's assets decreased by 3.7 percent to 99.1 Billion dollars, resulting in a fire loss rate of approximately 0.03 cents for each \$100 property value. This rate is 0.07 cents lower than the five year DOE average, and 0.61 cents less than private industry (non-nuclear) statistics. If the DOE were to match its fire loss rate to that of the private sector, it would have to incur losses of over 6.3 million dollars to meet comparable industry losses.

DOE's success in reducing risk or incidence from fire to the public and its workers is attributed to the implementation and maintenance of a comprehensive fire protection program, which compares favorably with the best of class in the private sector. This program includes the adoption of a "defense in depth" fire safety philosophy; conformance with industry standards and DOE-specific fire safety criteria for design, construction, and operation of its facilities; fully capable site emergency response personnel; and qualified fire safety professionals.

Recurring costs for fire protection exceeded 117 million dollars in CY 1998. On a ratio of cost to replacement value, the DOE spent approximately 12.01 cents per \$100 replacement value for recurring fire protection activities, 1.62 cents more than the corrected amount reported the previous year.

In CY 1998, 2 fires were controlled by an automatic wet pipe sprinkler system, continuing the DOE track record on sprinkler effectiveness at a 99 percent rate. The success of these fixed suppression systems were, however, offset by the fatality mentioned above, as well as the inadvertent actuation of 54 systems primarily due to human error. Also, concerns remain regarding inadvertent Halon discharges (9 of the above 54 events), causing the release of approximately 3,851 pounds of Halon to the environment. The DOE remains committed to minimizing this ozone depleting substance through implementation of its managed Halon phaseout guidelines.

DOE PROPERTY LOSS EXPERIENCE

Fire Protection Summary
For Calendar Year 1998

Property value estimates are taken from the CAIRS database and serve as a common denominator for comparing Annual Summary loss rates to the CAIRS Summary. CAIRS data shows that DOE property values dropped approximately 3.7 percent in CY 1998.

In all, 84 fire incidents were reported by field organizations accounting for a total year-end fire loss of \$294,255. Of these incidents, 72 fires were reported as falling below the CAIRS threshold of \$5,000. Field organizations reported non-fire loss amounts totaling \$807,720.

DOE's fire loss rate for CY 1998, as summarized from field organization reports, is approximately 0.03 cents loss per \$100 value; 60 percent less than last year's 0.05 cent figure. This statistic is also 3.3 times lower than the 1993-1997 DOE average of 0.10, continuing the downward trend in fire loss rates over the previous year. In comparison, the five year loss rate average for the highly protected risk (HPR) insurance industry was about 0.64 cents per \$100 value⁵. This success compared to private industry is attributed to a conservative, yet flexible fire safety program, as well as the efforts of DOE's safety professionals in identifying and mitigating fire hazards before they result in a loss.

Table 1 characterizes Annual Summary loss histories since 1950 and includes both fire and non-fire loss rate categories. Numbers shown in parentheses represent a 5-year running average, where applicable. The accompanying figures provide a graphical representation of the Department's property valuation since 1950 (Figure 1); fire and non-fire loss data since 1985 (Figure 2); fire loss rates since 1985 (Figure 3); non-fire loss rates over the same time period (Figure 4); the current year's fire loss rate for Field organizations (Figure 5); and, the current year's non-fire loss rate for the same (Figure 6). Sites that are not shown on Figures 5 and 6 reported either insignificant or zero losses for the year.

Trending of fire loss data indicates that a small number of incidents constitute the majority of losses reported to the DOE. For example, the largest fire incident accounted for approximately 34 percent of the total loss amount.

The largest fire and non-fire losses for the year are noted below:

1. CH/ANLE - A vacuum chamber experiment using a pyrophoric gas (Silane) extended beyond the experiment's boundary causing damage to the room and contents of approximately \$100,000.
2. AL/KCP - Poor construction of a copper piping solder joint allowed backflow preventer to separate from piping and cause approximately \$199,000. in water damage to tools instruments and other equipment

⁵. As reported by an HPR insurance company for standard business property loss from fires and explosions (1997).

Fire Protection Summary
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The fourth quarter CAIRS report (1998) identified 2 fire incidents over the year resulting in a loss of \$96,868; approximately \$197,000 less than the Annual Summary. Of this difference, \$100,000 can be traced to the CH/ANLE fire incident, with the remaining discrepancy linked to other incidents which were not incorporated into the CAIRS database. The CAIRS report also lists 16 non-fire incidents producing losses of \$889,558., approximately \$82,000 more than field reports.

This report has historically identified discrepancies between Annual Summary field reports and the CAIRS data. In many incidences, these discrepancies were traced to either delayed reporting, cost estimating differences, improper loss characterization, or a misinterpretation on the need to file a report at all. Since CAIRS loss statistics are often extracted for use in other documents such as reports to Congress, performance indicator studies, and media releases, a less accurate reflection is the result. CAIRS administrators are addressing these issues by increased field training programs and by streamlining the CAIRS reporting process using state of the art electronic technology. A part of this technology includes developing a "seamless" approach using a library of definitions that allows reporting data to be related to a number of different reports.

Comment [jb1]:

Fire Protection Summary
For Calendar Year 1998

Table 1
DOE Loss History From 1950 To Present

Year	Property Value (Millions of Dollars)	Fire Loss (Dollars)	Non-fire Loss (Dollars)	Loss Rates (cents per 100 Dollar Value)		
				Fire*	Non-Fire*	Total*
50	1,800.00	486,389	10,050	2.70	0.06	2.76
51	2,177.10	38,318	317,797	0.18	1.46	1.64
52	3,055.10	449,107	356,600	1.47	1.17	2.64
53	4,081.00	148,142	427,430	0.36	1.05	1.41
54	6,095.90	185,438	190,436	0.30	0.31	0.62
55	6,954.20	125,685	330,103	0.18 (1.00)	0.47 (0.81)	0.66 (1.81)
56	7,364.10	2,206,478	940,945	3.00 (0.50)	1.28 (0.89)	4.27 (1.39)
57	7,973.20	590,663	885,936	0.74 (1.06)	1.11 (0.86)	1.85 (1.92)
58	8,102.50	275,560	476,265	0.34 (0.92)	0.59 (0.84)	0.93 (1.76)
59	10,301.80	199,841	998,060	0.19 (0.91)	0.97 (0.75)	1.16 (1.67)
60	10,708.60	636,228	764,823	0.59 (0.89)	0.71 (0.88)	1.31 (1.77)
61	11,929.90	325,489	5,530,566	0.27 (0.97)	4.64 (0.93)	4.91 (1.91)
62	12,108.80	3,020,023	293,341	2.49 (0.43)	0.24 (1.60)	2.74 (2.03)
63	13,288.90	599,056	776,998	0.45 (0.78)	0.58 (1.43)	1.04 (2.21)
64	14,582.80	480,519	870,516	0.33 (0.80)	0.60 (1.43)	0.93 (2.23)
65	15,679.30	1,743,448	2,106,621	1.11 (0.83)	1.34 (1.35)	2.46 (2.18)
66	16,669.00	158,220	698,753	0.09 (0.93)	0.42 (1.48)	0.51 (2.41)
67	17,450.90	359,584	2,423,350	0.21 (0.90)	1.39 (0.64)	1.59 (1.53)
68	18,611.90	155,986	713,097	0.08 (0.44)	0.38 (0.87)	0.47 (1.31)
69	20,068.30	27,144,809	909,525	13.53 (0.37)	0.45 (0.83)	13.98 (1.19)
70	22,004.30	89,456	1,611,336	0.04 (3.00)	0.73 (0.80)	0.77 (3.80)
71	24,155.80	78,483	1,857,566	0.03 (2.79)	0.77 (0.68)	0.80 (3.47)
72	26,383.50	222,590	698,061	0.08 (2.78)	0.26 (0.75)	0.35 (3.52)
73	27,166.70	117,447	2,258,241	0.04 (2.75)	0.83 (0.52)	0.87 (3.27)
74	28,255.50	249,111	930,766	0.09 (2.75)	0.33 (0.61)	0.42 (3.36)
75	31,658.30	766,868	4,485,481	0.24 (0.06)	1.42 (0.59)	1.66 (0.64)
76	35,512.70	251,849	2,040,727	0.07 (0.10)	0.57 (0.72)	0.65 (0.82)
77	39,856.10	1,084,823	2,529,161	0.27 (0.11)	0.63 (0.68)	0.91 (0.79)
78	47,027.10	12,976,036	4,501,943	2.76 (0.14)	0.96 (0.76)	3.72 (0.90)
79	50,340.80	654,716	1,886,307	0.13 (0.69)	0.37 (0.78)	0.50 (1.47)
80	54,654.70	1,385,686	7,160,249	0.25 (0.69)	1.31 (0.79)	1.56 (1.49)
81	59,988.80	2,042,633	2,600,855	0.34 (0.70)	0.43 (0.77)	0.77 (1.47)
82	65,360.40	948,691	3,252,277	0.15 (0.75)	0.50 (0.74)	0.64 (1.49)
83	70,484.40	731,234	9,765,828	0.10 (0.73)	1.39 (0.71)	1.49 (1.44)
84	82,166.90	1,549,807	4,917,513	0.19 (0.19)	0.60 (0.80)	0.79 (0.99)
85	86,321.84	1,145,975	2,983,322	0.13 (0.21)	0.35 (0.85)	0.48 (1.05)
86	82,787.52	805,030	4,490,262	0.10 (0.18)	0.54 (0.65)	0.64 (0.83)
87	91,927.20	1,570,736	1,440,093	0.17 (0.13)	0.16 (0.67)	0.33 (0.81)
88	92,998.00	466,120	7,837,000	0.05 (0.14)	0.84 (0.61)	0.89 (0.74)
89	107,948.00	615,551	6,890,000	0.06 (0.13)	0.64 (0.50)	0.70 (0.63)
90	115,076.00	8,392,746	9,078,000	0.73 (0.10)	0.79 (0.51)	1.52 (0.61)
91	119,236.00	623,940	2,019,000	0.05 (0.22)	0.17 (0.59)	0.22 (0.81)
92	119,294.00	1,260,950	3,647,805	0.11 (0.21)	0.31 (0.52)	0.41 (0.73)
93	120,733.88	781,269	3,193,534	0.06 (0.20)	0.26 (0.55)	0.33 (0.75)
94	125,733.88	1,417,138	2,287,372	0.11 (0.20)	0.18 (0.43)	0.29 (0.64)
95	120,579.98	743,374	1,256,560	0.06 (0.21)	0.10 (0.34)	0.17 (0.56)
96	113,728.50	2,370,351	1,486,506	0.21 (0.08)	0.13 (0.21)	0.34 (0.28)
97	102,947.24	534,031	4,086,024	0.05 (0.11)	0.40 (0.20)	0.45 (0.31)
98	99,127.86	294,255	807,720	0.03 (0.10)	0.08 (0.22)	0.11 (0.32)

*Numbers shown in parentheses represent the 5-year running average.

Figure 1

DOE Property Valuation

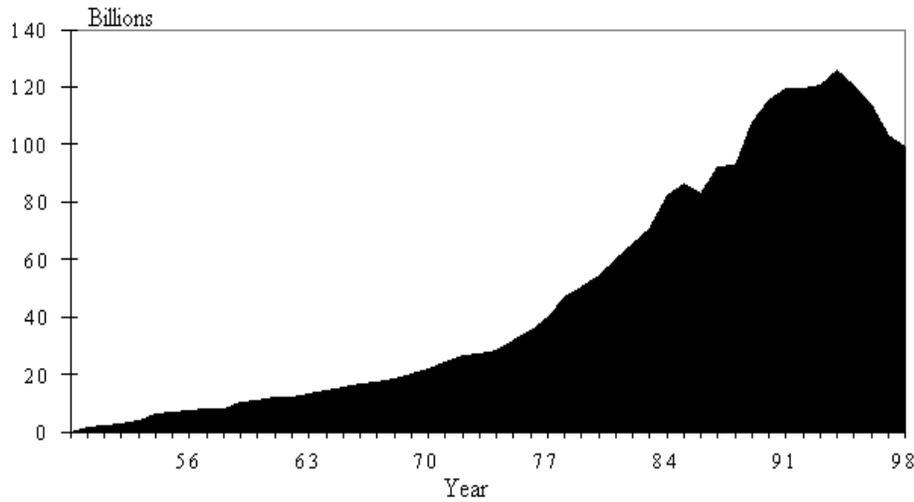


Figure 2

Property Loss

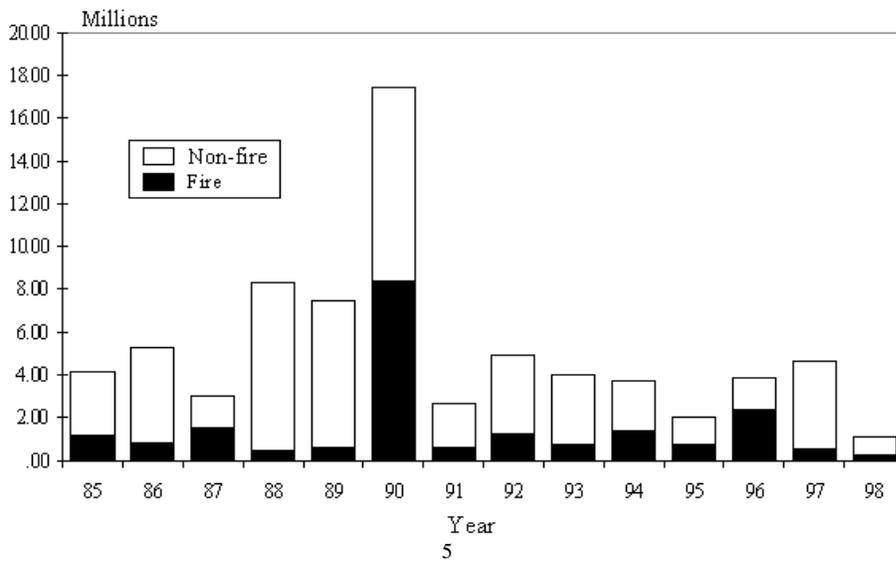


Figure 3

DOE Fire Loss Rate

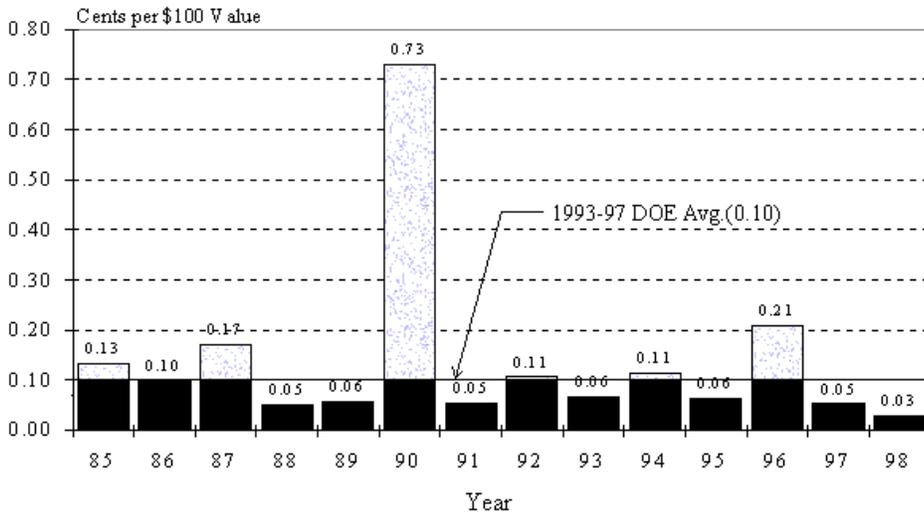


Figure 4

DOE Non-fire Loss Rate

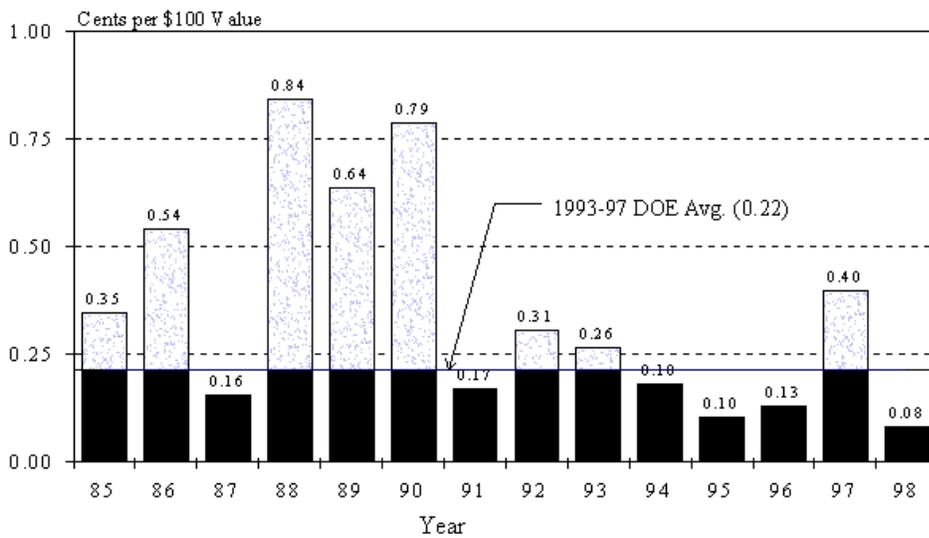


Figure 5
Fire Loss Rate by Field Organization

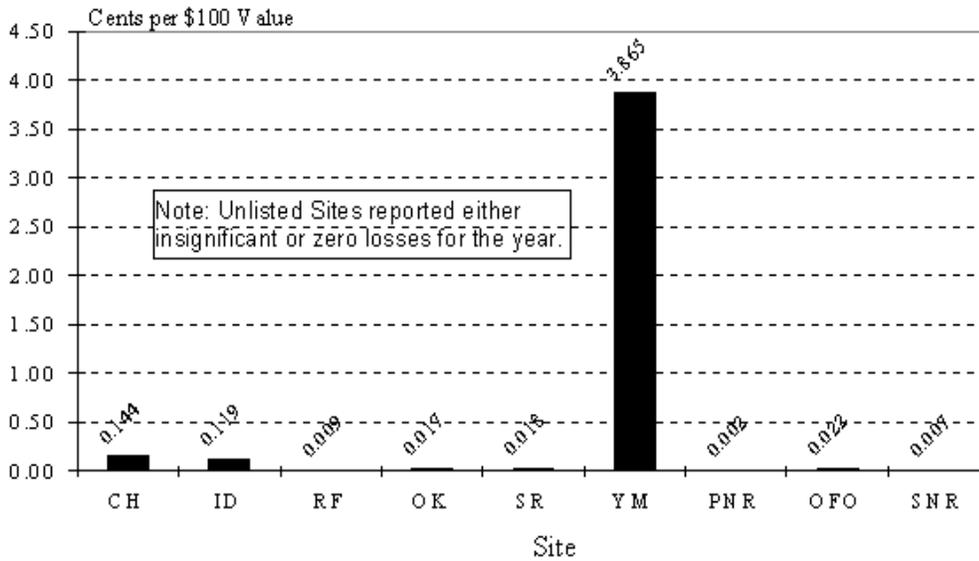
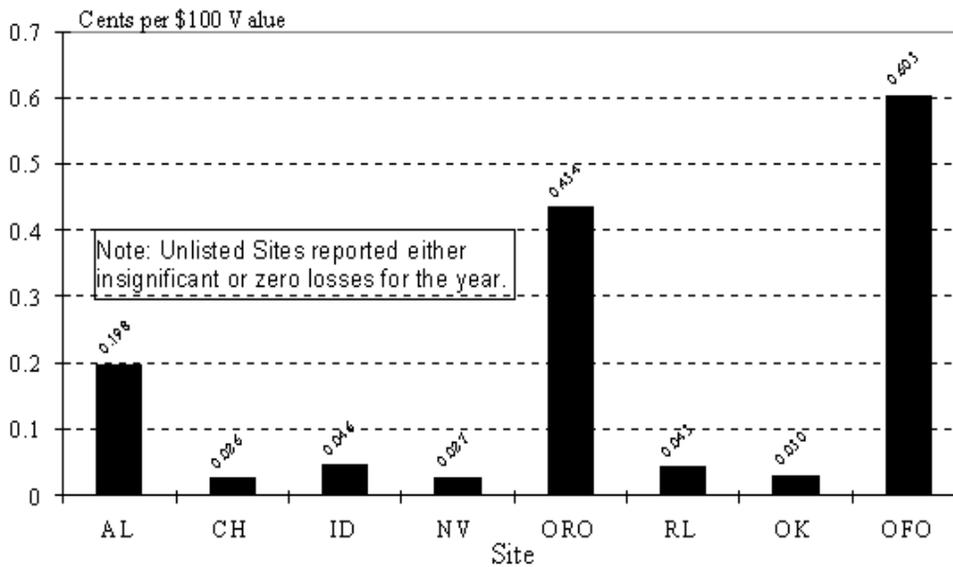


Figure 6
Non-fire Loss Rate by Field Organization



Fire Protection Summary
 For Calendar Year 1998

SUMMARY OF FIRE DAMAGE INCIDENTS

The following table provides a brief description notable DOE fire losses over the year:

Table 2
Summary of Fire Damage Incidents For CY-98

LOSS TYPE	LOCATION	DESCRIPTION	DOLLAR LOSS
Fire	YM	Air compressor fire.	89,000.
Fire	ID	The cooling line for the diesel raw water pump froze causing the turbocharger to overheat and ignite adjacent insulation materials.	28,813.*
Fire	SR	A seized bearing in a generator caused a fire in building 292-S	8,000.*
Fire	SR	HVAC unit fire in the attic of Trailer 704-172N caused a room and contents fire. The cause of the unit's malfunction was determined to be either a heat strip relay arc or a blower motor capacitor failure.	8,000.*
Fire	SPR/WI	Lighting control panel caught fire when one or more breakers arced due to possible panel moisture (leaking roof).	8,000.*
Fire	CH/BNL	Diesel-fueled forklift fire of unknown origin	6,000.*
Fire	ID	During conduct of research at Lab C-8, insulation on an off-gas afterburner ignited. Insulation on both the afterburner and ductwork were damaged	5,000.*
Fire	OK/LBNL	A 40 year old manually controlled industrial washer overheated, melting a plastic animal cage and causing a fire.	5,000.
Fire	CH/FA	Contract employees cleaning a concrete floor caused a fire when the floor buffer they were using ignited acetone vapors in the room. The fire was controlled by the actuation of three sprinklers.	NR**

*No CAIRS report. **NR (No Report Submitted on Field)

Fire Protection Summary
For Calendar Year 1998

WATER-BASED AUTOMATIC SUPPRESSION SYSTEM PERFORMANCE

A total of 43 incidents were reported where water-based suppression systems operated in CY 1997: 25 were wet-pipe systems, 10 dry-pipe, 6 deluge, 1 fire cycle, and 1 fire pump. Of the wet-pipe system activations, two events were directly related to fire. Other system activations were caused by the following events: acts of nature/freezing conditions(9), human error(17), mechanical(6), miscellaneous/overheat (9).

Water-based system activations of interest are listed in Table 3.

Table 3
Water Based System Actuations

LOSS TYPE	LOC.	DESCRIPTION	DOLLAR LOSS
Fire	CH/FA	Contract employees cleaning a concrete floor caused a fire when the floor buffer they were using ignited acetone vapors in the room. The fire was controlled by the actuation of three sprinklers.	NR*
Fire	SNR/KAPL	An improperly terminated 4160 V cable within a load center caused an explosion/fire which was controlled by a single sprinkler.	NR*
Nonfire	AL/PAN	On September 7,1998 at about 0949 hours, a water flow alarm was received from building 12-17. Investigation revealed that the temperature in the equipment room actuated 3 sprinkler heads.	NR*
Nonfire	AL/SNLA	An individual, while operating a fork lift, struck a fire protection sprinkler pipe which caused a break in the elbow and subsequent alarm.	NR*
Nonfire	AL/KCP	During a planned utility shutdown, electrical service was turned off to a basement air handling unit equipment room. The steam coil was left active which caused heat build-up to the point that 3 sprinklers and 3 heat detectors were actuated.	NR*
Nonfire	RL	Sprinkler was damaged while moving the overhead crane.	\$6,051.
Nonfire	RL	Cold weather damaged a wet-pipe sprinkler system	\$10,910.
Nonfire	OFO/FEN	Unscheduled electrical outage sitewide caused the actuation of three dry-pipe sprinkler systems due to the absence of supervisory air normally delivered via electric air compressors.	NR*

*NR (No Report Submitted on Field)

There are now a total of 236 incidents in DOE records where sprinkler systems operated in a fire. The satisfactory rate of performance is 99.2 percent, or 234 times out of 236 incidents. The two failures during a fire were attributed to; a closed cold weather valve in 1958 controlling a single sprinkler in a wood dust collector and, a deluge system failure due to a hung-up trip weight in a 1963 transformer explosion.

Fire Protection Summary
 For Calendar Year 1998

From the above history, DOE has experienced 108 fires that were either controlled or extinguished by the wet-pipe type of automatic suppression system. Table 4 below provides a summary on the number of sprinklers actuated to control or extinguish a fire against the number of occurrences where this event was reported. For example: 94 percent of these fires were controlled or extinguished with 4 or less sprinklers activating, 91 percent were controlled with 3 or less sprinklers activating, and so on.

The significance of this table is to highlight actual performance on systems that have been installed according to standard design practices (in this case the National Fire Protection Association(NFPA) Standard 13, Installation of Sprinkler Systems). By comparing the actual performance to design requirements, the designer or reviewer can get a sense of the conservativeness of the design requirement and adjust the design where necessary. Sprinkler system water containment, for example, could rely on actual performance rather than strict design practice, since no specific design criteria exist on the subject.

Table 4
**DOE Wet-Pipe Automatic Suppression Performance
 1955 to 1997**

Number of Sprinkler heads Activated per Fire Event	Number of Events	Cumulative Total of Events	Percentage of Event	Cumulative Percentage of Events
1	75	75	69	69
2	18	93	17	86
3	5	98	5	91
4	4	102	4	94
5	2	104	2	96
6	1	105	1	97
7	2	107	2	99
8	0	107	0	99
9+	1	108	1	100

NON WATER-BASED FIRE SUPPRESSION SYSTEM PERFORMANCE

Carbon Dioxide Fatality At the INEEL

On July 28, 1998, an unexpected activation of the high pressure carbon dioxide (CO₂) fire suppression system occurred in Building 648 at the Test Reactor Area of (INEEL). The accident resulted in one fatality, several life-threatening injuries, and significant risk to the safety of initial rescuers. At the time of the accident, workers were engaged in de-energizing electrical circuit breakers in preparation for preventive maintenance activity on the electrical system in Building 648. Thirteen people were in the building, including foremen, operators, electricians, and fire protection personnel. As the last electrical circuit breaker was opened, the CO₂ fire suppression system unexpectedly discharged without an evacuation warning alarm. Within seconds, the workers found themselves struggling to escape the potentially lethal atmosphere under near zero visibility and the disorienting effects of CO₂.

The DOE Accident Investigation Board determined that an electrical power transient caused sufficient disturbance to the releasing solenoids, tripping the CO₂ system without first initiating the software based pre-discharge warning. The control panel's manufacturer confirmed that any microprocessor, if sufficiently disturbed by power transients or nearby electromagnetic fields, can possibly change its program execution, making it possible to send erroneous instructions to directly actuate output or releasing circuits.

Subsequent to the incident, the DOE Office of Worker Health and Safety initiated a number of actions such as consensus standard proposals and the issuing of guidance on evaluating CO₂ systems aimed at preventing reoccurrence of the specific event. These actions centered on system lock-out, as well as required releasing panel features which were not a part of the system design at the INEEL.

Halon

Concerns regarding the effect of chlorinated fluorocarbons (CFCs) and Halon on the ozone layer have led to their regulation under the 1991 Clean Air Act. The Environmental Protection Agency has subsequently drafted rules on this regulation to include; prohibiting new Halon production, establishing container labeling requirements, imposing Federal procurement restrictions, imposing significant Halon taxes, issuing requirements for the approval of alternative agents, and listing essential areas where Halon protection is considered acceptable.

DOE's current policy does not allow the installation of any new Halon systems. Field organizations have been requested to aggressively pursue alternative fire protection configurations for existing systems and to effectively manage expanding Halon inventories as a result of downsizing. The long-term goal is the gradual replacement of these essential systems.

Fire Protection Summary
For Calendar Year 1998

In CY 1998, the DOE had 775 Halon 1301 systems in operation containing approximately 226,346 pounds of agent. Halon 1301 inventory was reported at approximately 120,173 pounds. Operational and inventory amounts for the Halon 1211 were reported at 145,168 and 29,132 pounds, respectively.

Field organizations reported that 43 non-essential systems have been disconnected in 1998, adding approximately 9,200 pounds to DOE's Halon inventory.

Table 5 provides a breakdown of the five largest Halon utilizing field organizations, listing both Halon 1301 (fixed system extinguishing agent) and Halon 1211 (portable extinguishing agent). Agent Drawdown amounts represent the amount of Halon that was released to the environment over the calendar year. The bulk of Halon utilized within the Power Administrations is shared between BPA (14,495 lbs. in 6 systems) and WAPA (11,489 lbs. in 9 systems with a 6,195 pound inventory).

Table 5
Primary DOE Sites Utilizing Halon Suppression Systems

LOCATION	HALON 1301		AGENT DRAWDOWN	HALON 1211	
	ACTIVE (lbs.)	INVENTORY (lbs.)		ACTIVE (lbs.)	INVENTORY (lbs.)
SR*	46000	30326	2718	2600	15818
AL	45104	13880	0	47573	4281
CH	32048	16687	74	16919	367
PA**	25984	6195	0	36000	3855
SPR	28788	0	0	3	0
Total	177924	67088	2792	103095	24321

* Designated as DOE's Halon bank .

** BPA data based on the CY 96 report

A total of 11 incidents were reported at DOE where Halon 1301 or other non-water based suppression systems operated in CY 1998. No sites reported any system failures during a fire. Additionally, approximately 3851⁶ pounds of Halon 1301 were released in these events. A brief description of Halon actuations, as well as other non-water based system actuations are provided in Table 6 below.

Comparing total Halon stores reported in CY 1998 (346,519 pounds) to the those reported in CY 1997 (371,497 pounds) indicates that DOE's Halon supply shrunk by 24,978 pounds. Comparing this difference to the drawdown amount (3,851 pounds) leaves a discrepancy of approximately 21,127 pounds. This discrepancy can be attributed to a number of factors including: leakage, missing discharge reports, accounting errors, or the transfer of Halon to sources outside the DOE. For example, RL reported that 15,048 pounds of Halon 1301 were sold at public auction in CY-1998.

⁶ The above figure does not consider system leakage in a stable condition.

Fire Protection Summary
For Calendar Year 1998

Sites considering any Halon transfers outside the DOE are reminded that a Halon bank has been established so that reserve capacity can be maintained for mission essential systems in the complex that have not yet been replaced. The SR Fire Department may be contacted for further information regarding Halon transfers.

Table 6
Non-Water Based System Actuations

LOSS TYPE	LOC.	DESCRIPTION	DOLLAR LOSS
Nonfire	AL/WIPP	The Fletcher Scaler mobile mining machine overheated causing the CO2 cartridge bursting disk to rupture and actuate one tank of the fixed dry chemical suppression system	NR*
Nonfire	RL	Personnel inadvertently tripped the Halon system during preventative maintenance releasing 319 pounds of agent. Personnel disconnected operational indicator switch instead of the system solenoid actuators.	\$9,890.
Nonfire	SR	On 04/29/98, 22 cylinders were accidently discharged in the HB Line releasing 1700 pounds of agent.	NR*
Nonfire	SR	On 06/18/98, 1 cylinder was accidently discharged in the HB Line releasing 250 pounds of agent.	NR*
Nonfire	SR	On 07/27/98, 622 pounds of agent was released in bldg 735-A,D-Wing for unknown reasons.	NR*
Nonfire	PNR/BAPL	On 03/17/98, 740 pounds of agent was released at the Digital Equipment Software Engineering Laboratory when a smoke detector actuated. The cause of the smoke detector's operation was unknown, but it was noted that a soot-like material was in the area of the detector that could have originated from a nearby HVAC unit.	NR*

*NR (No Report Submitted on Field)

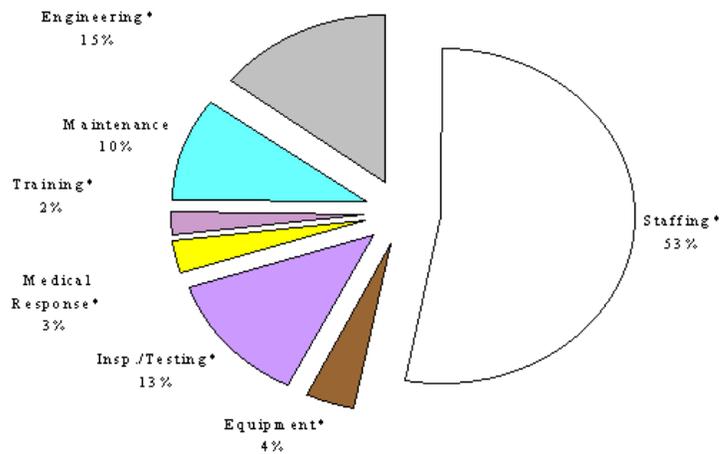
RECURRING FIRE PROTECTION PROGRAM COSTS

Yearly or recurring fire protection costs for CY 1998 reached over \$117 million for the DOE Complex. On a ratio of cost to CAIRS replacement value, the DOE spent approximately 12.01 cents per \$100 replacement value for recurring fire protection activities, up 1.62 cents from the previous year's corrected amount.

Figure 7 shows the CY 1998 recurring cost distribution by activity . Figure 8 lists the recurring cost rate by DOE's field organization. It should be noted that not all recurring cost activities were consistently reported from field organizations, such as outside contracts and maintenance activities. Therefore, the accuracy of Figure 7 is questionable.

Figure 7

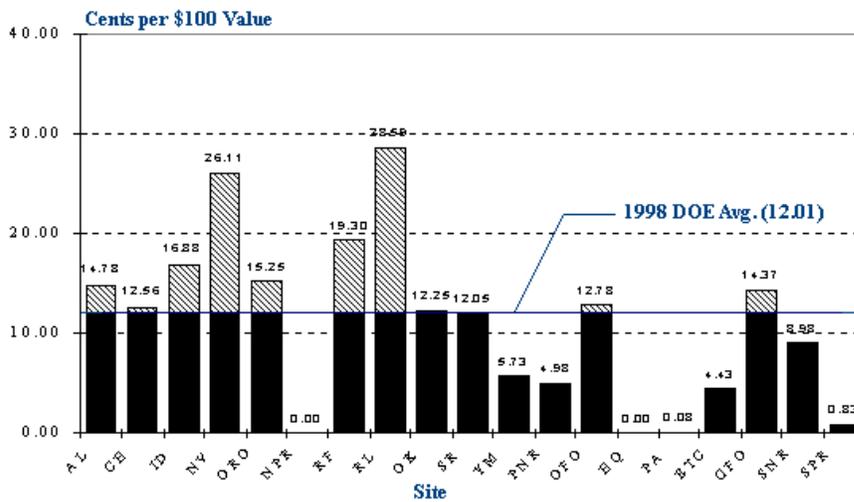
Recurring Fire Protection Cost Distribution



* Fire Department Activities

Figure 8

Cost Rate by Operations Office



Fire Protection Summary
For Calendar Year 1998

The following is a summary of fire department responses for CY 1998. These numbers represent data sent in from approximately 27 fire departments stationed at DOE sites.

1. Fire	575
2. Hazardous Materials	581
3. Other Emergency	3,272
4. Other Non-Emergency	3,632
5. Medical	2,031
Total	10,091

Comparing this data to the actual type of response is difficult since sites do not report incident responses in a consistent fashion. The Office of Environment, Safety and Health is examining the use of a standard reporting format which complies with the National Fire Protection Association's Guide 901, "Uniform Coding for Fire Protection" that could be linked to other DOE incident reporting programs for an accurate and cost effective approach to data collection in DOE. Other options, such as folding DOE's fire data collection into State or National programs such as the National Fire Incident Reporting System, is also being considered.

CONCLUSION

The DOE experienced its first known fire suppression system related fatality in CY 1998. Lessons learned from the incident are currently being implemented throughout the Complex. In addition, information sharing with the private sector on the event has been completed, with positive steps underway to prevent reoccurrence.

The loss characteristics reported in this document are generated from annual reports sent to headquarters from field elements. These reports have historically shown that DOE's approach to estimating property loss favors the DOE (i.e. the Department's actual losses exceed its reported losses). A likely cause of this discrepancy is the multitude of data requests that need processing for any single event as well as lack of uniform guidance on the definition and quantification of the loss. An attempt to rectify the situation currently is underway to streamline the mechanics of data collection by consistently defining loss terms and reporting attributes.

A comparison of the DOE's recurring fire protection cost to private industry costs is difficult to measure since no comparable industry data exists. If the DOE were, however, to match its fire loss rate to that of the private sector, it would have to incur losses of over 6.3 million dollars to meet comparable industry losses for CY-1998. DOE's recorded fire losses of less than \$295,000. are an indication that the department's fire protection programs are successful at maintaining public confidence in our ability to manage fire risk.