

SUMMARY OF FIRE PROTECTION PROGRAMS FOR CALENDAR YEAR 1997



UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF WORKER HEALTH AND SAFETY
October 1998

This report is dedicated to the memory of Jim Scott, an admirable Fire Protection Engineer who departed this life on April 18, 1998 at the age of 48. Jim was well aware of the particular nuances associated with incident reporting at DOE having completed two iterations of the Annual Summary while employed in the Office of Environment Safety and Health.

TABLE OF CONTENTS

FOREWORD ii

GLOSSARY iii

DEFINITIONS v

EXECUTIVE SUMMARY 1

FIRE RELATED DEATHS AND INJURIES 2

DOE PROPERTY LOSS EXPERIENCE 2

SUMMARY OF FIRE DAMAGE INCIDENTS 9

WATER-BASED AUTOMATIC SUPPRESSION SYSTEM PERFORMANCE 10

HALON SUPPRESSION SYSTEM PERFORMANCE 12

RECURRING FIRE PROTECTION PROGRAM COSTS 14

CONCLUSION 16

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) 1997 was summarized from information sent to Headquarters by 67 out of 97 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
OAK	Oakland Operations (San Francisco)
OFO	Ohio Field Office
OR	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
ANL-W	Argonne National Laboratory, West
ANL-E	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 its first fatality ever from fire in CY 1997 when a welder at the East Tennessee Technology Park died from burns sustained in an acetylene-torch incident. 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.

In all, 114 fire occurrences during the period caused an estimated \$534,031 in property damage. These losses are approximately \$1.8 million less than fire losses sustained in CY 1996, with 70 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 1997, DOE's assets decreased by 10.5 percent to 102.9 Billion dollars, resulting in a fire loss rate of approximately 0.05 cents for each \$100 property value. This rate is 0.06 cents lower than the five year DOE average, and 0.59 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 6.5 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 102 million dollars in CY 1997, despite the absence of data from a key site, Pantex. The corrected amount is most likely in the \$107 million range, with about 77 percent of the costs attributed to fire department activities.

During the year, 6 fires were controlled by an automatic wet pipe sprinkler system, continuing the DOE track record on sprinkler effectiveness at a 99 percent rate. The effectiveness of these fixed suppression systems were, however, offset by the inadvertent actuation of 95 systems primarily due to human error activities. Also, concerns remain regarding inadvertent Halon discharges (7 of the above 95 events), causing the release of approximately 5,151 pounds of Halon to the environment. The DOE remains committed to minimizing this ozone depleting substance through implementation of its managed Halon phaseout guidelines.

Future activities of the DOE fire protection community center on reducing the incidence of fire risk at its sites, optimizing costs associated with fire protection, and providing support for mission advances within the Department.

FIRE RELATED DEATHS AND INJURIES

The following is an excerpt from the DOE Type A Accident Investigation Board Report's Executive Summary of April, 1997:

“The accident occurred at approximately 11:10 a.m. on Thursday, February 13, 1997 at the K-33 Building. The work involved the removal of six converters from Cell 7. These cells were scheduled to be shipped to Portsmouth and/or Paducah as spare parts. Although the roof of the cell was removed, the cell's lighting was very poor, and temporary lighting was installed. The physical layout of the equipment in the cell created a constricted work space with very difficult ingress and egress. Converters 2 and 3 had already been removed, and the welder was performing a cutting operation on Converter 4. During this cutting operation, a spark or a piece of hot metal ignited his anti-contamination coveralls at, or somewhat below, his left knee. At the time of the accident, the welder was wearing multiple layers of clothing and radiological protective equipment that limited his ability to detect and extinguish the flames quickly. Since the welder was working alone, the flames spread undetected until they were beyond his ability to extinguish them without assistance. By the time a co-worker responded to the emergency and extinguished the fire with a dry chemical fire extinguisher, flames had totally engulfed the welder's body. At approximately 11:46 a.m., he was transported by ambulance to Methodist Medical Center in Oak Ridge, arriving at noon. The welder had suffered third-degree burns over 95 percent of his body. He died at 10:41 a.m. on February 14, 1997, after being transferred to Erlanger Burn Center in Chattanooga.”

The Accident Investigation Board Report also stated that “the overall quality of the accident response effort on February 13, 1997, was satisfactory and provided the welder opportunity for survival, if his burn wounds had not been so extensive.”

Subsequent to this incident, the DOE Office of Worker Health and Safety initiated a number of actions such as order revisions, consensus standard proposals and field guidance aimed at preventing reoccurrence of the event. These actions centered on protective clothing requirements, as well as expansion of fire watch duties to include worker surveillance in similar activities.

DOE PROPERTY LOSS EXPERIENCE

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 10.5 percent in CY 1997.

In all, 114 fire incidents were consistently reported by field organizations accounting for a total year-end fire loss of \$534,031. Of these incidents, 94 fires were reported as falling below the

Fire Protection Summary
For Calendar Year 1997

CAIRS threshold of \$5,000. Field organizations did not consistently report the number of non-fire events, but did identify loss amounts totaling \$4,086,024.

DOE's fire loss rate for CY 1997, as summarized from field organization reports, is approximately 0.05 cents loss per \$100 value; a decrease of about 420 percent over last year's 0.21 cent figure. This statistic is also 2.2 times lower than the 1992-1996 DOE average of 0.11, beginning a 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 1950 (Figure 2); fire loss rates over a 13 year period (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 these sites. Sites that are not shown on these graphs 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 70 percent of the total loss category.

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

1. ID/INEEL - Trailer TR-40, in CPP-1685, was completely destroyed by a fire. Although the exact cause of the fire could not be determined, subsequent investigations concluded that the fire originated in the electrical heating system. Total loss estimate - \$371,541. CAIRS and ORPS report numbers were not identified.
2. OR/Y-12 - Severe weather with heavy rain caused flood damage to facilities. Total loss estimate - \$4,772,787.

The CY 1997 CAIRS reported 1 fire incident over the year resulting in a loss of \$6,000; approximately \$528,031 less than the Annual Summary. Of this difference, \$371,541 can be traced to a single fire incident, with the remaining discrepancy linked to other incidents which were not incorporated into the CAIRS database. The CAIRS also reports 14 non-fire incidents producing losses of \$5,550,000, approximately \$1,463,976 more than field reports. The difference is traced to missed reporting of the top 1 CAIRS incident (4,772,787) in the Annual

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

Fire Protection Summary
For Calendar Year 1997

Summary. One non-fire event (chilled water rupture) reported by LANL and not included in CAIRS amounted to losses of approximately \$3,200,000.

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 1997

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)

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

Figure 1

DOE Property Valuation

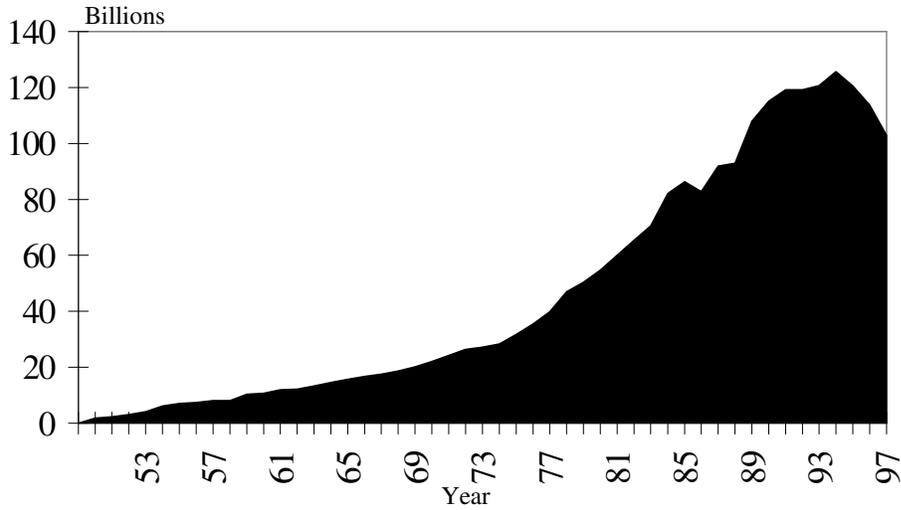


Figure 2

Property Loss

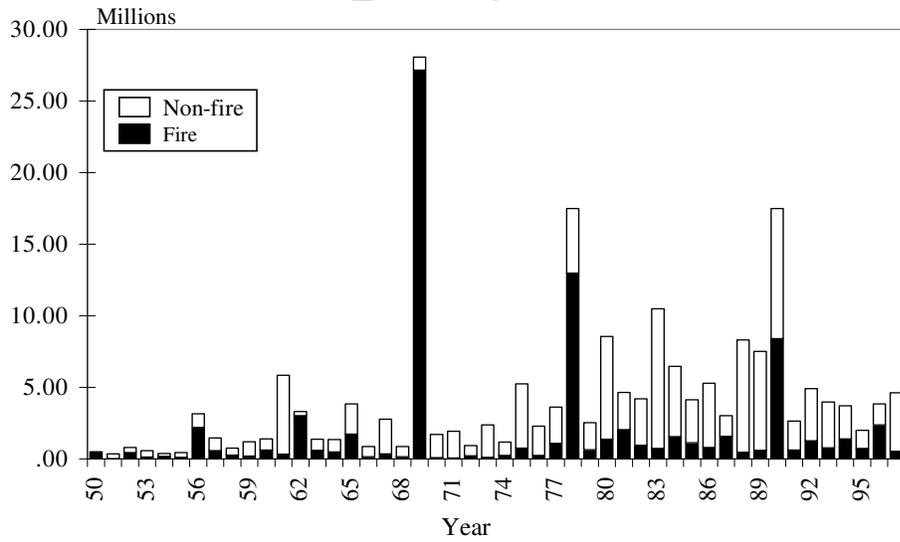


Figure 3
DOE Fire Loss Rate

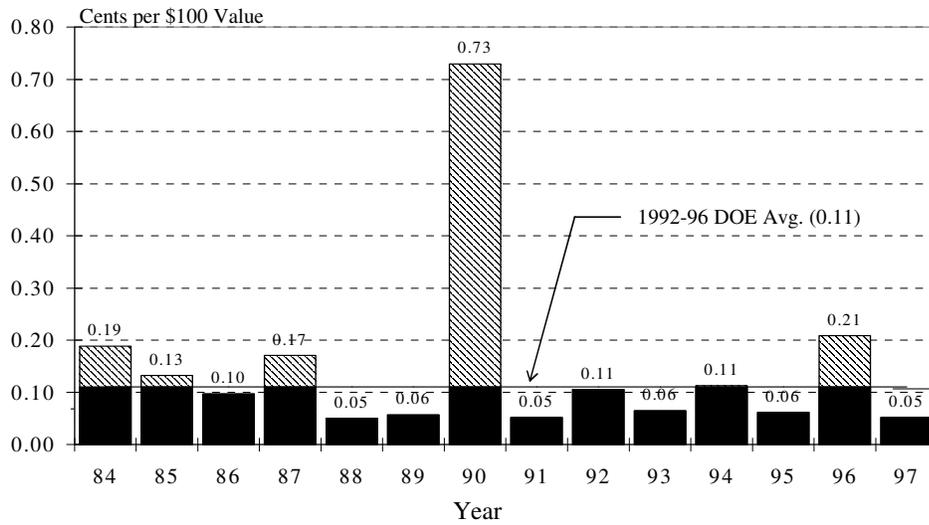


Figure 4
DOE Non-fire Loss Rate

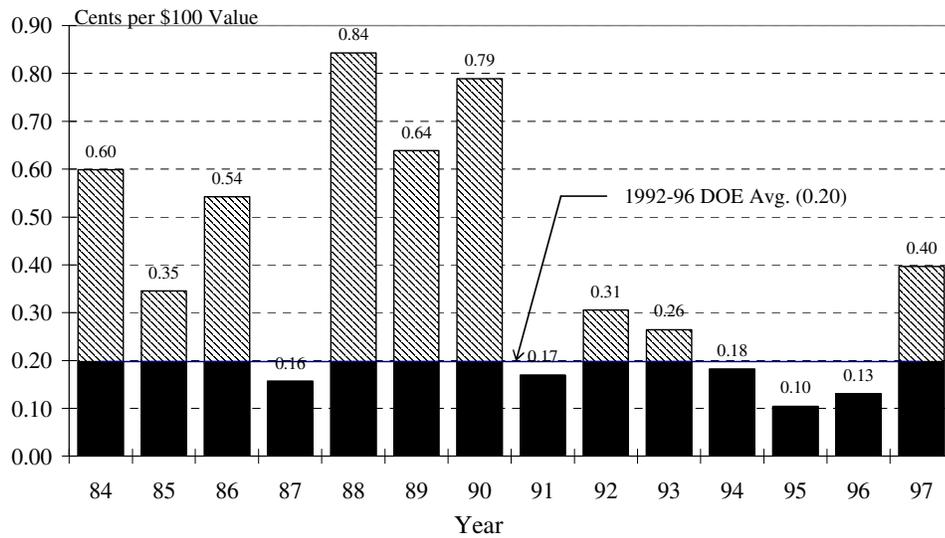


Figure 5

Fire Loss Rate by Field Organization

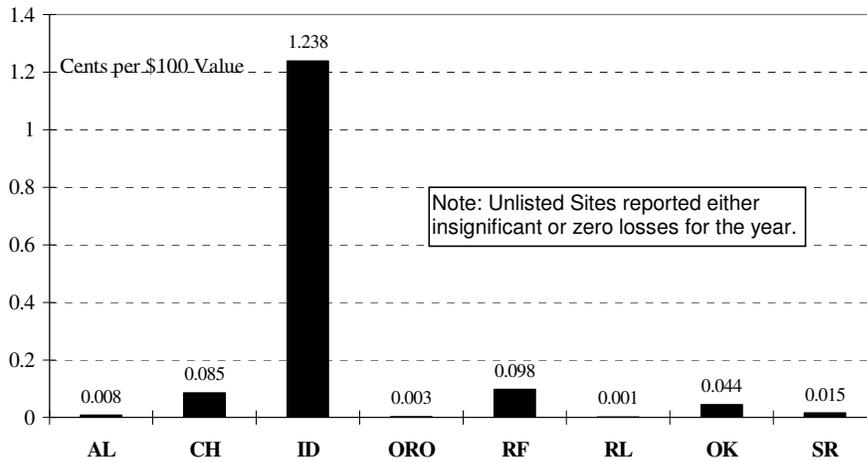
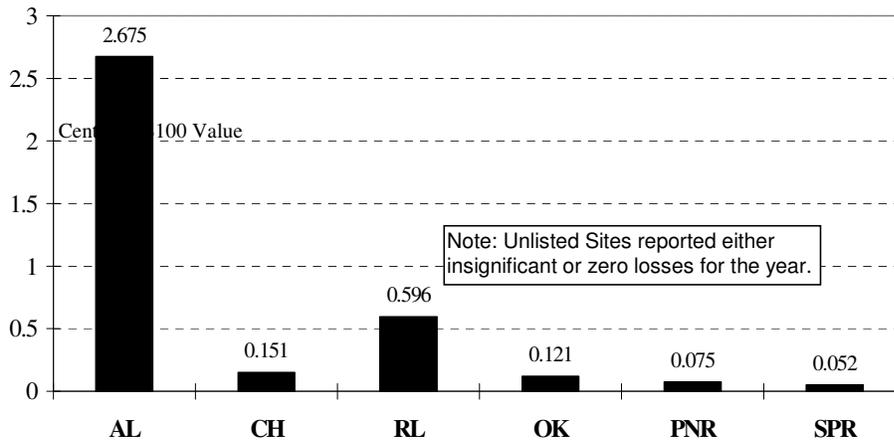


Figure 6

Non-fire Loss Rate by Field Organization



Site

Fire Protection Summary
For Calendar Year 1997

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-97

LOSS TYPE	LOCATION	DESCRIPTION	DOLLAR LOSS
Fire	ID	Trailer TR-40, in CPP-1685, was completely destroyed by a fire. Although the exact cause of the fire could not be determined, subsequent investigations concluded that the fire originated in the electrical heating system. Total loss estimate	\$371,541*
Fire	OR/ORNL	Fire, originating in a trailer HVAC compartment was detected by the trailer's security system and not the building fire detection system. Investigation revealed that detectors (ionization) did not actuate because smoke particles were too large	\$6,640.*
Fire	CH/ALA	On April 18, 1997, an induction furnace containing a Gadolinium sample lost its O-ring causing a fire that was quickly extinguished.	\$17,250.*
Fire	CH/ANL-E	On February 23, 1997, a fire occurred in a large high power copper coil unit. Flames from insulation destroyed the experimental magnet.	\$20,000.*
Fire	OK/LLNL	A fire occurred during annual load testing of a standby generator, caused by improper penetration of wood roof for the hot metal exhaust pipe. Fire was controlled by a single sprinkler.	\$5,000.*
Fire	SR	On October 26, 1997 a fire occurred in a fan housing in building 105K. Fire was caused by an overheated bearing.	\$9,000.*
Fire	RF	Fire in switchgear.	\$13,000.
Fire	RF	Grounding wire struck object in the ground causing explosion and damage to the generator.	\$10,000.

*No CAIRS report.

WATER-BASED AUTOMATIC SUPPRESSION SYSTEM PERFORMANCE

A total of 79 incidents were reported where water-based suppression systems operated in CY 1997: 49 were wet-pipe systems, 18 dry-pipe, 7 deluge, 3 pre-action, 1 AFFF foam deluge system, and 1 kitchen water spray system. 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(13), human error(19), electrical(3), mechanical(6), miscellaneous(7), not reported(29).

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

Table 3
Water Based System Actuations

LOSS TYPE	LOC.	DESCRIPTION	DOLLAR LOSS
Non-fire/Misc.	AL/KCP	On 12/18/97, a sprinkler head operated due to operation of the solder link caused by exposure to heat and a 'cold flow' condition (creep)	\$102,000.*
Fire	AL/LANL	Fire in TEC area 53, Bldg. M, Rm. 105 actuated a single sprinkler and controlled the event until Fire Department Arrival	\$10,000.*
Non-fire/HE	AL/ROSS	Water supply upgrades necessitating the need for manual control of an elevated water storage tank caused the actuation of a AFFF deluge system when operator failed to adequately monitor tank water level.	\$32,320.*
Non-fire/HE.	ID	The heads for the cooking hood and exhaust sprinkler system were rated at 175 ^o F but, per the installation requirements should be 325 ^o F. Heat from cooking operations actuated the system.	NR
Non-fire/Misc.	ID	Heat from an adjacent room, which houses an incinerator, was allowed to enter the area. This caused the sprinkler head to fuse and discharge as designed.	NR
Non-fire/Misc.	OFO/MB	Failure of an AC control valve caused a room over-temperature and actuation of the building Sprinkler system.	NR
Fire	OK/LLNL	A single sprinkler head opened as a result of a fire in Building 691.	\$5,000.*
Non-fire/HE	RL	On 5/14/97, a chemical solution of hydroxylamine nitrate in a water diluted nitric acid resulted in a tank explosion in bldg. 236 Z. Explosion caused sprinkler system to actuate	\$250,000.
Non-fire/HE	RL	On 5/14/97, a chemical solution of hydroxylamine nitrate in a water diluted nitric acid resulted in a tank explosion in bldg. 236 Z. Explosion caused sprinkler system to actuate	\$250,000.

* No CAIRS report. NR (No reported figures)

There are now a total of 234 incidents in DOE records where sprinkler systems operated in a fire. The satisfactory rate of performance is 99.1 percent, or 232 times out of 234 incidents. The two failures during a fire were attributed to: a closed cold weather valve in 1958 controlling a single

Fire Protection Summary
For Calendar Year 1997

sprinkler in a wood dust collector; and, a deluge system failure due to a hung-up trip weight in a 1963 transformer explosion.

From the above history, DOE has experienced 106 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, 70 percent were controlled with 1 sprinkler 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	74	74	69.81	70
2	18	92	16.98	87
3	4	96	3.77	91
4	4	100	3.77	94
5	2	102	1.89	96
6	1	103	0.94	97
7	2	105	1.89	99
8	0	105	0.00	99
9+	1	106	0.94	100

Comment [jb2]:

HALON SUPPRESSION SYSTEM PERFORMANCE

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.

In CY 1997, the DOE had 664 Halon 1301 systems in operation containing approximately 225,091 pounds of agent. Halon 1301 inventory was reported at approximately 146,406 pounds. Operational and inventory amounts for the Halon 1211 were reported at 157,810 and 31,613 pounds, respectively.

Field organizations reported that 90 non-essential systems have been disconnected in 1997, increasing DOE's Halon inventory by approximately 13,000 pounds.

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 (7,955 lbs. in 11 systems with a 6,000 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*	46535	33224	150	5664	13557
AL	41902	8041	390	47576	2266
CH	36953	25634	0	19429	18
PA**	22450	6000	0	36000	3855
SPR***	29072	0	600	90	0
Total	176912	72899	1140	108759	19696

* Designated as DOE's Halon bank . Agent drawdown was estimated since complete descriptions were not provided by SRS on agent discharge amounts from two events.

** BPA did not report this period. Last period data were used

***Estimated agent drawdown since SPR did not say how many pounds of agent was discharged (6 cylinders).

Fire Protection Summary
For Calendar Year 1997

A total of 11 incidents were reported at DOE (4 fire ,7 non-fire) where Halon 1301 suppression systems operated in CY 1997. No sites reported any Halon system failures during a fire. Approximately 5,691⁶ pounds of agent were released in these events. A brief description of these events, as well as other non-water based system actuations are provided in Table 6 below.

Comparing total Halon stores reported in CY 1997 (371,497 pounds) to the those reported in CY 1996 (400,122 pounds) indicates that our Halon supply shrunk by 28,625 pounds. Comparing this difference to the conversion amount (13,000 pounds) and the drawdown amount (5,691 pounds) leaves a discrepancy of approximately 9,934 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.

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 at the Complex that have not yet been replaced. The SR Fire Department may be contacted for further information.

Table 6
Non-Water Based System Actuations

LOSS TYPE	LOC.	DESCRIPTION	DOLLAR LOSS
Non-fire/HE	AL/KCP	A contractor performing demolition work near a CO2 fixed system accidentally struck the manual releasing cable resulting in the discharge of 150 lbs. of agent	NR
Fire	AL/SNLA	Saturn Accelerator-Fan motor overheated causing smoke to enter control room, causing Halon system to trip releasing 390 lbs. of agent.	NR
Non-fire/HE	ID	Generator exhaust tripped the CFA-681 Halon system when windows and doors were opened during construction activities. 373 lbs. of agent was released.	\$9609.*
Non-fire/HE	ID	Halon system actuated when dust was disturbed in CFA-681 during construction activities. 373 lbs. of agent was released.	\$9609.*
Non-fire/EL	ID	Heat detector shorted out when melting snow and ice leaked through roof at Howe Pk tripping the building Halon system. 282 lbs. of agent was released.	\$8108.*
Non-fire/EL	PNR/BAPL	April 1,1997. Water leaking into the control panel from a roof leak caused component corrosion resulting in the release of 1077 lbs. Halon into room CC2. SRS bank replenished agent.	\$6,031.*
Fire/EL	PNR/BAPL	System discharged 164 lbs. of Halon due to a defective time release module in the control unit.	\$683.
Non-fire/EL	PNR/BAPL	November 7,1997. Water leaking into the control panel through a roof leak caused the release of 1963 lbs. Halon into rooms CC2 &CC3. SRS bank replenished agent.	\$10898.*
Non-fire/HE	RL	Testing personnel inadvertently actuated the Halon system's manual discharge switch, releasing 319 lbs. of agent	\$9890.*

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

Fire Protection Summary
 For Calendar Year 1997

Table 6
Non-Water Based System Actuations

LOSS TYPE	LOC.	DESCRIPTION	DOLLAR LOSS
Non-fire/HE	RL	CO2 system in Building 313 released 150 lbs. of agent when the manual release station was bumped by an employee.	\$600.
Non-fire/EL	SNR	CO2 system at the Kesselring site actuated for unknown reasons in the control unit.	NR
Non-fire/HE	SPR	Inadvertent release of (est..approx. 600 lbs.) Halon due to not adequately disarming system for troubleshooting activities.	\$27,634.*
Fire	SPR	FM200 system actuation due to failure of a motor starter.	NR
Fire	SPR	FM200 system actuation due to failure of the pump motor capacitor.	NR
Fire	SRS	Power conditioner in the 221-HB line failed and actuated the Halon suppression system.	\$900.
Fire	SRS	Locked pulleys on the 221-H hot Crane caused the Halon system to actuate. 28 lbs. of agent was released	\$500.

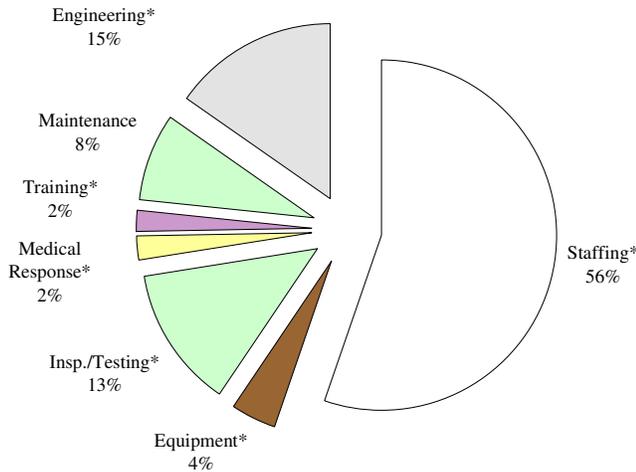
* No CAIRS report. NR (No reported figures)

RECURRING FIRE PROTECTION PROGRAM COSTS

Yearly or recurring fire protection costs for CY 1997 reached over \$102 million for the DOE Complex. On a ratio of cost to CAIRS replacement value, the DOE spent approximately 9.97 cents per \$100 replacement value for recurring fire protection activities, up 1.0 cents from the previous year. These costs however, do not reflect previously reported costs from a key site, Pantex. The corrected amount is most likely in the 107 million range, with a cost ratio of 10.39 cents.

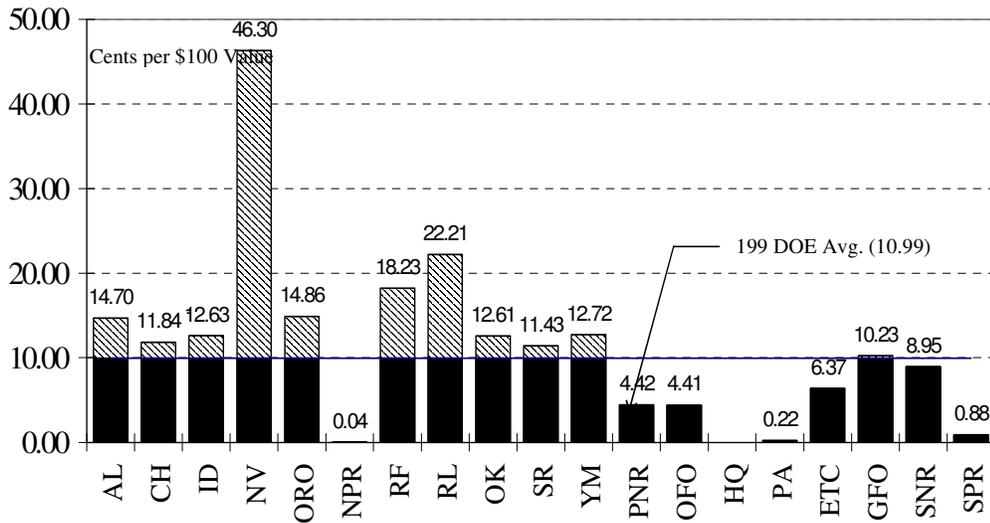
Figure 7 shows the CY 1997 recurring cost distribution by activity . Figure 8 lists the recurring cost rate by DOE's field organization. It should be noted that not all recurring cost activities were consistently reported from field organizations, such as outside contracts and maintenance activities; 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



The following is a summary of fire department responses for CY 1997. These numbers represent data sent in from approximately 27 fire departments stationed at DOE sites.

Fire Protection Summary
For Calendar Year 1997

1. Fire	640
2. Hazardous Materials	557
3. Other Emergency	3,028
4. Other Non-Emergency	4,248
5. Medical	2,604
Total	<u>11,077</u>

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 fatality ever from fire in CY 1997. 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 and by consistently defining loss terms or 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 6.5 million dollars to meet comparable industry losses for CY-1997. DOE's recorded fire losses of less than \$600,000. are an indication that the department's fire protection programs are successful at maintaining public confidence in our ability to manage fire risk.