

NATURAL HAZARD LOSSES: A DOE PERSPECTIVE

INJURY AND PROPERTY DAMAGE EXPERIENCE FROM NATURAL PHENOMENA HAZARDS DEPARTMENT OF ENERGY 1943 - 1989

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INTRODUCTION

Historical information on life and property losses can provide an insight into natural hazard reduction opportunities [1]. Efforts to mitigate natural hazards have been ongoing for thousands of years, but the complex infrastructure of our current world requires creative and cost-effective mitigation strategies. The Department of Energy (DOE) has developed several standards and guidelines aimed at reduction of losses caused by earthquake, wind, tornado, flood, volcanic ash, and lightning hazards. This paper presents a historical perspective on losses due to natural hazard incidents (1943-1989) at DOE and predecessor agencies including the Atomic Energy Commission [2]. This historical focus can support planning for 1) loss reduction strategies for DOE and 2) participation in the International Decade for Natural Hazard Reduction [3] and in the U.S. Decade for Natural Disaster Reduction [4].

A few comments on DOE's upgrading program for natural phenomena should provide a perspective on the review of past losses. The Lawrence Berkeley Laboratory was one of the first DOE sites to complete a site-wide earthquake mitigation program [5]. The earthquake, flood and wind upgrading programs at several DOE sites were reported at the 1985 DOE Natural Phenomena Conference [6] and seismic mitigation activities for DOE have been reported annually to Congress beginning in 1983 [7]. Also, a seismic seminar was held in 1986 to exchange design and upgrading experience among DOE contractors in the San Francisco Bay Area. The information presented in this paper should help determine future upgrading priorities.

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SUMMARY

DOE property damage for incidents due to natural hazards reported during the past 46 years (1943-1989) totaled nearly \$20 million. Losses due to all phenomena are shown by state in Figure 1 and are tabulated in Table 1. Losses due to specific phenomena are shown in other Figures. The largest incident loss for various phenomena are provided in Table 2. Loss data for the DOE power administrations was not readily available; however, informal estimates indicate annual costs of \$0.5 to \$1.0 million for restoration of power due to the effects of natural phenomena for the five 'administrations'. Based upon reported and estimated loss information, natural phenomena incidents cause over \$1 million annually in damage to DOE property. Much of the loss occurs in a relatively few incidents. A listing of the 29 largest losses to occur in DOE is shown in Table 3, where some losses exceeded \$1 million.

Information is also collected on injuries caused by natural phenomena, but no dollar loss is assigned even where medical treatment and lost work is involved. A comparison of the number of injuries caused by various phenomena during the past ten years is given in Table 4. No fatalities were reported that could be directly attributed to natural causes for the period 1943-1989.

Hurricane damage to DOE facilities is minor compared to the overall U.S. statistics. However,

the six of the seven hurricanes that damaged DOE sites (Table 5) were among the 30 largest DOE natural phenomena incidents.

The DOE Computer Assisted Incident Reporting System (CAIRS) [8] maintains records of reported incidents caused by fire and other accidents and annual [9] and quarterly [10] statistical reports are compiled for incidents including natural phenomena. Special investigations are conducted for incidents involving fatalities and large property damage.

The DOE manages or operates research, production, oil reserves and power distribution facilities valued at nearly \$100 billion. These activities are carried on in over 10,000 buildings (>1000 sq ft) in nearly all states. Total construction averages about \$1.5 billion annually [11].

Losses due to natural hazards account for about 5 percent of all losses reported from 1943 to 1975. For the period 1984 to 1988 natural losses were one percent of the total incidents but accounted for 20 percent of the total dollar loss.

CONCLUSIONS

This presentation provides a perspective of DOE losses during the past 46 years even though loss data was not readily available for all DOE operations. As such this paper is considered preliminary and more work is needed to provide an informed view of all DOE losses. Review of the reported historical losses has provided an opportunity to create an awareness of the extent and location of a wide variety of natural phenomena hazards that have caused damage at most DOE sites.

Some suggestions and observations to consider are:

- Mitigation strategies may achieve greatest reductions in wind damage.
- Most damage has occurred to conventional construction.
- Lightning damage review may provide insight for design standards change.

- Flood damage occurred where least expected.

Through this awareness, I hope you are encouraged to provide your ideas and your professional skills for a Decade of Natural Hazard Reduction in the Department of Energy.

REFERENCES

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- [8] Department of Energy, Computer Assisted Incident Reporting System (CAIRS), EG&G Data Base, 1989.
- [9] Office of the Deputy Assistant Secretary for Safety, Health and Quality Assurance-DOE, Department of Energy Safety and Health Highlights - Fiscal Year 1988 (prepared by the Systems Safety Development Center, EG&G Idaho, Inc., 1988).

[10] Office of the Deputy Assistant Secretary for Safety, Health and Quality Assurance, Occupational Injury and Property Damage Summary - January-March 1989 (prepared by the Systems Safety Development Center, EG&G Idaho, Inc., 1989).

[11] Department of Energy, Real Property Inventory System (data base current 1989).

TABLE 1
LOSSES DUE TO TYPES
OF NATURAL HAZARDS BY STATE
DOE 1943-1989

DOLLAR LOSS (\$000)

STATE	SEISMIC	WIND	FLOOD	HAIL, SLEET SNOW, RAIN	LIGHTNING	FREEZING	SUBSIDENCE	TOTAL
CA	3429	246	258	-	7	17	370	4327
CO	-	447	1347	87	21	161	-	2090
FL	-	237	231	-	39	-	-	507
ID	*	120	66	12	69	54	-	321
IL	-	510	14	36	50	88	-	698
KY	-	-	-	-	-	-	23	23
LA	-	415	-	-	33	-	-	448
MD	-	-	188	-	-	-	-	188
MO	-	42	478	4	5	11	-	540
NM	-	384	299	38	112	74	-	907
NV	-	40	9	8	76	-	-	133
NY	-	64	-	20	295	50	-	429
OH	-	292	-	-	9	43	19	363
PA	-	12	-	-	33	3	-	48
PACIFIC	-	399	-	-	-	-	-	399
SC	-	104	110	597	135	182	-	1128
TN	-	23	-	-	45	17	-	85
TX	-	3000	-	2380	25	54	-	5459
WV	-	40	-	-	-	-	-	40
WA	-	137	66	8	335	106	-	652
WY	-	10	16	-	34	-	-	60
TOTALS	3429	6522**	3109	3190**	1323	860	412	18845

*Mt. Borah earthquake of 1985 resulted in minimal damage.

**Losses with both wind and hail damage allocated between wind and hail.

TABLE 2
DEPARTMENT OF ENERGY
LARGEST LOSS BY TYPE OF NATURAL HAZARD
(\$000)

YEAR	DESCRIPTION	LOSS (\$000)
1980	LIVERMORE <u>EARTHQUAKES</u>	3,416
1980	PANTEX <u>WIND AND HAIL STORM</u>	2,546
1967	PANTEX <u>WIND AND HAIL STORM</u>	1,872
1986	ROCKY FLATS PLANT <u>FLOOD</u>	1,174
1973	SAVANNAH RIVER SITE <u>SLEET</u>	393
1973	BERKELEY <u>LANDSLIDE</u>	370
1983	BAYOU CHOCTAW <u>HURRICANE</u>	268
1976	ARGONNE <u>TORNADO</u>	285
1952	PACIFIC <u>TYPHOON</u>	250
1989	BROOKHAVEN <u>LIGHTNING</u>	240
1984	PINELLAS <u>RAIN</u>	231
1984	ROCKY FLATS PLANT <u>FREEZING</u>	161
1957	SAVANNAH RIVER SITE <u>SNOW</u>	98
1980	HANFORD AND INEL <u>VOLCANIC ASH</u>	*

*Losses not reported.

**TABLE 3
MAJOR DOE LOSSES
DUE TO NATURAL PHENOMENON**

1943-1989

<u>HAZARD</u>	<u>\$ LOSS (000)</u>	<u>YEAR</u>	<u>STATE</u>	<u>LOCATION</u>	<u>DESCRIPTION</u>
EARTHQUAKE	3416	80	CA	Livermore	0.25G, 2 major shocks
WIND/HAIL	2546	84	TX	Amarillo	106 MPH wind, baseball-size hail
WIND/HAIL	1872	67	TX	Amarillo	Damage to buildings and equipment
FLOOD	1174	86	CO	Golden	Runoff flooded equipment
WIND	658	89	TX	Amarillo	101 MPH wind, gravel broke glass
FLOOD	449	61	MO	Kansas City	Hurricane Carla
SLEET	393	73	SC	Aiken	Damaged pine trees
LANDSLIDE	370	73	CA	Berkeley	6 weeks of heavy rain
TORNADO	285	76	IL	Argonne	Damaged equipment and buildings
WIND/RAIN	268	83	LA	Bayou Choctaw	Hurricane Alicia
FLOODING	258	83	CA	Santa Barbara	Spread Contamination
TYPHOON	250	52		Pacific	Damage
LIGHTNING	240	89	NY	Long Island	Ignition of gases
RAIN	231	84	FL	Clearwater	Rain caused electrical short
WIND/FLOOD	224	80	NM	Albuquerque	Hurricane Allen, Flooding
WIND	221	88	OH	Fernald	Damage to trailer and equipment
WIND	210	80	CA	Tupman	Building burned
FLOOD	200	83	CO	Golden	Damage transmission lines
FLOOD	188	72	MD	Baltimore	Explosion from water/calcium reactions
HAIL	174	77	TX	Amarillo	Damaged buildings and vehicles
WIND	166	80	CO	Golden	Loosened bolts on equipment
FREEZING	161	84	CO	Golden	Pipe rupture damage (computer)
LIGHTNING	156	84	WA	Hanford	Range fire damage equipment
WIND	140	78	IL	Argonne	Damaged electrical equipment
WIND	125	82	CO	Golden	116 MPH, property damage
FREEZING	112	83	SC	Aiken	Pipe burst
SNOW	98	57	SC	Aiken	Collapsed warehouse
SLEET	96	58	SC	Aiken	Damaged pine trees
WIND	95	86	LA	Bayou Choctaw	Hurricane damage

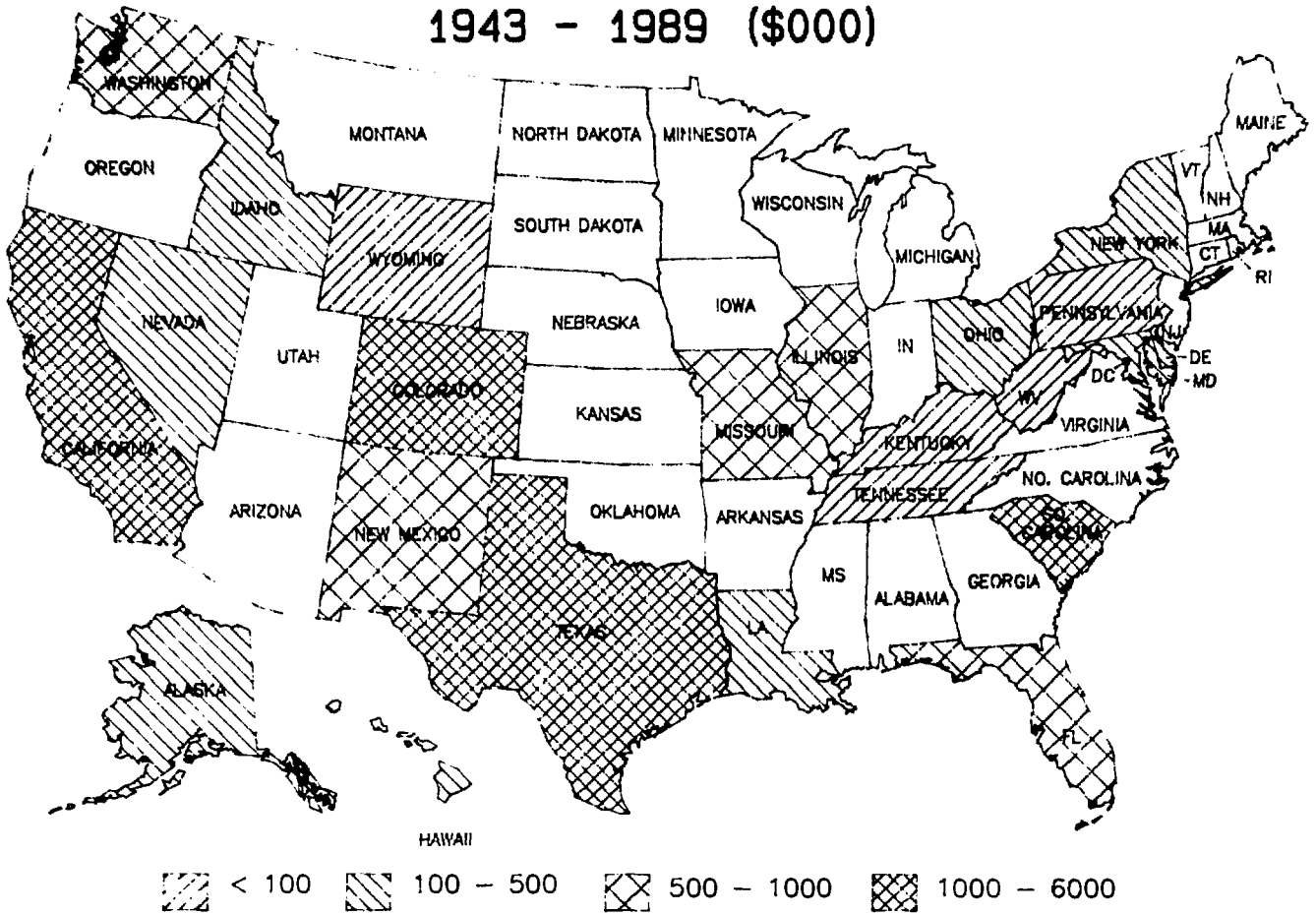
**TABLE 4
DEPARTMENT OF ENERGY
INJURY INCIDENTS DUE TO NATURAL HAZARDS
1979-1989**

ICE/SNOW	631
WIND	180
LIGHTNING	5
EXTREME COLD TEMPERATURES	11
EXTREME HOT TEMPERATURES	21
RAIN	13
MIXED PRECIPITATION	0
FOG	0
EARTHQUAKES	0
FLOOD	0
TOTAL INCIDENTS	862

**TABLE 5
DEPARTMENT OF ENERGY
HURRICANE LOSS SUMMARY**

YEAR	(\$000)	HURRICANE	LOCATION
1961	449	CARLA	KANSAS CITY, MO
1983	268	ALICIA	BAYOU CHOCTAW, LA
1952	250	TYPHOON	PACIFIC
1980	224	ALLEN	ALBUQUERQUE, NM
1972	188	AGNES	BALTIMORE, MD
1986	95		BAYOU CHOCTAW, LA
1959	50	GRACIE	AIKEN, SC
1943-1989	1524	7 EVENTS	6 STATES

DEPARTMENT OF ENERGY DOLLAR LOSSES FROM NATURAL CAUSES 1943 - 1989 (\$000)



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Figure 1

DEPARTMENT OF ENERGY
 EARTHQUAKE LOSSES (\$ 000)
 1943 - 1989

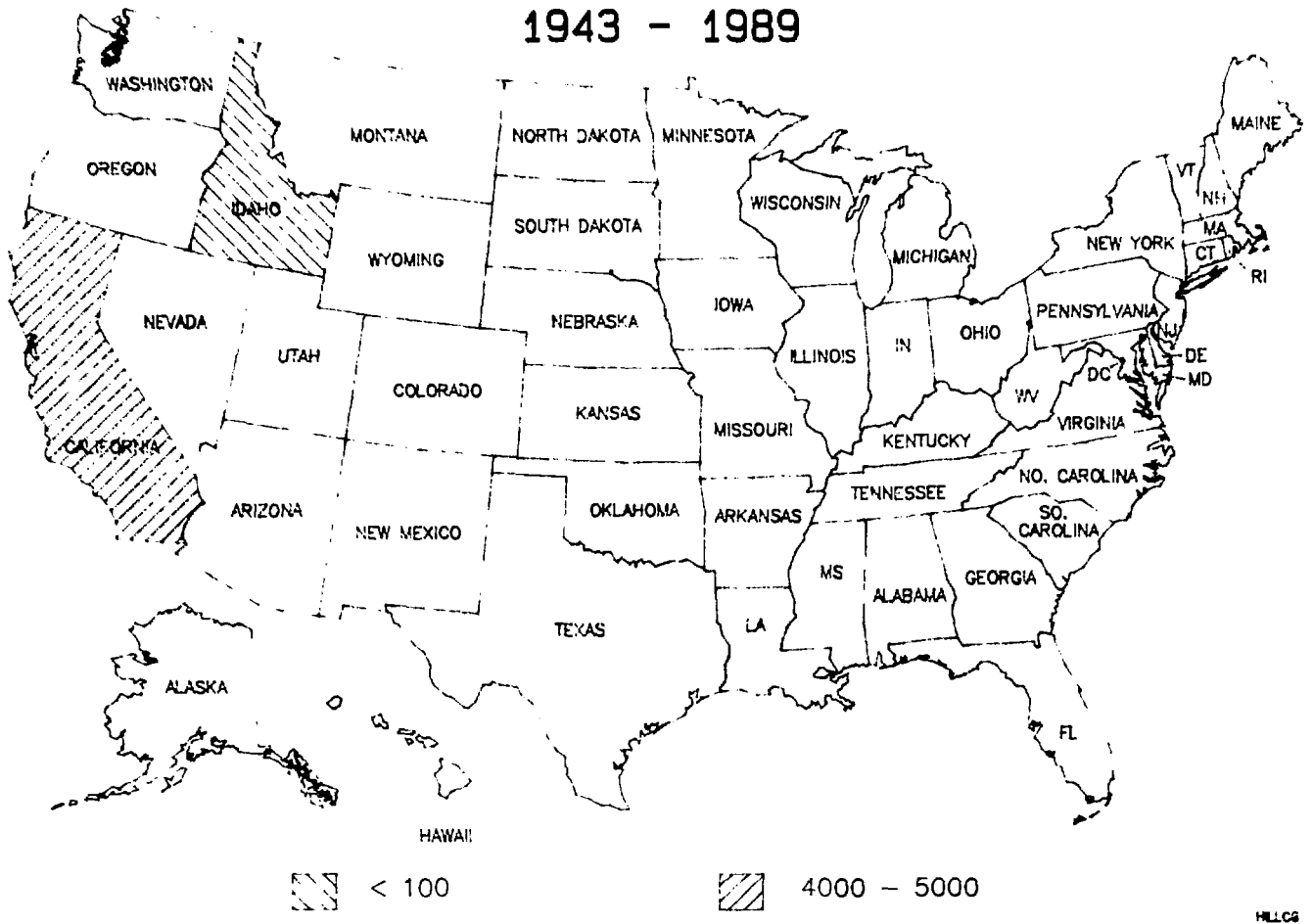


Figure 5