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SAND2004-5901

Identification and Analysis of Factors Affecting Emergency Evacuations

Appendices

Sandia National Laboratories

U.S. Nuclear Regulatory Commission
Office of Nuclear Security and Incident Response
Washington, DC 20555-0001

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ABSTRACT

Volume II contains the data and information that support Volume I. Appendix A contains a detailed listing of the 230 evacuations that comprise the universe of evacuations. Appendix B contains the evacuation form used to collect data for each of the 50 cases studied. Appendix C contains the results of the frequency analysis. The remaining appendices contain the SAS 8.02 output for the regression analyses (Appendices F through K) and the correlation analyses (Appendix L).

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EVACUATION UNIVERSE

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
1	September-99	Hurricane Floyd	88B	Natural Disaster	Hurricane	South to Broward	FL	373,144	78
2	September-99	Hurricane Floyd	88A	Natural Disaster	Hurricane	Miami-Dade	FL	270,403	78
3	November-01	Atlanta Airport	201	Malevolent Act	Malevolent Act	Atlanta	GA	10,000	76
4	July-01	ATOFINA Chemicals Tank Car Failure	28	Technological Hazard	Fixed Site Hazmat Incident	Riverview	MI	6,000	76
5	September-01	Kennedy Space Center	183	Malevolent Act	Malevolent Act	Kennedy Space Center	FL	12,000	73
6	August-92	Hurricane Andrew	80	Natural Disaster	Hurricane	Miami-Dade Co.	FL	650,000	71
7	September-99	Hurricane Floyd	88C	Natural Disaster	Hurricane	Central Florida	FL	665,969	67
8	August-99	Hurricane Dennis	208	Natural Disaster	Hurricane	Rodathe	NC	22,000	67
9	September-98	Hurricane Georges	202	Natural Disaster	Hurricane	Orleans and Jefferson Parishes	LA	1,500,000	67
10	September-98	Hurricane Georges	150	Natural Disaster	Hurricane	Multiple Counties	FL	63,000	67
11	September-99	Hurricane Floyd	88D	Natural Disaster	Hurricane	Northern Florida	FL	451,676	67
12	August-98	Hurricane Bonnie	85	Natural Disaster	Hurricane	Multiple Counties	NC, SC	200,000-500,000	67
13	July-98	Ormond Beach Fire	200	Natural Disaster	Wildfire	Ormond Beach	FL	35,000	67

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
14	July-98	Mims Fire	146	Natural Disaster	Wildfire	Mims	FL	16,000	67
15	July-96	Centennial Olympic Park	124	Malevolent Act	Malevolent Act	Atlanta	GA	60,000	64
16	September-01	General Motors Corp.	185	Malevolent Act	Malevolent Act	Detroit	MI	6,000	64
17	September-01	World Trade Center	126	Malevolent Act	Malevolent Act	Lower Manhattan	NY	300,000	64
18	July-01	CSX Train Derailment and Fire	96	Technological Hazard	Railroad Accident	Baltimore	MD	10,000	64
19	September-02	American Storage and Warehouse Company	74	Technological Hazard	Fixed Site Hazmat Incident	Charlotte	NC	1,000	64
20	May-03	Brandon Pipeline Rupture	235	Technological Hazard	Pipeline Rupture	Brandon	FL	2,000	62
21	September-98	Tropical Storm Frances	199	Natural Disaster	Tropical Storm	Corpus Christi	TX	6,000	62
22	May-95	New Orleans Flood	175	Natural Disaster	Flood	New Orleans	LA	50,000	62
23	September-96	Hurricane Fran	84	Natural Disaster	Hurricane		NC	500,000+	62
24	May-00	New Iberia Transportation Accident	61	Technological Hazard	Transportation Accident	New Iberia	LA	2,000	62
25	March-01	Choctaw Maid Farm Poultry Plant	4	Technological Hazard	Fixed Site Hazmat Incident	Forest	MS	2,000	62

Table A-1. Comprehensive List of Evacuation Incidents, January 1, 1990, through June 30, 2003.

Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
26	May-00	Union Pacific Railroad	30	Technological Hazard	Railroad Accident	Eunice	LA	2,000- 3,500	62
27	February-03	Mathis Farm Supply Store	75	Technological Hazard	Fixed Site Hazmat Incident	Slocomb	AL	3,500	62
28	October-95	Gaylord Tank Car Failure	18	Technological Hazard	Railroad Accident	Bogalusa	LA	3,000	62
29	August-00	Hurricane Debbie	151	Natural Disaster	Hurricane	Multiple Counties	FL	>10,000	60
30	1995	Hurricane Opal	149	Natural Disaster	Hurricane	Multiple Counties	FL	>100,000	60
31	August-95	Hurricane Felix	82	Natural Disaster	Hurricane	Multiple Counties	AL, FL	100,000	60
32	July-99	Proctor & Gamble Factory	25	Technological Hazard	Fixed Site Hazmat Incident	Iowa City	IA	5,000	60
33	August-00	Truck Accident	27	Technological Hazard	Transportation Accident	Hugo	OK	2,000- 2,500	60
34	June-02	Deadwood Fire	213	Natural Disaster	Wildfire	Deadwood	SD	15,000	58
35	May-00	Cerro Grande Fire	209	Natural Disaster	Wildfire	White Rock	NM	7,000	58
36	May-00	Cerro Grande Fire	107	Natural Disaster	Wildfire	Los Alamos	NM	12,000	58
37	October-02	Hurricane Lili	230	Natural Disaster	Hurricane	Southern Louisiana	LA	>5,000	58
38	January-98	Cargill Chemical Plant	166	Technological Hazard	Fixed Site Hazmat Incident	Maysville	KY	2,500	58

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
39	June-93	Great Flood of 1993	5	Natural Disaster	Flood	Mississippi River	MN, WI, IA, IL, MO, SD, ND, NE, KS	31,000-85,000	58
40	June-02	Hayman Blaze	119	Natural Disaster	Wildfire	Douglas	CO	5,500	56
41	July-97	Flora Transportation Accident	198	Technological Hazard	Transportation Accident	Flora	MS	6,000	56
42	September-02	Tropical Storm Fay	229	Natural Disaster	Flood	Brazoria County	TX	>5,000	53
43	June-01	Tropical Storm Allison	162	Natural Disaster	Flood	Gulf Coast	TX	30,000	53
44	July-1998	Flagler Wildfire	99	Natural Disaster	Wildfire	Flagler County	FL	45,000	53
45	October-99	Hurricane Irene	238	Natural Disaster	Hurricane	Wilmington	NC	>5,000	53
46	October-02	Hurricane Lili	156	Natural Disaster	Hurricane	Jefferson and Orange Counties	TX	330,000	53
47	October-99	Hurricane Irene	89	Natural Disaster	Hurricane	Unknown	FL	>5,000	53
48	February-01	Purdue University Campus	240	Technological Hazard	Pipeline Rupture	West Lafayette	IN	3,000	51
49	July-02	LAX Airport	214	Malevolent Act	Malevolent Act	Los Angeles	CA	>1,000	51
50	September-01	Space and Naval Warfare Systems Center	184	Malevolent Act	Malevolent Act	Goose Creek	SC	1,700	51

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
51	March-98	Alabama Flood	170	Natural Disaster	Flood	Elba	AL	18,000	51
52	February-03	Chemical Plant Ammonia Leak	153	Technological Hazard	Fixed Site Hazmat Incident	Gulfport	MS	~1,000	51
53	February-93	World Trade Center Bombing	122	Malevolent Act	Malevolent Act	New York City	NY	150,000	51
54	December-00	Railcar Fire	97	Technological Hazard	Railroad Accident	Oshkosh	WI	2,300	51
55	September-02	Norfolk Southern Railway Derailment	73	Technological Hazard	Railroad Accident	Farragut	TN	3,000	51
56	May-02	Grand Trunk Derailment	70	Technological Hazard	Railroad Accident	Potterville	MI	2,200	51
57	March-00	Railcar Leak	58	Technological Hazard	Fixed Site Hazmat Incident	Sterling Heights	MI	2,400	51
58	October-01	LSU Anthrax Hoax	1	Malevolent Act	Malevolent Act	Alexandria	LA	2,000	51
59	March-94	Prichard Train Derailment	95	Technological Hazard	Railroad Accident	Prichard	AL	2,000	49
60	January-02	San Francisco Airport	216	Malevolent Act	Malevolent Act	San Francisco	CA	>1,000	49
61	July-01	West Virginia Flood	161	Natural Disaster	Flood	Wyoming County	WV	6,000	49
62	September-02	Tropical Storm Isidore	157	Natural Disaster	Flood	Multiple Counties	LA, MS	2,500	49

Table A-1. Comprehensive List of Evacuation Incidents, January 1, 1990, through June 30, 2003.

Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
63	July-94	Hinds Co. Railroad Accident	98	Technological Hazard	Railroad Accident	Hinds County	MS	5,000	49
64	August-93	Hurricane Emily	90	Natural Disaster	Hurricane	Dade County	FL	250,000	49
65	August-99	Hurricane Bret	87	Natural Disaster	Hurricane	Kennedy County	TX	100,000	49
66	July-96	Hurricane Bertha	83	Natural Disaster	Hurricane	Multiple Counties	NC	250,000+	49
67	May-0 2	Twin City Foods Plant	69	Technological Hazard	Fixed Site Hazmat Incident	Arlington	WA	1,500	49
68	December-95	North Attleboro Pipeline Rupture	19	Technological Hazard	Pipeline Rupture	North Attleboro	MA	40,000	49
69	June-92	Burlington Northern Railroad Derailment	16	Technological Hazard	Railroad Accident	Superior	WI	40,000	49
70	April-94	Pesticide Tanker Truck Explosion	243	Technological Hazard	Transportation Accident	Balch Springs	TX	5,000	47
71	November-94	Hurricane Gordon	81	Natural Disaster	Hurricane	Citrus, Franklin, Hernando, Levy and Taylor Counties	FL	300,000	47
72	October-01	Fish Plant Ammonia Leak	66	Technological Hazard	Fixed Site Hazmat Incident	Morro Bay	CA	3,500	47

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
73	November-00	Burlington Northern Santa Fe Derailment	26	Technological Hazard	Railroad Accident	Scottsbluff	NE	5,000	47
74	November-98	Louisville Cargo Transfer Accident	24	Technological Hazard	Fixed Site Hazmat Incident	Louisville	KY	2,400	47
75	June-00	Hanford Fire	103	Natural Disaster	Wildfire	Benton City	WA	2,500	47
76	October-91	East Bay Hills Fire	234	Natural Disaster	Wildfire	Oakland	CA	20,000-30,000	44
77	August-92	Champion Technologies Inc.	245	Technological Hazard	Fixed Site Hazmat Incident	Odessa	TX	27,000	44
78	September-98	Bossier City Transportation Accident	239	Technological Hazard	Transportation Accident	Bossier City	LA	~2,000	44
79	January-95	California Flood	177	Natural Disaster	Flood	Rio Linda	CA	20,000	44
80	June-02	Roxborough Village Fire	140	Natural Disaster	Wildfire	Roxborough Village	CO	5,300	44
81	June-02	Show Low Fire	131	Natural Disaster	Wildfire	Show Low & Pinetop-Lakeside	AZ	11,000	44
82	May-98	Mason City Chemical Fire	79	Technological Hazard	Fixed Site Hazmat Incident	Mason City	IA	3,600	44
83	December-97	Keystone Cement	53	Technological Hazard	Fixed Site Hazmat Incident	Bath	PA	>1,600	44

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
84	November-97	Railroad Accident	52	Technological Hazard	Railroad Accident	Appleton and Grand Chute	WI	5,000	44
85	August-97	Paint Plant Hazardous Materials Release	51	Technological Hazard	Fixed Site Hazmat Incident	Chicago	IL	2,500	44
86	March-97	Port Allen Transportation Accident	48	Technological Hazard	Transportation Accident	Port Allen	LA	>1,300	44
87	May-91	Liquified Chlorine Gas Leak	36	Technological Hazard	Fixed Site Hazmat Incident	Henderson	NV	~7,000	44
88	October-94	San Jacinto River	10	Natural Disaster	Flood	Southeast Texas	TX	10,000	44
89	June-93	Tropical Storm Arlene	6	Natural Disaster	Tropical Storm	Hildalgo/Willacy/ Starr Counties	TX	2,000	44
90	October-98	Propane Storage Facility Fire	3	Technological Hazard	Fixed Site Hazmat Incident	Pascagoula	MS	>1,500	44
91	November-91	Shepherdsville Railroad Accident	92	Technological Hazard	Railroad Accident	Shepherdsville	KY	1,000	42
92	June-02	Rodeo-Chedeski Fire	116	Natural Disaster	Wildfire	Show Low	AZ	20,000	42
93	May-96	Lansing Pipeline Rupture	242	Technological Hazard	Pipeline Rupture	Lansing	MI	1,200	42
94	August-01	Chicago Transportation Accident	223	Technological Hazard	Transportation Accident	Chicago	Il	1,500	42

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
95	July-02	Cibecue, Arizona Fire	215	Natural Disaster	Wildfire	Cibecue	AZ	30,000	42
96	June-02	Payson Fire	212	Natural Disaster	Wildfire	Payson	AZ	30,000	42
97	July-99	Charles City Flood	207	Natural Disaster	Flood	Charles City	IA	~8,000	42
98	April-99	Port St. Lucie Fire	204	Natural Disaster	Wildfire	Port St. Lucie	FL	1,000	42
99	March-98	Elba Flood	195	Natural Disaster	Flood	Elba	AL	2,000	42
100	September-01	Internal Revenue Service	186	Malevolent Act	Malevolent Act	Detroit	MI	1,600	42
101	May-03	Detroit Pipeline Rupture	179	Technological Hazard	Pipeline Rupture	Detroit	MI	>1,000	42
102	June-98	Midwest Floods	165	Natural Disaster	Flood	Midwest, Eastern OH	Midwest, Eastern OH	11,000	42
103	June-02	Missionary Ridge Blaze	120	Natural Disaster	Wildfire	Near Durango	CO	7,500	42
104	August-99	Hurricane Bret	206	Natural Disaster	Hurricane	San Antonio	TX	1,000	42
105	July-98	Campbell Chemical Fire	77	Technological Hazard	Fixed Site Hazmat Incident	Campbell	MO	3,000	42
106	September-00	St. Paul Hazmat Incident	64	Technological Hazard	Fixed Site Hazmat Incident	St. Paul	MN	1,500	42
107	April-98	St. Louis Transportation Accident	2	Technological Hazard	Transportation Accident	St. Louis	MO	2,500	42

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
108	May-03	Silver Lake Dam	251	Technological Hazard	Flood	Marquette	MI	1,750	40
109	April-01	Franklin Pipeline Rupture	241	Technological Hazard	Pipeline Rupture	Franklin	IN	1,000	40
110	April-00	Everglades Fire	219	Natural Disaster	Wildfire	Miami-Dade	FL	1,450	40
111	October-98	Guadalupe River Flood	203	Natural Disaster	Flood	Cuero	TX	>1,000	40
112	July-97	Colorado State University Campus	190	Natural Disaster	Flood	Fort Collins	CO	5,000	40
113	June-02	Berkeley Township Fire	180	Natural Disaster	Wildfire	Berkeley Township	NJ	~1,500	40
114	April-99	Columbine High School	125	Malevolent Act	Malevolent Act	Littleton	CO	2,085	40
115	February-03	CTA Acoustics	76	Technological Hazard	Unknown	Corbin	KY	~1,000	40
116	January-02	Danville Transportation Accident	68	Technological Hazard	Transportation Accident	Danville	KY	1,000	40
117	April-00	Danville Chemical Fire	60	Technological Hazard	Railroad Accident	Danville	KY	1,000	40
118	April-00	Keyport Incident	59	Technological Hazard	Unknown	Keyport	NJ	1,200	40
119	August-99	Temple Incident	57	Technological Hazard	Unknown	Temple	TX	2,500	40
120	June-03	Lake Manatee Dam	246	Natural Disaster	Flood	Bradenton	FL	1,000	38

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
121	April-95	Oklahoma City Bombing	123	Malevolent Act	Malevolent Act	Oklahoma City	OK	>1,000	38
122	September-02	Phoenix Fixed Site Hazmat	72	Technological Hazard	Fixed Site Hazmat Incident	Phoenix	AZ	1,000	38
123	March-96	Railroad Accident	43	Technological Hazard	Railroad Accident	Weyeyauwega	WI	1,700	38
124	April-90	C.S.S. & S.B.RR	32	Technological Hazard	Railroad Accident	Michigan City	IN	3,000	38
125	February-03	Tamaroa Train Derailment	29	Technological Hazard	Railroad Accident	Tamaroa	IL	1,000	38
126	September-93	Odessa Fixed Site Hazmat	244	Technological Hazard	Fixed Site Hazmat Incident	Odessa	TX	1,000	36
127	November-02	Veteran's Day Storms	218	Natural Disaster	Tornadoes	Multiple Counties	AL, OH, TN, MS, GA, PA, WV	1,900	36
128	1990	Elba Flood	196	Natural Disaster	Flood	Elba	AL	4,000	36
129	July-94	Tropical Storm Alberto	192	Natural Disaster	Flood	Albany	GA	20,000	36
130	April-97	Red River Flood	172	Natural Disaster	Flood	Multiple Counties	ND, MN	50,000+	36
131	February-98	California Floods	171	Natural Disaster	Flood	CA Coast and Mexico	CA	3,500	36
132	April-01	Midwest Floods	163	Natural Disaster	Flood	Multiple Counties	WI, MN, IA, IL	4,400	36
133	March-02	Floods	160	Natural Disaster	Flood	Multiple Counties	KY, TN, VA, OH, AK, OK	2,000	36

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
134	October 02	Texas Floods	155	Natural Disaster	Flood	Laredo, Brownsville	TX	~1,000	36
135	1994	Northridge Earthquake	148	Natural Disaster	Earthquake	LA County	CA	2,000	36
136	November-93	Jefferson County Railroad Accident	93	Technological Hazard	Railroad Accident	Jefferson County	KY	2,500	36
137	November-96	Lake Cormorant Transportation Accident	46	Technological Hazard	Transportation Accident	Lake Cormoront	MS	2,100	36
138	December-94	Terra International	39	Technological Hazard	Unknown	Sergeant Bluff	IA	2,000	36
139	June-91	USDA	37	Technological Hazard	Unknown	Phoenix	AZ	2,000	36
140	October-98	Guadalupe River Flood	11	Natural Disaster	Flood	5 Southeastern counties. (Bexar, Travis, etc.)	TX	2,000	36
141	May-00	Tulsa Flood	7	Natural Disaster	Flood	Multiple Counties	MO, OK	1,200	36
142	July-02	Buscuit Fire	133	Natural Disaster	Wildfire	Cave Junction	OR	1,000	33
143	June-03	California Wildfire	249	Natural Disaster	Wildfire	Lebec	CA	2,500	33
144	November-00	Bellemont Railroad Accident	236	Technological Hazard	Railroad Accident	Bellemont (near Flagstaff)	AZ	1,000	33
145	March-98	Flint River Flood	191	Natural Disaster	Flood	Albany	GA	5,000	33

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
146	June-02	Flenwood Springs Fire	181	Natural Disaster	Wildfire	Near Denver	CO	4,000	33
147	March-95	California Floods	176	Natural Disaster	Flood	Monterey, San Luis, Obispo, Santa Barbara, and Santa Cruz counties.	CA	10,000	33
148	February-02	Sterling Hazmat Incident	152	Technological Hazard	Fixed Site Hazmat Incident	Sterling	KS	~1,000	33
149	June-00	Hanford Fire	105	Natural Disaster	Wildfire	Horn Rapids	WA	>2,000	33
150	June-00	Hanford Fire	104	Natural Disaster	Wildfire	West Hanford	WA	>2,000	33
151	September-98	Hurricane Earl	86	Natural Disaster	Tropical Storm	Plaquemines Parish	LA	>1,000	33
152	April-97	E. St. Louis Transportation Accident	49	Technological Hazard	Transportation Accident	East Saint Louis	IL	1,669	33
153	October-98	Kansas City Floods	9	Natural Disaster	Flood	Kansas City	MO	2,000	33
154	July-99	Central Iowa Flash Floods	8	Natural Disaster	Flood	Worth County Floyd County	IA	1,500	33
155	September-02	Williams Fire "Angel National Forest"	227	Natural Disaster	Wildfire	Wrightwood	CA	2,320	31
156	July-02	Mesa Verde Park Wildfire	226	Natural Disaster	Wildfire	Mesa Verde National Park	CO	2,000	31

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Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
157	June-02	Glenwood Springs Fire	225	Natural Disaster	Wildfire	Glenwood Springs	CO	2,000	31
158	September-93	Midwest Floods	178	Natural Disaster	Flood	US Midwest	OK	2,500	31
159	July-02	Central Texas Floods	158	Natural Disaster	Flood	Central Texas	TX	4,000	31
160	June-98	Gainesville Fire	139	Natural Disaster	Wildfire	Gainesville	FL	>1,000	31
161	September-02	Glendora Fire, San Gabriel Canyon	136	Natural Disaster	Wildfire	San Gabriel Canyon	CA	2,000	31
162	July-02	Cache Mountain Fire	134	Natural Disaster	Wildfire	Black Butte Ranch	OR	5,000	31
163	June-03	Heber-Overgaard Fire	132	Natural Disaster	Wildfire	Heber-Overgaard	AZ	2,700	31
164	May-02	Black Mountain Fire	128	Natural Disaster	Wildfire	Clear Creek	CO	2,444	31
165	August-00	Blodgett Trailhead Fire	127	Natural Disaster	Wildfire	Bitterroot Valley	MT	2,000	31
166	August-01	Weaverville Mining Town Fire	121	Natural Disaster	Wildfire	Weaverville	CA	3,550	31
167	June-02	Mogollon Rim	118	Natural Disaster	Wildfire	Pinedale, Linden & Clay Springs	AZ	4,000	31
168	June-02	Million Fire	117	Natural Disaster	Wildfire	South Fork	CO	3,000	31

Table A-1. Comprehensive List of Evacuation Incidents, January 1, 1990, through June 30, 2003.									
Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
169	June-99	Selinsgrove Transportation Accident	56	Technological Hazard	Transportation Accident	Selinsgrove	PA	1,000	31
170	February-99	Dallas Fixed Site Hazmat	55	Technological Hazard	Fixed Site Hazmat Incident	Dallas	TX	1,000	31
171	December-97	Kansas City Transportation Accident	54	Technological Hazard	Transportation Accident	Kansas City	KS	1,600	31
172	June-98	Carson City Plant Accident	23	Technological Hazard	Fixed Site Hazmat Incident	Carson City	CA	1,000	31
173	June-97	Lexington Flood	232	Natural Disaster	Flood	Lexington	MS	1,000	29
174	May-95	South Dakota Flood	174	Natural Disaster	Flood	Black Hills Area	SD	75,000	29
175	April-98	Tennessee Flood	169	Natural Disaster	Flood	Davidson County	TN	1,200	29
176	October-98	Banning Fire	135	Natural Disaster	Wildfire	Banning	CA	1,000	29
177	July-97	Rossville Train Collision	21	Technological Hazard	Railroad Accident	Rossville	KS	1,500	29
178	June-03	Tropical Storm Bill	250	Natural Disaster	Tropical Storm	Gulf Coast	Gulf Coast	>1,000	27
179	January-96	Appelton Railroad Accident	231	Technological Hazard	Railroad Accident	Appleton	WI	>1,000	27
180	February-98	Notalia Fixed Site Hazmat	193	Technological Hazard	Fixed Site Hazmat Incident	Natalia	TX	1,400	27

Table A-1. Comprehensive List of Evacuation Incidents, January 1, 1990, through June 30, 2003.

Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
181	May-90	Tipton County Railroad Accident	91	Technological Hazard	Railroad Accident	Tipton County	TN	1,000	27
182	December-96	Lake Zurich Transportation Accident	47	Technological Hazard	Transportation Accident	Lake Zurich	IL	1,500	27
183	August-95	DuPont Plant	40	Technological Hazard	Fixed Site Hazmat Incident	Wurtland	KY	1,400	27
184	June--90	Alcolac Plant	34	Technological Hazard	Fixed Site Hazmat Incident	Sedalia	MO	1,500	27
185	April-90	Lomac	33	Technological Hazard	Fixed Site Hazmat Incident	Muskegon	MI	1,000	27
186	August-00	Flood	237	Natural Disaster	Flood	Sussex County	NJ	>1,000	24
187	February-01	Seattle Earthquake	211	Natural Disaster	Earthquake	Seattle	WA	>1,000	24
188	May-95	Flood	173	Natural Disaster	Flood	Multiple Counties	IL, MO, OK	4,900	24
189	May-02	Flood	159	Natural Disaster	Flood	Multiple Counties	WV, VA	1,000	24
190	August-00	Wildfire	115	Natural Disaster	Wildfire	Boise	ID	>1,000	24
191	December-96	Crane Hazmat Incident	78	Technological Hazard	Fixed Site Hazmat Incident	Crane	MO	1,200	24
192	May-91	Angus	35	Technological Hazard	Fixed Site Hazmat Incident	Sterlington	LA	1,000	24

Table A-1. Comprehensive List of Evacuation Incidents, January 1, 1990, through June 30, 2003.									
Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
193	June-03	Bosque Fire	248	Natural Disaster	Wildfire	Albuquerque	NM	1,000	22
194	August-00	Helena Fire	147	Natural Disaster	Wildfire	Helena	MT	>1,000	22
195	July-00	Valley Complex Fire	142	Natural Disaster	Wildfire	East of Darby	MT	>1,000	22
196	August-00	Twin Fire and Sula Complex Fires	141	Natural Disaster	Wildfire	Ravilli County	MT	>1,000	22
197	July-00	Wildfire	101	Natural Disaster	Wildfire	Idaho Falls	ID	1,800	22
198	February-94	Ward County Railroad Accident	94	Technological Hazard	Railroad Accident	Ward County	ND	1,500	22
199	March-96	Latta Railroad Accident	44	Technological Hazard	Railroad Accident	Latta	OK	1,000	22
200	February-91	Carmichael Transportation Accident	15	Technological Hazard	Transportation Accident	Carmichael	CA	~1,000	22
201	February-93	Flood	13	Natural Disaster	Flood	Unknown	AZ	1,600	22
202	June-03	Wildfire	247	Natural Disaster	Wildfire	Summerhaven	AZ	1,000	20
203	March-02	Kokopelli Fire	228	Natural Disaster	Wildfire	Ruidoso	NM	1,300	20
204	August-95	Watsonville Flooding	222	Natural Disaster	Flood	Watsonville	CA	>2,700	20
205	October-03	Texas Flood	217	Natural Disaster	Tornadoes and Flooding	Houston Area	TX	>1,700	20

Table A-1. Comprehensive List of Evacuation Incidents, January 1, 1990, through June 30, 2003.

Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
206	July-02	Sequoia National Park Fire	189	Natural Disaster	Wildfire	Pine Flat	CA	1,000	20
207	September-01	Sierra Nevada Fire	187	Natural Disaster	Wildfire	Yankee Hill	CA	~1,600	20
208	June-02	Copper Fire	182	Natural Disaster	Wildfire	Small community west of Los Angeles (Green Valley)	CA	1,500	20
209	April-96	Stanwood Incident	154	Technological Hazard	Fixed Site Hazmat Incident	Stanwood	WA	1,800	20
210	July-02	Sequoia National Forest Fire	145	Natural Disaster	Wildfire	Johnsondale	CA	>1,000	20
211	June-98	Tallahassee Fire	144	Natural Disaster	Wildfire	Tallahassee	FL	>1,000	20
212	June-02	Cannon City Fire	138	Natural Disaster	Wildfire	Walker River	CA	1,000	20
213	May-00	Flood	106	Natural Disaster	Flood	Multiple Counties	MO, OK	1,200	20
214	June-00	Hanford Fire	102	Natural Disaster	Wildfire	DOE Hanford Facility	WA	1,700	20
215	November-96	Railroad Accident	45	Technological Hazard	Railroad Accident	Outside of Phoenix	AZ	1,500	20
216	February-96	Grandview Incident	42	Technological Hazard	Fixed Site Hazmat Incident	Grandview	TX	1,100	20
217	February-96	Stratford Incident	41	Technological Hazard	Fixed Site Hazmat Incident	Stratford	TX	1,800	20

Table A-1. Comprehensive List of Evacuation Incidents, January 1, 1990, through June 30, 2003.									
Total Ranking	Date	Event Name	Identifier	Category	Specific Type	City/County	State	# Evacuated	Rank Value
218	April-96	Montana Rail Link	20	Technological Hazard	Railroad Accident	Alberton	MT	1,000	20
219	August-95	Pajaro Flood	220	Natural Disaster	Flood	Pajaro	CA	3,000	18
220	June-98	Flood	167	Natural Disaster	Flood	Multiple Counties	IA, IN	1,000	18
221	October-99	Belle Vista Fire	205	Natural Disaster	Wildfire	Belle Vista	CA	>1,000	16
222	September-97	Sierra Nevada Foothills Fire	194	Natural Disaster	Wildfire	Oregon House	CA	1,500	13
223	May-98	Flood	168	Natural Disaster	Flood	Prineville	OR	1,600	13
224	August-98	Tropical Storm Charley	164	Natural Disaster	Flood	Del Rio and Laredo	TX	>1,000	13
225	September-99	Kirk Complex	113	Natural Disaster	Wildfire	Near Big Sur	CA	~1,000	13
226	August-99	Dunn Glen Complex	112	Natural Disaster	Wildfire	Near Battle Mountain	NV	>1,000	13
227	August-99	Big Bear Complex	111	Natural Disaster	Wildfire	Big Bear Lake	CA	>1,000	13
228	August-95	Salinas River Flood	221	Natural Disaster	Flood	Castroville	CA	>1,000	9
229	March-93	Flood	12	Natural Disaster	Flood	U.S. Midwest	NE	1,500	9
230	January-93	Flood	14	Natural Disaster	Flood	U.S. Southwest	CA, AZ	1,100	7

APPENDIX B

EVACUATION FORM

EVACUATION FORM

TITLE

(Event Name, City, State, Date, Identifier)

INTRODUCTION

Brief introduction to the evacuation incident, including date and time, location, type of hazard, number of people evacuated, and special or unusual circumstances.

COMMUNITY CONTEXT

Community information summarized to include:

General community information
History or experience with hazards or emergencies
Resources available, emergency preparedness activities (e.g., planning, training, drills and exercises, and community awareness)

<u>Specific questions to be answered:</u>
<u>General</u>
Community: Urban, Rural, Suburban
Population: _____
Number of people evacuated: _____
Percent of population evacuated: _____
Population density of area during evacuation (High, Low, Medium)
Was ethnicity, nationality, or age important factor in evacuation (Yes, No)
Size (sq. mi.; sq. km) of the community: _____
Size (sq. mi.; sq. km) of evacuated area: _____
Land uses in evacuation area (Residential, Commercial/Retail, Industrial, Agricultural, Other, Don't Know)
Type of Community (Town, County, City, State, Other)
Form of Government (Mayoral, City Manager, Commission/Board, Other)
Community's main economic base (Farming, Tourism, Manufacturing/Industry, Commercial/Retail/Services, Other)
Any special characteristics (e.g., tourism) that attract large number of non-residents (Yes (Explain _____), No, Don't Know, N/A)
Proximity to a commercial nuclear power plant (0-10 mi., 11-50 mi., >50 mi.)
Is community located in a state that contains a nuclear power plant (Yes, No, Don't Know)

History of Emergencies
Is area more prone to hazards than average (No, Yes-Natural Disasters, Yes-Technological Hazards, Yes-Both)
Has community had any experience with the hazard that led to this evacuation (Yes, No, Don't Know, N/A)
Has community experienced evacuations in previous ten years (Yes, No, Don't Know, N/A)
Has the community had previous experience with the alerting mechanism used in this evacuation (Yes, No, Don't Know, N/A)

Emergency Preparedness
Planning
Did community have a written emergency plan (Yes, No, Don't Know, N/A)
Did emergency plan contain an evacuation section (Yes, No, Don't Know, N/A)
Was plan used in this emergency (Yes, No, Don't Know, N/A)
Did plan conform to NUREG-0654 (Yes, No, Don't Know, N/A)
Was there an Evacuation Time Estimate (ETE) in the plan (Yes, No, N/A)
How did the actual evacuation time compare to the ETE (Over __%, Under __%, N/A)

Training
Is training provided to emergency response personnel (Yes, No, Don't Know, N/A)
Is joint training between industry and government regularly conducted (Yes, No, Don't Know, N/A)

Drills and Exercises

Do the community's emergency response agencies regularly conduct emergency drills and exercises (Yes, No, Don't Know, N/A)
Was the emergency plan used in this evacuation previously tested in a full-scale field exercise (Yes, No, Don't Know, N/A)
If so, what type of exercise was performed immediately prior to this evacuation (Full-scale field exercise, Functional Drill, Tabletop Exercise, Other)

Community Awareness

Level of community awareness of local hazards (High, Medium, Low)
Level of community awareness of evacuation procedures (High, Medium, Low)
Level of community awareness of hazard that caused evacuation (High, Medium, Low)
Level of community awareness of alerting methods used (High, Medium, Low)

THREAT CONDITIONS

Brief summary of the threat or hazard that caused the evacuation, including weather, road conditions, and unusual circumstances.

CONSEQUENCES

Brief summary of the consequences of the event, including, date, time and duration of the event, time to complete evacuation, statistics on the number of people evacuated, killed or injured, the distance necessary to adequately evacuate from hazard, and cost information.

<u>Specific questions to be answered:</u>
How many people evacuated: _____
Number of deaths _____ and injuries _____ caused by the hazard
Number of deaths _____ and injuries _____ caused by the evacuation
Estimated total cost of evacuation-related expenses and property damages (not damages due to hazard) incurred by the public: _____

EMERGENCY RESPONSE

Summary of the emergency response, including general information on the organization(s) responding, decision-making, communications, notification and warning (e.g., time to warn), traffic movement and control, shelters, law enforcement, and re-entry.

<u>Specific questions to be answered:</u>
Hazard that led to evacuation (Technological Hazard, Natural Disaster, or Terrorism)
Time of day (Night, Day, Don't Know)

<u>Decision Making</u>
Level of cooperation between local, state, and federal agencies (high, low, moderate)
Were political boundaries crossed (i.e., more than one county or state involved) (Yes, No)
Command, control and coordination processes (Ad hoc or Pre-planned)
Who made decision to evacuate (Mayor, Fire Chief, Police Chief, Emergency Manager, Governor, Other)
Problems with decision making process (Yes (Explain), No, Don't Know, N/A)

<u>Communications</u>
Emergency Operations Center (EOC) used (Yes, No, Don't Know, N/A)

Field (incident) command post used (Yes, No, Don't Know, N/A)
Communication between field emergency responders and EOC (Radio, Telephone, Cell Phone, Other (List))
Problems with communications (Yes, No, Don't Know, N/A)

Notification and Warning
How were senior local officials notified of the incident: _____
How were emergency responders notified of the incident: ____
Elapsed time between discovery of the incident and mobilization of response personnel (0-15 min., 15-30 min., 31-60 min., 60+min.)
Elapsed time between start of hazard and decision to evacuate: _____
Time to complete the evacuation: ____
Problems with notification of emergency personnel or senior local official (Yes, No, Don't Know)
How was the public notified (Sirens, Telephone, Radio/TV Broadcasts, EBS, Police/Fire PA System, NOAA, Other)
Was evacuation staged or all at once (Staged, All at Once)
Any special problems regarding warning and subsequent citizen action (Yes (Explain), No, Don't Know, N/A)

Traffic Movement and Control
Were people given specific instructions about where to go when they evacuated (Yes (Explain), No, Don't Know, N/A)
Were people told to use specific routes (Yes, No, Don't Know, N/A)
How were these routes designated: ____
How many special institutions (e.g. hospitals, prisons) were evacuated: _____ (Explain)
Road conditions prior to evacuation (Dry, Wet, Icy, Other)
Were any major roadways unavailable for use due to construction, damage caused by the hazard, etc. (Yes, No, Don't Know, N/A)
Were there any special traffic problems encountered (Yes (Explain), No, Don't Know, N/A)
Did some people spontaneously evacuate before being told to do so (Yes (Explain), No, Don't Know, N/A)
Was reverse-laning used (Yes, No, Don't Know, N/A)
Were there any traffic accidents during the evacuations (Yes, No, Don't Know, N/A)
Did anyone refuse to evacuate (Yes, No, Don't Know, N/A)

Shelters
Were public shelters used (Yes, No, Don't Know, N/A)
Who managed the shelters (Red Cross, Civil Defense, Other)
What type of buildings were used as shelters (Schools, Churches, Public Buildings, Other (List))
What percent of evacuees went to shelters:____
Did people evacuate from areas outside the designated evacuation area (Yes, No, Don't Know)
Did this cause an impact on traffic (Yes, No, Don't Know)

Did this cause an impact on shelter capacity (Yes, No, Don't Know, N/A)

<u>Law Enforcement</u>
How was the area secured following the evacuation to prevent looting and vandalism (Police, National Guard, Other)
Were there any instances of looting or vandalism (Yes, No, Don't Know, N/A)
Any problems with law enforcement (Yes, No, Don't Know, N/A)

<u>Re-Entry</u>
Who authorized re-entry (Mayor, Fire Chief, Police Chief, Emergency Manager, Governor, Other)
Describe the Re-entry Process (Controlled Phased Reentry, No Special Controls, Other)
Were evacuees compensated for their expenses (Yes (Explain), No, Don't Know, N/A)
Any major problems during re-entry (Yes, No, Don't Know, N/A)

INVESTIGATOR COMMENTS

Specific questions asked of, or offered by, the Investigator to include, but not be limited to:
What factors made the evacuation work well?
What factors contributed to the evacuation's faults or problems?
What were the lessons learned in this evacuation?
Did the public's prior knowledge of the hazard, or prior evacuations, contribute to the success of the evacuation?

CONTACT INFORMATION AND REFERENCES

List of all personal contacts (e.g., fire chief, police chief, emergency manager) and other references (e.g., news items, reports) used to answer the questionnaire and construct the case study narrative.

APPENDIX C

STATISTICAL SUMMARY CASE STUDIES

CONTENTS

Table C-1. General Community Statistics.

Question	Response	# of Cases	% of Cases
Community type	Urban	9	18
	Rural	5	10
	Suburban	36	72
	Unknown	0	0
Population	<2,000	2	4
	2,000-5,000	4	8
	>5,000	44	88
	Unknown	0	0
Number of people evacuated	<2,000	6	12
	2,000-5,000	23	46
	>5,000	21	42
Percent of population evacuated	<10%	15	30
	10-20%	8	16
	20-50%	12	24
	51-99%	3	6
	100%	10	20
	Unknown	2	4
Population density during evacuation	High	14	28
	Low	8	16
	Medium	24	48
	Unknown	4	8
Was ethnicity, nationality, or age an important factor in evacuation?	Yes	10	20
	No	32	64
	Unknown	8	16

Table C-1. General Community Statistics (continued).

Question	Response	# of Cases	% of Cases
Community size	<2.6 km^2 (<1 mi^2)	1	2
	2.6-13 km^2 (1-5 mi^2)	5	10
	>13 km^2 (>5 mi^2)	43	86
	Unknown	1	2
Size of evacuated area	<2.6 km^2 (<1 mi^2)	3	6
	2.6-13 km^2 (1-5 mi^2)	24	48
	>13 km^2 (>5 mi^2)	13	26
	Unknown	10	20
Land uses in evacuation area	Residential	41	82
	Commercial/Retail (plus other uses)	26	52
	Industrial Agricultural	18	36
	Multiple Land Use	30	60
	Unknown	1	2
Type of community	Town	9	18
	County	8	16
	City	31	62
	State	0	0
	Other	2	4
Form of government	Mayoral	32	62
	City Manager	2	4
	Commission/Board	8	16
	Other	8	16
	Unknown	0	0

Table C-1. General Community Statistics (continued).

Question	Response	# of Cases	% of Cases
Community's main economic base	Farming	9	18
	Tourism	14	28
	Manufacturing/Industry	21	42
	Government	1	2
	Commercial/Retail/ Services	20	40
	Other	13	26
Any special characteristics (e.g., tourism) that attract large number of non-residents?	Yes	37	74
	No	11	22
	Unknown	2	4
Proximity to a commercial nuclear power plant	0-16 km (0-10 mi)	4	8
	17-80 km (11-50 mi)	11	22
	>80 km (>50 mi)	35	70
Is the community located in a state that contains a nuclear power plant?	Yes	39	78
	No	11	22

Table C-2. History of Emergencies Statistics.

Question	Response	# of cases	% of cases
Is the area more prone to hazards than average?	No	13	26
	Yes- Natural Disasters	8	16
	Yes- Technological Hazards	9	18
	Yes- Both	20	40
Has the community had any experience with the hazard that led to this evacuation?	Yes	25	50
	No	24	48
	Unknown	1	2
Has the community experienced evacuations in previous ten years?	Yes	23	46
	No	25	50
	Unknown	2	4
Has the community had previous experience with the alerting mechanism used in this evacuation?	Yes	22	44
	No	18	36
	Unknown	5	10
	N/A	5	10

Table C-3. Emergency Preparedness Statistics.

Question	Response	# of cases	% of cases
Planning			
Did the community have a written emergency plan?	Yes	47	94
	No	3	6
Did the emergency plan contain an evacuation section?	Yes	40	80
	No	3	6
	Unknown	4	8
	N/A	3	6
Was the plan used in this emergency?	Yes	43	86
	No	1	2
	Unknown	2	4
	N/A	4	8
Did the plan conform to NUREG-0654?	Yes	6	12
	No	16	32
	Unknown	23	46
	N/A	5	10
Was there an Evacuation Time Estimate (ETE) in the plan?	Yes	1	2
	No	13	26
	Unknown	2	4
	N/A	34	68
Training			
Was training provided to response personnel?	Yes	50	100
	No	0	0
Was there joint training between industry and government?	Yes	40	80
	No	8	16
	N/A	2	4
Drills and Exercises			
Do the community's emergency response agencies regularly conduct emergency drills and exercises?	Yes	42	84
	No	7	14
	Unknown	1	2
Was the emergency plan used in this evacuation previously tested in a full-scale field exercise?	Yes	20	40
	No	20	40
	Unknown	8	16
	N/A	2	4
If so, what type of exercise was performed immediately prior to this?	Full-scale field exercise	16	32
	Functional Drill	3	6
	Tabletop Exercise	2	4
	N/A	27	54
	Unknown	2	4

Table C-3. Emergency Preparedness Statistics (continued).

Question	Response	# of cases	% of cases
Community Awareness			
Awareness of local hazards	High	12	24
	Medium	25	50
	Low	13	26
Awareness of evacuation procedures	High	10	20
	Medium	21	42
	Low	19	38
Awareness of hazard that caused evacuation	High	15	30
	Medium	9	18
	Low	26	52
Awareness of alerting methods used	High	16	32
	Medium	22	44
	Low	11	22

Table C-4. Emergency Response Statistics.

Question	Response	# of cases	% of cases
Hazard that led to evacuation	Technological Hazard	33	66
	Natural Disaster	14	28
	Terrorism	3	6
Time of Day	Night	10	20
	Day	40	80
Decision Making			
Level of cooperation between local, state and federal agencies	High	45	90
	Low	0	0
	Moderate	4	8
	Unknown	1	2
Were political boundaries crossed?	Yes	19	38
	No	26	52
	Unknown	5	10
Command, control and coordination	Ad hoc	12	24
	Pre-planned	38	76
	Unknown	0	0
Who made the decision to evacuate?	Mayor	3	6
	Fire Chief	25	50
	Police Chief	11	22
	Fire/Police Chief Jointly	4	8
	Emergency Manager	5	10
	Governor	2	4
	Multiple Joint Decision	10	20
	Other	14	28
Were there problems with the decision making process?	Yes	6	12
	No	44	88
Communications			
Was an Emergency Operations Center (EOC) used?	Yes	34	68
	No	15	30
	Unknown	1	2
Was an Incident Command Post (ICP) used?	Yes	45	90
	No	4	8
	Unknown	0	0
	N/A	1	2
Communication between field emergency responders and EOC or ICP	Radio	46	92
	Telephone (plus other methods)	7	14
	Cell phone	19	38
	Pager (plus other methods)	2	4
	Multiple	20	40
	Other	0	0

Table C-4. Emergency Response Statistics (continued).

Question	Response	# of cases	% of cases
Problems with communication	Yes	14	28
	No	35	70
	Unknown	1	2
Notification and Warning			
How were senior local officials notified of the incident?	Telephone/Phone Tree	35	70
	Cell Phone	2	4
	Pager	2	4
	Radio	3	6
	911 Dispatch	0	0
	Public Notification	3	6
	Unknown	4	8
	N/A	1	2
How were emergency responders notified of the incident?	911	41	82
	Saw Incident	2	4
	Telephone	1	2
	Unknown	3	6
	N/A	3	6
Elapsed time between discovery of incident and mobilization of response personnel	0-15 min.	37	74
	16-30 min.	0	0
	31-60 min.	1	2
	60+ min.	4	8
	Unknown	7	14
	N/A	1	2
Elapsed time between start of hazard and decision to evacuate	0-15 min.	11	22
	16-30 min.	8	16
	31-60 min.	5	10
	60+ min.	16	32
	Unknown	9	18
	N/A	1	2
Time to complete the evacuation	<1 hr.	9	18
	1-3 hrs.	18	36
	4-8 hrs.	9	18
	9-24 hrs.	4	8
	>24 hrs.	0	0
	Unknown	10	20
Were there problems with notification of emergency personnel or senior local official?	Yes	2	4
	No	46	92
	Unknown	2	4

Table C-4. Emergency Response Statistics (continued).

Question	Response	# of cases	% of cases
How was the public notified?	Sirens (plus other methods)	7	14
	Telephone	9	18
	Radio/TV broadcasts (plus other methods)	24	48
	EBS (plus other methods)	2	4
	Police/Fire PA system	27	54
	Door-to-Door	31	62
	Multiple	34	68
Was the evacuation staged or all at once?	Staged	20	40
	All at once	30	60
Were there any special problems regarding warning and subsequent citizen action?	Yes	12	24
	No	38	76
	Unknown	0	0
Traffic Movement and Control			
Were people given specific instructions about where to go and when they evacuated?	Yes	39	78
	No	6	12
	Unknown	4	8
	N/A	1	2
Were people told to use specific routes?	Yes	31	62
	No	15	30
	Unknown	3	6
	N/A	1	2
How many special institutions (e.g., hospitals, prisons) were evacuated?	0	26	52
	1	8	16
	2-5	9	18
	>5	1	2
	Unknown	6	12
Road conditions prior to evacuation	Dry	46	92
	Wet	1	2
	Icy	0	0
	Other	2	4
	Unknown	1	2
Were any major roadways unavailable for use due to construction, damage caused by the hazard, etc.?	Yes	15	30
	No	32	64
	Unknown	2	4
	N/A	1	2
Were there any special traffic problems encountered?	Yes	14	28
	No	36	72

Table C-4. Emergency Response Statistics (continued).

Question	Response	# of cases	# of cases
Did some people spontaneously evacuate before being told to do so?	Yes	22	44
	No	21	42
	Unknown	6	12
	N/A	1	2
Was reverse-laning used?	Yes	6	12
	No	40	80
	Unknown	3	6
	N/A	1	2
Were there any traffic accidents during the evacuations?	Yes	4	8
	No	40	80
	Unknown	6	12
Did anyone refuse to evacuate?	Yes	26	52
	No	21	42
	Unknown	3	6
Congregate Care Centers			
Were public congregate care centers used?	Yes	40	80
	Unknown	2	4
	No	8	16
Who managed the congregate care centers?	Red Cross	30	60
	Civil Defense	2	4
	Other	7	14
	N/A	10	20
	Unknown	1	2
What type of buildings were used as congregate care centers?	Schools	31	62
	Churches	10	20
	Public Buildings	8	16
	Other	4	8
	N/A	10	20
What percent of evacuees went to congregate care centers?	<1%	1	2
	1-5%	6	12
	6-10%	10	20
	11-20%	4	8
	>20%	3	6
	N/A	9	18
	Unknown	17	34
Were there shadow evacuations?	Yes	18	36
	No	24	48
	Unknown	7	14
	N/A	1	2
Did this cause an impact on traffic?	Yes	5	10
	No	13	26
	Unknown	1	2
	N/A	31	62

Table C-4. Emergency Response Statistics (continued).

Question	Response	# of cases	% of cases
Did this cause an impact on congregate care center capacity?	Yes	0	0
	No	17	34
	Unknown	2	4
	N/A	31	62
Law Enforcement			
How was the area secured following the evacuation to prevent looting and vandalism?	Police only	38	76
	National Guard only	4	8
	Police and National Guard	5	10
	Other	3	6
Were there any instances of looting or vandalism?	Yes	5	10
	No	45	90
Were there any problems with law enforcement?	Yes	3	6
	No	47	94
Re-Entry			
Who authorized re-entry?	Mayor	6	12
	Fire Chief	22	44
	Police Chief	6	12
	Emergency Manager	4	8
	Governor	0	0
	Multiple	11	22
	Other	23	46
Describe the re-entry process	Controlled phased re-entry	9	18
	No special controls	40	80
	Unknown	1	2
Were evacuees compensated for their expenses?	Yes	14	28
	No	32	64
	Unknown	4	8
Were there any major problems during re-entry?	Yes	4	8
	No	44	88
	Unknown	2	4

APPENDIX D

CASE STUDIES

CONTENTS

Table D-1. Evacuation Case Studies.

Identifier	Date	Category	Specific Type	City/ County	State	# Evacuated	Rank Value
88A	September-99	Natural Disaster	Hurricane	Miami-Dade	FL	270,403	78
88B	September-99	Natural Disaster	Hurricane	South to Broward	FL	373,144	78
28	July-01	Technological Hazard	Fixed Site Hazmat Incident	Riverview	MI	6,000	76
80	August-92	Natural Disaster	Hurricane	Miami-Dade	FL	650,000	71
88C	September-99	Natural Disaster	Hurricane	Central Florida	FL	665,969	67
146	July-98	Natural Disaster	Wildfire	Mims	FL	16,000	67
74	September-02	Technological Hazard	Fixed Site Hazmat Incident	Charlotte	NC	1,000	64
96	July-01	Technological Hazard	Railroad Accident	Baltimore	MD	10,000	64
126	September-01	Malevolent Act	Malevolent Act	Lower Manhattan	NY	300,000	64
124	July-96	Malevolent Act	Malevolent Act	Atlanta	GA	60,000	64
18	October-95	Technological Hazard	Railroad Accident	Bogalusa	LA	3,000	62
30	May-00	Technological Hazard	Railroad Accident	Eunice	LA	2,000-3,500	62
235	May-03	Technological Hazard	Pipeline Rupture	Brandon	FL	2,000	62
75	February-03	Technological Hazard	Fixed Site Hazmat Incident	Slocomb	AL	3,500	62
4	March-01	Technological Hazard	Fixed Site Hazmat Incident	Forest	MS	2,000	62
27	August-00	Technological Hazard	Transportation Accident	Hugo	OK	2,000-2,500	60
25	July-99	Technological Hazard	Fixed Site Hazmat Incident	Iowa City	IA	5,000	60
166	January-98	Technological Hazard	Fixed Site Hazmat Incident	Maysville	KY	2,500	58
107	May-00	Natural Disaster	Wildfire	Los Alamos	NM	12,000	58
213	June-02	Natural Disaster	Wildfire	Deadwood	SD	15,000	58
209	May-00	Natural Disaster	Wildfire	White Rock	NM	7,000	58
119	June-02	Natural Disaster	Wildfire	Douglas County	CO	5,500	56
198	July-97	Technological Hazard	Railroad Accident	Flora	MS	6,000	56
99	July-1998	Natural Disaster	Wildfire	Flagler County	FL	45,000	53
1	October-01	Malevolent Act	Malevolent Act	Alexandria	LA	2,000	51
58	March-00	Technological Hazard	Fixed Site Hazmat Incident	Sterling Heights	MI	2,400	51
70	May-02	Technological Hazard	Railroad Accident	Potterville	MI	2,200	51
97	December-00	Technological Hazard	Railroad Accident	Oshkosh	WI	2,300	51
73	September-02	Technological Hazard	Railroad Accident	Farragut	TN	3,000	51
19	December-95	Technological Hazard	Pipeline Rupture	North Attleboro	MA	40,000	49
69	May-02	Technological Hazard	Fixed Site Hazmat Incident	Arlington	WA	1,500	49
95	March-94	Technological Hazard	Railroad Accident	Prichard	AL	2,000	49

Table D-1. Evacuation Case Studies (continued).

Identifier	Date	Category	Specific Type	City/ County	State	# Evacuated	Rank Value
16	June-92	Technological Hazard	Railroad Accident	Superior	WI	40,000	49
103	June-00	Natural Disaster	Wildfire	Benton City	WA	2,500	47
26	November-00	Technological Hazard	Railroad Accident	Scottsbluff	NE	5,000	47
66	October-01	Technological Hazard	Fixed Site Hazmat Incident	Morro Bay	CA	3,500	47
24	November-98	Technological Hazard	Fixed Site Hazmat Incident	Louisville	KY	2,400	47
243	April-94	Technological Hazard	Transportation Accident	Balch Springs	TX	5,000	47
234	October-91	Natural Disaster	Wildfire	Oakland	CA	20,000-30,000	44
52	November-97	Technological Hazard	Railroad Accident	Appleton and Grand Chute	WI	5,000	44
53	December-97	Technological Hazard	Fixed Site Hazmat Incident	Bath	PA	>1,600	44
3	October-98	Technological Hazard	Fixed Site Hazmat Incident	Pascagoula	MS	>1,500	44
239	September-98	Technological Hazard	Transportation Accident	Bossier City	LA	~2,000	44
51	August-97	Technological Hazard	Fixed Site Hazmat Incident	Chicago	IL	2,500	44
79	May-98	Technological Hazard	Fixed Site Hazmat Incident	Mason City	IA	3,600	44
245	August-92	Technological Hazard	Fixed Site Hazmat Incident	Odessa	TX	27,000	44
36	May-91	Technological Hazard	Fixed Site Hazmat Incident	Henderson	NV	~7,000	44
92	November-91	Technological Hazard	Railroad Accident	Sheperdsville	KY	1,000	42
116	June-02	Natural Disaster	Wildfire	Show Low	AZ	20,000	42
133	July-02	Natural Disaster	Wildfire	Cave Junction	OR	1,000	33

CAVEAT

The following case study discussions frequently use relativistic terms such as low, medium, and high, below and above average, etc. In all such cases, "average" refers to the average U.S. city or average U.S. community and does not refer to the "average" case among the 50 cases studied.

Hurricane Floyd, Miami-Dade County, Florida, September 13, 1999, ID #88A

Summary

Rank Value: 78
Number Evacuated: 270,403
Category: Natural Disaster
Specific Type: Hurricane
Community: Suburban

INTRODUCTION

On September 13, 1999, Hurricane Floyd caused the largest peacetime evacuation in U.S. history. Four states had evacuations in response to Hurricane Floyd (Florida, Georgia, North Carolina, and South Carolina). Although estimates vary, it was widely reported that two million people were evacuated in the state of Florida alone. The following case study examines the evacuation in Miami-Dade County, Florida, where 270,403 people were evacuated. No deaths or injuries occurred during the evacuation. However, many people experienced near gridlock on the major evacuation routes. Others expressed frustration over the lack of communication and poor dissemination of emergency information by officials.

COMMUNITY CONTEXT

General

Miami-Dade County consists of suburban communities with a total population of 2,253,362 people. Approximately 270,403 residents (12% of the population) were evacuated. Land use in the evacuated area is residential, commercial, industrial, and agricultural. The total area of Miami-Dade is 6,297 km^2 (2,431 mi^2) and the evacuated area covered 629 km^2 (243 mi^2). The population density of the area during the evacuation was variable (high in some places and low in others). Nationality and age were important factors in the evacuation. Florida has a large elderly population and there were some problems associated with evacuating elderly residents from their own homes as well as from assisted-living facilities. Florida also has a large Hispanic population, and there were some problems related to the language barrier.

Miami-Dade County has a commission form of government and its economic base is farming, tourism, manufacturing, and commercial. Tourism attracts a large number of non-residents. A portion of the evacuated area is located within the EPZ of the Turkey Point Nuclear Power Plant, which is located 48 km (30 mi) south of Miami, Florida. Turkey Point sustained a direct hit from Hurricane Andrew in 1992. Florida has several commercial nuclear power plants.

History of Emergencies
The Miami-Dade area is more prone to natural disasters, particularly storms, than the average U.S. community. Miami-Dade residents had evacuated in response to Hurricane Andrew in 1992 and had previous experience with the alerting mechanisms used for Hurricane Floyd. Evacuations are common in Florida because of its vulnerability to hurricanes and dense population along the coast. The communities involved in the Floyd evacuation were well prepared for an evacuation event. Since the mid-1980s, the Department of Community Affairs, Division of Emergency Management has performed regional hurricane evacuation studies in order to provide critical emergency management data to state and local officials who must make decisions to evacuate. These studies have determined the extent of an expected hurricane storm surge, the number of residents living in surge areas, the destinations of evacuees, evacuation routes, and congregate care center locations. They have also calculated the amount of clearance time needed to safely evacuate vulnerable residents to places of greater safety. Based on these results, state and local emergency management officials can determine how much advance time will be needed to evacuate all vulnerable residents to safety, and plan accordingly.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and did not contain an ETE.

Training
Training is provided to emergency response personnel and joint training between industry and government is regularly conducted.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in a full-scale field exercise.

Community Awareness
The level of community awareness of local hazards and of evacuation procedures was medium. The level of community awareness about the hazard that caused this evacuation and with alerting methods used was high.

THREAT CONDITIONS

On September 13, 1999, Hurricane Floyd threatened Florida as a massive Category 4 storm, equal in power to Hurricane Andrew (1992), but four times larger. The area of hurricane force winds extended well over 150 miles from the eye of the storm, requiring hurricane warnings from south Florida to Massachusetts. Weather conditions during the evacuation were dry and warm, and there were no unusual circumstances that occurred during this incident other than the hazard itself.

CONSEQUENCES

Over two million people in Florida evacuated in response to Hurricane Floyd. Approximately 270,403 residents were evacuated from their homes and businesses in the Miami-Dade area alone. No injuries or deaths were associated with the evacuation or the hurricane in Florida. However, there were 56 deaths in other states, mostly due to drowning from freshwater floods. Hurricane Floyd caused only minor property damage as it skirted the state of Florida. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation between local, state, and federal agencies was high and political boundaries were crossed. The command, control, and coordination process could best be described as pre-planned. The decision to evacuate was made by the county commissioner, and there were no problems with the decision-making process.

Communications

An EOC was used but there was no ICP. Communication among emergency responders was by radio, and there were no problems with communication.

Notification and Warning

Senior local officials were notified by radio. The elapsed time between the discovery of the incident and the mobilization of response personnel is unknown. The elapsed time between the start of the hazard and the decision to evacuate was 108 hours. It took approximately 14 hours to complete the evacuation. There were no problems with notification of emergency response personnel or senior local officials. The public was notified by radio and television broadcasts, police and fire department PA systems, and a reverse-911 phone system. The evacuation was staged, and there were no problems regarding warning or subsequent citizen action.

Traffic Movement and Control

Major evacuation routes were gridlocked because too many people tried to leave at the same time. This study identified the need for reverse-laning along major evacuation routes. Mammoth traffic jams had left motorists stuck, in many instances, on bumper-to-bumper interstate highways for ten hours or more, in order to complete drives to safety they expected would last two to three hours.

Evacuees were not given specific instructions about where to go when they evacuated, but a list of congregate care centers was provided. Special institutions were evacuated, including hospitals and assisted living facilities. Road conditions prior to the evacuation were dry, and all major roadways were available to evacuees. There were special traffic problems encountered involving very heavy traffic. Some people spontaneously evacuated and others refused to evacuate. There were no traffic accidents during the evacuation and reverse-laning was not used.

Congregate Care Centers
The Red Cross, Salvation Army, and local agencies set up congregate care centers in various schools and churches. Approximately 6% of the evacuees made use of the congregate care centers. There were shadow evacuations that did have an impact on traffic but did not impact congregate care center capacity.

Law Enforcement
Police secured the area following the evacuation. There were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry
The county commissioner authorized re-entry and there were no special controls in place. Insurance companies compensated evacuees for their expenses and there were no problems during re-entry. However, it was unclear to some evacuees when it was safe to go home (re-entry), which is one reason the Task Force recommended disseminating this type of information over the internet.

INVESTIGATOR COMMENTS

County and state coordination and the public's prior knowledge of the hazard and evacuations are factors that made the evacuation work well. Some lessons learned from the evacuation were:

- People need to be better informed about who does not need to evacuate.
- Congregate Care Centers need to be very visible and made more public.
- A better system needs to be developed to communicate with people on the road.

Some solutions that Florida has developed for these problems are:

- The community now has a system that counts and monitors the amount of traffic across the state.
- Florida's public radio can now broadcast evacuation updates.
- The community now has a plan that can implement reverse-laning.
- The community now has an Evacuation Liaison Team
- Transportation models were developed to show evacuation transportation information systems and their impact on surrounding states and regions.

- The federal highway administration is now involved in Florida's evacuations.
- The community now has a state web site.

CONTACT INFORMATION AND REFERENCES

Contacts

State of Florida, All Hazards Planning Manager, Division of Emergency Management (Meeting, 8/26/03)

FEMA Region IV
Atlanta, GA
(770) 220-5430
(Personal communications, April and May 2003)

References

Dumont, Robert. "The Legacy of Hurricane Floyd-Inland Flooding and a Massive Evacuation." <http://www.ofcm.gov/fp-fy01/pdf/sec1.pdf>

Federal Highway Administration (U.S.). "Evacuation Traffic Information System, Southeast Hurricane Evacuation Study." 2003. <http://www.fhwaetis.com/etis/Report_Links/floyd_rpt.htm> (April 2003).

Florida Department of Transportation. "Governor's Hurricane Evacuation Task Force Report." <http://www11.myflorida.com/publicinformationoffice/EvacuationStudy/HurricaneTaskForceReport.doc> (June 2003).

North Carolina Shore and Beach (U.S.). "Beach Nourishment for Hurricane Protection: North Carolina Project Performance In Hurricanes Dennis and Floyd." 2000. <http://www.ncshoreandbeach.org/Dennis-Floyd-Study.htm> (April 2003).

Hosock, H. "Safe But Annoyed: The Hurricane Floyd Evacuation in Florida." Case 1652. Kennedy School of Government Case Programs, Harvard University, Boston, Massachusetts.

The Disaster Center. "Hurricane Floyd Reports." <http://www.disastercenter.com/hurricf9.htm> (June 2003).

Hurricane Floyd, S. Florida to Broward County, Florida, September 13, 1999, ID #88B

Summary

Rank Value: 78
Number Evacuated: 373,144
Category: Natural Disaster
Specific Type: Hurricane
Community: Suburban

INTRODUCTION

On September 13, 1999, Hurricane Floyd was the cause of the largest peacetime evacuation in U.S. history. Four states had evacuations in response to Hurricane Floyd (Florida, Georgia, North Carolina, and South Carolina). Although estimates vary, it was widely reported that two million people were evacuated in the state of Florida alone. The following case study examines the evacuation of 373,144 people in the southern portion of Florida down to Broward County. No deaths or injuries occurred during the evacuation. However, many people experienced near gridlock on the major evacuation routes. Others expressed frustration over the lack of communication and poor dissemination of emergency information by officials.

COMMUNITY CONTEXT

General
The southern portion of Florida down to Broward County has a total population of 3,109,538 people. Approximately 373,144 residents (or 12% of the population) were evacuated. Land use in the area is primarily residential, commercial, retail, and industrial. The total area of that part of the state is 6,039 mi^2 (15,640 km^2) and the evacuated area was 483 mi^2. The population density of the area during the evacuation was high in some areas and low in others. Ethnicity and nationality were not important factors in the evacuation; however, age was an important factor because a large population of elderly residents was evacuated.

The form of government in the region includes a commission and a board. The region's main economic base includes farming, tourism, manufacturing, commercial, and retail. Tourism attracts a large number of non-residents to the area. The EPZ of the St. Lucie Nuclear Power Plant is located in St. Lucie County, which is in the northern portion of the evacuated area. Florida has several commercial nuclear power plants.

History of Emergencies
South Florida to Broward County is more prone than average to both natural and technological hazards. It is located in a hurricane-prone region and it has a high volume of interstate and railroad traffic, making it more prone to technological hazards as well. The community had

previous experience with hurricanes and evacuations in the last ten years and had prior experience with the alerting mechanisms used in this evacuation.

Emergency Preparedness

The community's emergency preparedness activities included planning, training, drills and exercises, and community awareness as described below.

Planning

The community had a written emergency plan, which contained an evacuation section, and was the plan used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and did not contain an ETE.

Training

Training is provided to emergency response personnel, and joint training between industry and government is regularly conducted.

Drills and Exercises

The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in a full-scale field exercise and a tabletop exercise.

Community Awareness

The level of community awareness about local hazards and about evacuation procedures was medium. The level of community awareness about the hazard that caused this evacuation and about the alerting methods used was high.

THREAT CONDITIONS

On September 13, 1999, Hurricane Floyd threatened Florida as a massive Category 4 storm, equal in power to Hurricane Andrew (1992), but four times larger. The area of hurricane force winds extended well over 150 miles from the eye of the storm, requiring hurricane warnings from south Florida to Massachusetts. Weather conditions during the evacuation were dry and clear. However, some unusual traffic conditions (gridlock) occurred during the evacuation.

CONSEQUENCES

Over two million people in Florida evacuated in response to Hurricane Floyd. Approximately 373,144 residents were evacuated from their homes and businesses in the southern portion of Florida down to Broward County. There were no injuries or deaths associated with the evacuation or the hurricane in Florida. However, there were 56 deaths in other states, mostly due to drowning from freshwater floods. Hurricane Floyd caused only minor property damage as it skirted the state of Florida. The estimated total cost of evacuation related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local, state, and federal agencies was high and political boundaries were crossed. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the County Board of Commissioners, and there were no problems with the decision-making process.

Communications
An EOC was used but there was not an ICP. Communication between field emergency responders and EOC was by radio. There were no problems with communication.

Notification and Warning
Senior local officials were notified by telephone. The elapsed time between the discovery of the incident and mobilization of response personnel is unknown. The elapsed time between the start of the hazard and the decision to evacuate was 108 hours. It took approximately 17 hours to complete the evacuation. There were no problems with notification of emergency personnel or senior local officials. Radio and television broadcasts, police and fire department PA systems, and a reverse-911 phone system notified the public. The evacuation was staged and there were no special problems regarding warning and subsequent citizen action.

Traffic and Movement
Evacuees were not given any special instructions about where to go when they evacuated, but a list of available congregate care centers was provided. There were numerous special institutions evacuated, including hospitals and nursing homes. Road conditions before the evacuation were dry and all major roadways were available to evacuees. Very heavy traffic congestion problems were encountered. Some people spontaneously evacuated before being told to do so and some people refused to evacuate. Reverse-laning was not used and there were no traffic accidents during the evacuation.

Congregate Care Centers
The Red Cross, Salvation Army, and local agencies set up congregate care centers at schools and churches. About 7% of the evacuees used the congregate care centers. There were shadow evacuations and this did impact traffic but did not impact congregate care center capacity.

Law Enforcement
Police secured the area following the evacuation and there were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry
The county commissioner authorized re-entry. There were no special controls during the re-entry process. Insurance agencies compensated evacuees for their expenses. There were no major problems during re-entry.

INVESTIGATOR COMMENTS

County and state coordination and the public's prior knowledge of the hazard and evacuations are factors that made the evacuation work well. Some lessons learned form the evacuation were:

- People need to be better informed about who does not need to evacuate.
- Congregate Care Centers need to be very visible and made more public.
- A better system needs to be developed to communicate with people on the road.

Some solutions that Florida has developed for these problems are:

- The community now has a system that counts and monitors the amount of traffic across the state.
- Florida's public radio can now broadcast evacuation updates.
- The community now has a plan that can implement reverse-laning.
- The community now has an Evacuation Liaison Team.
- Transportation models were developed to show evacuation transportation information systems and their impact on surrounding states and regions.
- The federal highway is now involved in Florida's evacuations.
- The community now has a state web site.

CONTACT INFORMATION AND REFERENCES

Contacts
State of Florida, All Hazards Planning Manager, Division of Emergency Management (Meeting, 8/26/03)

References

Dumont, Robert. "The Legacy of Hurricane Floyd-Inland Flooding and a Massive Evacuation." <http://www.ofcm.gov/fp-fy01/pdf/sec1.pdf>

Federal Highway Administration (U.S.). "Evacuation Traffic Information System, Southeast Hurricane Evacuation Study." 2003.
<http://www.fhwaetis.com/etis/Report_Links/floyd_rpt.htm> (April 2003).

Florida Department of Transportation. "Governor's Hurricane Evacuation Task Force Report." <http://www11.myflorida.com/publicinformationoffice/EvacuationStudy/HurricaneTaskForceReport.doc> (June 2003).

North Carolina Shore and Beach (U.S.). "Beach Nourishment for Hurricane Protection: North Carolina Project Performance In Hurricanes Dennis and Floyd." 2000. <http://www.ncshoreandbeach.org/Dennis-Floyd-Study.htm> (April 2003).

Hosock, H. "Safe But Annoyed: The Hurricane Floyd Evacuation in Florida." Case 1652. Kennedy School of Government Case Programs, Harvard University, Boston, Massachusetts.

The Disaster Center. "Hurricane Floyd Reports." <http://www.disastercenter.com/hurricf9.htm> (June 2003).

ATOFINA Chemicals Tank Car Failure, Riverview, Michigan, July 14, 2001, ID #28

Summary

Rank Value: 76
Number Evacuated: 6,000
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

On July 14, 2001, a release of methyl mercaptan, a poisonous and flammable gas, occurred at the ATOFINA Chemicals, Inc. (ATOFINA) plant in Riverview, Michigan, resulting in the evacuation of about 6,000 people. A pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, which is the odorant that is used in natural gas. The Riverview Fire Department arrived within minutes and, shortly after their arrival, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball approximately 60 m (200 ft) into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, another poisonous gas. Three plant employees were killed in the incident and several others were injured. The evacuation proceeded smoothly and lasted approximately ten hours. However, there were communications issues associated with the length of time it took to notify the residents, local communities, and Canadian authorities on the far side of the Detroit River.

COMMUNITY CONTEXT

General
On July 14, 2001, at 5:19 a.m. approximately 600 residences in Riverview, Trenton, Grosse Ile, and Wyandotte, Michigan, were ordered to evacuate. According to the Riverview Fire Marshal there was approximately 90% compliance with the order. A total of 6,000 people were evacuated, including approximately 2,000 residents from homes and industrial facilities within the area and an additional 4,000 people from the Trenton street fair located approximately 4.8 km (3 mi) south of the incident.

Riverview is a suburb of Detroit with shopping centers, commercial retail centers, and industrial facilities. The size of the community is 11.4 km^2 (4.4 mi^2) and the size of the evacuated area is 10.4 km^2 (4 mi^2). The population density during the evacuation was low. Riverview is run by a city manager and its main economic base is retail trade and service industries. There was a midsummer festival (street fair) in Trenton on July 14, 2001, that drew approximately 250,000 visitors. The start of this event was delayed, and individuals were evacuated from the area. There is one commercial nuclear plant, Fermi II, located in Newport, Michigan, approximately

24 km (15 mi) south of Riverview. The evacuation did not impact operations and took place outside the 10-mile emergency planning zone (EPZ) of the plant.

History of Emergencies
Riverview is more prone to hazards than the average community of its size. Trenton, Wyandotte, and Riverview each have a chemical plant, and local fire departments are familiar with local hazards. The ATOFINA plant has been at this location for over 100 years, and this is the first major catastrophe resulting in a large-scale evacuation.

Riverview has experienced evacuations in the previous ten years and has had prior experience with the alerting mechanism used in this evacuation, which included patrolmen going door-to-door and using loud speakers. Approximately six years ago, there was a train derailment involving small evacuations, and minor evacuations associated with the chemical plant occur periodically.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
ATOFINA has implemented an extensive emergency plan for the Riverview facilities, which included emergency procedures specific to the plant processes. The purpose of the plan is to minimize hazards to public health or the environment caused by fires, explosions, or releases of hazardous constituents. A copy of the plan was given to the Riverview Fire Department in March 2000. Riverview has a local emergency plan and a county plan. The Riverview plan was used in the emergency. It did not address evacuation organization, communication, or traffic routing. It only addressed evacuations in terms of exposure limits that require evacuations. This evacuation covered multiple communities that were not addressed in sufficient detail in the Riverview or county emergency plans. There was no evacuation time estimate (ETE) in the plan, and it is difficult to estimate the total time for the evacuation because it covered multiple communities and was being conducted by separate police departments. The Riverview emergency plan did not meet the requirements of NUREG-0654/FEMA-REP-1, Rev. 1.

Training
ATOFINA provides training to Riverview and Wyandotte Fire Departments and conducts periodic tours of the facility.

Drills and Exercises
Riverview emergency response did not conduct emergency drills or exercises for the emergency plan used in this evacuation.

Community Awareness
Although each of the surrounding communities of Riverview, Trenton, and Wyandotte have chemical plants, the local community had a low level of awareness of the hazards, of evacuation procedures, and of alerting methods. Previous evacuations were much smaller in scale.

THREAT CONDITIONS

The Riverview chemical release began as a normal chemical transfer operation on July 14, 2001. A connecting pipe separated from a faulty valve on a railcar as two workers unloaded methyl mercaptan. All 113,652 L (25,000 gal) of methyl mercaptan contained in the railcar was released into the environment. In addition, approximately 11,794 kg (26,000 lb) of chlorine was released from an adjacent railcar.

A total of 6,000 people were evacuated from Riverview and the surrounding communities. The evacuations occurred during the early morning. The weather was hot and the roads were dry. The Riverview evacuation involved three unusual circumstances. First, the community of Grosse Ile is located on an island in the river with only the southern bridge open to traffic. Second, the U.S. Coast Guard closed a 16.1 km (10 mi) stretch of the Detroit River. Finally, there was a street fair in Trenton, approximately 4.8 km (3 mi) south of the incident, that required the evacuation of approximately 4,000 vendors and members of the public.

CONSEQUENCES

Within 15 minutes of the initial event, the first two units of the Riverview Fire Department were on scene. Approximately ten minutes later, the methyl mercaptan ignited, resulting in a fireball that extended an estimated 60 m (200 ft) into the air. When the fireball occurred, the Riverview fire chief requested mutual aid from the surrounding communities. As the uncontrolled vapor cloud approached Riverview and the surrounding communities, portions of the communities were evacuated based on the wind direction. The initial incident resulted in the death of three workers in the immediate area and injuries to at least nine ATOFINA personnel. No reported deaths or injuries resulted from the evacuation. Residents voiced numerous complaints that the evacuation was too slow, resulting in inhalation of the chemical fumes and causing throat irritation and stinging eyes. However, there were no reports of anyone from the general public being hospitalized. The overall cost to the public of the evacuation is difficult to estimate because the release covered multiple communities, each with its own implementation.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local, state, and federal agencies was very high. Some of the local, state and federal agencies involved in this emergency included the Riverview Fire Department, Wyandotte Fire Department, Grosse Ile Police Department, Downriver Mutual Aid Hazmat Team, U.S. Coast Guard, and the U.S. Environmental Protection Agency (EPA). The

evacuation crossed multiple political boundaries, including city, county, and the international border with Canada. The command, control and coordination processes could best be described as ad hoc.

The decision to evacuate was made by the Riverview fire chief. There was a delay in the initial order to evacuate. At about 5:00 a.m., the Grosse Ile Police Department notified the Riverview fire chief that there were strong odors detected in Grosse Ile and the fire chief advised residents to shelter in place. However, at about 5:19 a.m., after re-evaluating the situation, he requested the evacuation of residents in parts of Riverview, Trenton, Grosse Ile, and Wyandotte. Approximately 6,000 people were evacuated from their homes, businesses, and the street fair.

Communications

There was no Emergency Operations Center (EOC); however, the county EOC was on standby. An incident command post (ICP) was established near the event, complete with tents set up by the ATOFINA personnel. Radio was the primary means of communication and, according to the Riverview fire marshal, the system worked flawlessly.

Notification and Warning

The public safety dispatcher notified the mayor and city manager via telephone. The city manager was then responsible for notification of other senior local officials. Emergency responders were notified through the 911 system, which was likely being used as a general alarm, since the first evidence of a fire was when the escaping gas ignited some 19 minutes later. There were no problems with notification of either local officials or responders.

Emergency response personnel mobilized and were onsite within 15 minutes of discovery of the incident, and the decision to evacuate was made approximately one hour after the start of the incident. The time to complete the evacuation was not known because multiple communities were involved. The public was notified by the police using a loudspeaker and going door-to-door to notify residents to evacuate. The evacuation was staged, beginning with a one-mile radius, and expanding as the fire chief received additional information from ATOFINA on the hazards.

There were no special problems with warning the public; however, approximately 10% of the public did not evacuate when requested. In addition, residents complained that the evacuation took too long. The Riverview fire marshal stated that it took time to get accurate information from the plant on the chemicals involved. The deaths and injuries due to this event resulted in some onsite confusion that delayed the flow of information.

Traffic Movement and Control

Evacuees were told what congregate care centers to go to and what routes to take. The routes were designated with police barricades. No special institutions were evacuated. Road conditions prior to the evacuation were clear and dry. The island of Grosse Ile has two bridges; however, only the southern bridge was open for access. This did not create any traffic problems, as there were only about 400 homes evacuated from the island. Reverse-laning was not used. No traffic accidents were reported during the evacuations. A 16 km (10 mi) stretch of the Detroit River was shut down because of the fumes.

Congregate Care Center

A congregate care center was set up at the Riverview City Hall and was managed by the city staff. Approximately 20% of evacuees stayed at the congregate care centers. The vast majority of evacuees stayed with friends and relatives. There were no shadow evacuations.

Law Enforcement

The area was secured by barricades set up by the local police. There were no reported instances of looting or vandalism or any other problems identified with law enforcement.

Re-Entry

Re-entry was authorized by the Riverview fire chief at approximately 3 p.m. The media were used to convey information to the public about when it was safe to return home. No special controls were in place during the re-entry process. The total evacuation time was approximately 10 hours. There is no report of costs being reimbursed to the public.

INVESTIGATOR COMMENTS

As a result of the accident, ATOFINA was required to provide financial support to the surrounding communities to improve the emergency response capabilities. Improvements in the capabilities and relevant lessons learned include:

1. The fire marshal stated that the evacuation went well with a few exceptions. First, there was a delay in obtaining accurate information on the chemicals involved because three ATOFINA employees had been killed. Second, approximately 10% of the public did not want to evacuate. Third, no large-scale exercises or drills had been conducted with surrounding communities prior to the event.

2. Riverview has since been funded to increase the local sirens from one to four. In addition, they have sent out mass mailings to the public with detailed instructions on what to do when the sirens go off.

3. Riverview has now implemented a "first call" automated telephone citizen notification system. However, experience in recent events has shown that residents hang up when the recording begins and do not listen to the full message.

4. Riverview has since been funded for a fully functional EOC, which is now in full operation.

CONTACT INFORMATION AND REFERENCES

Contacts

Riverview Fire Marshal
(734) 281-4264
(Personal Communication, July 2, 2003)

References

CNN (U.S.), "Chemical plant fire kills 3 in Michigan." 2001. <http://www.cnn.com/U.S.7/14/01> (June 2003).

Potts, L. "Two Dead, One Missing in Chemical Fire Downriver." *Associated Press*. July 14, 2001.

National Transportation Safety Board (U.S.) (NTSB). HZM-02-01, "Hazardous Materials Release from Railroad Tank Car With Subsequent Fire at Riverview, Michigan." NTSB: Washington, D.C. July 2001.

SEMCOSH (Southeast Michigan Coalition on Occupational Safety and Health). "ATOFINA Chemical Explosion." <http://www.semcosh.org/atofina_explosion.htm> (June 2003).

Hurricane Andrew, Miami-Dade County, Florida, August 24, 1992, ID #80

Summary

Rank Value: 71
Number Evacuated: 650,000
Category: Natural Disaster
Specific Type: Hurricane
Community: Suburban

INTRODUCTION

Hurricane Andrew, which was initially classified as a Category 4 storm and later reclassified as a Category 5 storm in 2002, was the most destructive and most expensive natural disaster in U.S. history. It forced the evacuation of approximately 1.9 million people. One-third, or 650,000 of those evacuated were in Miami-Dade County, Florida, which is the focus of this case study. The hurricane hit south Florida on August 24, 1992, with violent winds that caused over $25 billion in property damages. In Miami-Dade County, Hurricane Andrew resulted in 15 deaths and left up to 250,000 people temporarily homeless. However, there were no deaths or serious injuries during the evacuation. The estimated total cost of evacuation-related expenses is between $5 and $8 million.

COMMUNITY CONTEXT

General
Miami-Dade County is in the southeastern portion of Florida. As of the 2000 census, the population was 2,253,362 people. The county has a total area of 6,297 km^2 (2,431 mi^2) and is a combination of urban, rural, and suburban areas. Approximately 650,000 people, or 30% of the population, were evacuated in August 1992 due to Hurricane Andrew. The evacuation covered approximately 2,600 km^2 (1,000 mi^2) in the southern portion of the county. Population density was relatively low at the time of the evacuation. Land use in the evacuated areas was primarily residential and agricultural. The community's main economic base is derived from multiple sources, including farming, tourism, manufacturing/industry, and commercial/retail. Tourism and colleges attract a large number of non-residents. Age was an important factor in the evacuation because the large population of elderly residents was less likely to heed the evacuation order.

The Turkey Point Nuclear Power Plant is located in Miami-Dade County near Homestead, approximately 40 to 48 km (25 to 30 mi) south of Miami. The Turkey Point Plant sustained a direct hit from Hurricane Andrew, causing extensive onsite and offsite damage. The nuclear reactors were shut down in anticipation of the hurricane, and 235 employees stayed at the plant and rode out the storm. The plant's exterior buildings suffered extensive damage, but the reactors survived unharmed. A 30-meter (100-foot) tall smokestack at the plant was lost during the storm.

History of Emergencies
The Miami-Dade area is more prone to both natural disasters, including hurricanes and tornadoes, and man-made hazards, including accidents at manufacturing plants, nuclear power plants, and railroads. The community had prior experience with hurricanes and had experienced evacuations in the previous 10 years, although not on the scale of this evacuation. Residents had prior experience with the alerting mechanism used in this evacuation [i.e., radio and television broadcasts, emergency broadcasting system (EBS)].

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Miami-Dade County had an emergency management plan, including an evacuation section, which was implemented during this emergency. The plan contains an annex for the Turkey Point Nuclear Power Plant, which contains an Evacuation Time Estimate (ETE) for the 16-km (10-mile) emergency planning zone (EPZ) of the plant. However, the broader plan, which covers all of Miami-Dade County, does not contain an ETE for the county.

Training
Training is provided to emergency response personnel and joint training is conducted between industry and government. The frequency of training has increased since Hurricane Andrew.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. However, it is unknown whether the emergency plan used in this evacuation was previously tested in a full-scale field exercise.

Community Awareness
Community awareness of local hazards and of evacuation procedures is approximately average. However, community awareness about the hazard that caused this evacuation (i.e., hurricanes) is very high. In addition, community awareness about the alerting methods used in this evacuation was high.

THREAT CONDITIONS

The threat condition that led to this evacuation was Hurricane Andrew, a Category 4 storm with winds of 235 km per hour (145 miles per hour) as it approached south Florida. The National Oceanic and Atmospheric Administration (NOAA) reclassified Andrew as a Category 5 storm in

2002. Andrew was (and as of this writing still is) the third strongest hurricane on record to hit the U.S. It was the most destructive and most expensive natural disaster in U.S. history.

Conditions during the evacuation, prior to Andrew's landfall, were clear and calm and road conditions were good. The evacuation took place during the day and there were no unusual circumstances during the evacuation. However, there are some conflicting reports regarding the evacuation. For example, emergency response personnel describe the evacuation as going rather smoothly while some reports, authored by citizen activist groups, claim that residents were caught horribly off-guard by Hurricane Andrew. These groups claim that some local residents did not receive ample warning to evacuate, and their deaths were directly attributed to that lack of ample warning.

CONSEQUENCES

Hurricane Andrew was the most destructive and most expensive natural disaster in U.S. history, forcing the evacuation of 650,000 people in Miami-Dade County, Florida on and before August 24, 1992. There were 15 deaths and hundreds of injuries due to the hurricane but no deaths or significant injuries due to the evacuation. Hurricane Andrew struck southern Miami-Dade County especially hard with violent winds that destroyed homes, buildings, and power lines. Florida Power and Light reported losing 1,900 transmission towers, 8.5 million feet of distribution lines, 18,700 utility poles, and 16,800 switches. Up to 1.4 million customers lost power in Florida alone. The Turkey Point Nuclear Power Plant near Homestead also sustained extensive onsite and offsite damage. The estimated total cost of evacuation-related expenses and property damages incurred by the public was between $5 to $8 million.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was moderate since there was some lack of coordination between federal agencies in the aftermath of Hurricane Andrew. The Department of Defense, Federal Emergency Management Agency and National Guard participated in the evacuation process. Political boundaries were crossed since Broward County was also evacuated. Command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made jointly by the Miami-Dade County manager and the emergency operations manager. There were no major problems with the decision-making process.

Communications

An EOC and an ICP were both used in this emergency. Communication between field emergency responders and the EOC was via radio and telephone. Radio transmission was limited but was still the primary means of communication. There were problems associated with communications because most radio towers were down, but telephone communications were still working.

Notification and Warning
Senior local officials and emergency responders were well aware of the incident because of the extensive radio and television coverage, and there were no problems with notification. Evacuation of the county took approximately 12 hours to complete. The public was notified through radio and television broadcasts and by the EBS. The evacuation was ordered all at once. There were no special problems regarding warning and subsequent citizen action, although some citizen activist groups claim that residents did not receive ample warning to evacuate and were caught in the storm and died as a result.

Traffic Movement and Control
Evacuees were told which congregate care centers were open when they were ordered to evacuate but were not told to use specific routes. Most of the congregate care centers in the southern portion of Miami-Dade County had to be shut down because they were in the evacuation zone. The closest congregate care centers were in the northern part of the county. Five out of 30 area hospitals were evacuated. Road conditions were clear and dry during the evacuation; however, construction work on some of the major roads slowed evacuation traffic. In the future, all highway construction will cease, and roadways will operate at maximum capacity. Reverse-laning was not used. There were no reported traffic accidents during the evacuation. Some people spontaneously evacuated prior to being told to do so and others refused to evacuate.

Congregate Care Centers
Congregate care centers managed by the American Red Cross were used. Schools were primarily used as congregate care centers and approximately 20% of evacuees registered at the congregate care centers. There were shadow evacuations; however, this did not impact either traffic movement or congregate care center capacity.

Law Enforcement
Police and National Guardsmen secured the evacuated area; however, there were some instances of looting and vandalism. There were no other problems with law enforcement.

Re-Entry
Re-entry was authorized by the mayor and the county commissioner. Re-entry was a controlled phased process (some areas were re-opened before others). Because this was a declared evacuation, some evacuees were reimbursed for evacuation-related expenses by their insurance company. In addition, grant money was provided to cover damage to houses, vehicles, etc. Trailers were set up for people in public housing, and some people lived in recreational vehicles in the driveways of their destroyed homes. Problems during re-entry included lack of water and power. There was severe damage to many homes and tents and churches were used to temporarily house people.

INVESTIGATOR COMMENTS

What factors made the evacuation work well?

The public's awareness and knowledge of hurricanes, especially once Hurricane Andrew was upgraded to a Category 4 storm, certainly contributed to the effectiveness of the evacuation.

What factors contributed to the evacuation's faults or problems?

Problems during the evacuation included:

- Evacuation zones were too broad;
- Traffic pattern predictions and clearance times were "vague and undefined;"
- The media tended to dramatize and exaggerate the situation, leading to public panic and shadow evacuations.

CONTACT INFORMATION AND REFERENCES

Contacts

Miami-Dade Emergency Management Coordinator
Florida International University Professor
National Oceanic and Atmospheric Administration (NOAA) (305) 229-4404

References

Akers, R. L., R. Dunham, and L. Lanza-Kaduce. "Policing the Wake of Hurricane Andrew: Comparing Citizens' and Police Priorities." *Disaster Prevention and Management.* Volume 7. Number 5. 1998: 413-419.

Issue 178: "Effect of Hurricane Andrew on Turkey Point" (Rev. 2).
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0933/sec3/178r2.html>

Lepore, Frank. "After 10 Years, Hurricane Andrew Gains Strength." Online posting. 21 Aug. 2002. United States Department of Commerce News. Jan. 29, 2003.
<http://www.nhc.noaa.gov/NOAA_pr_8-21-02.html>

Nuclear Power Plants Stand in Floyd's Path, September 14, 1999, CNN.
<http://www.cnn.com/WEATHER/9909/14/hurricane.utilities/>

Hurricane Floyd, Central Florida, September 13, 1999, ID #88C

Summary

Rank Value: 67
Number Evacuated: 665,969
Category: Natural Disaster
Specific Type: Hurricane
Community: Suburban

INTRODUCTION

On September 13, 1999, Hurricane Floyd caused the largest peacetime evacuation in U.S. history. Four states had evacuations in response to Hurricane Floyd (Florida, Georgia, North Carolina, and South Carolina). Although estimates vary, it was widely reported that two million people were evacuated in the state of Florida alone. The following case study examines the evacuation in central Florida where 665,969 people were evacuated. No deaths or injuries occurred during the evacuation. However, many people experienced near gridlock on the major evacuation routes. Others expressed frustration over the lack of communication and poor dissemination of emergency information by officials.

COMMUNITY CONTEXT

General
Central Florida is a suburban community with a total population of 2,466,553 people. Approximately 665,969 residents (27% of the population) were evacuated. The area consists of residential, commercial, industrial, and agricultural land. The total area of central Florida is 16,735 km^2 (6,461mi^2) and the evacuated area was 1,673 km^2 (646 mi^2). The population density in the area during the evacuation was high in certain areas and low in others. Age was an important factor in this evacuation.

Central Florida has a commission and board form of government, and its economic base is farming, tourism, manufacturing, and commercial. Tourism attracts a large number of non-residents to the area. This evacuation was not located in an EPZ of a commercial nuclear power plant. However, the St. Lucie Nuclear Power Plant is located less than fifty miles away. Florida has several commercial nuclear power plants.

History of Emergencies
Central Florida is more prone than average to both natural and technological hazards. It is located in a hurricane-prone region, and it has a high volume of interstate and railroad traffic, making it more prone to technological hazards as well. The Kennedy Space Center is also located in this region. The community has had previous experience with the hazard that led to

this evacuation and has experienced evacuations in the previous 10 years. The community also had previous experience with the alerting methods used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan that contained an evacuation section, and the plan was used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and did not contain an ETE.

Training
Training is provided to emergency response personnel and joint training between industry and government is regularly conducted.

Drills and Exercises
Central Florida's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in a full-scale field exercise. The exercise performed immediately before evacuation was a full-scale field exercise and a tabletop exercise.

Community Awareness
The level of community awareness about local hazards and about evacuation procedures was medium, but the level of community awareness regarding the hazard that caused this evacuation and the methods used to alert the community was high.

THREAT CONDITIONS

On September 13, 1999, Hurricane Floyd threatened Florida as a massive Category 4 storm, equal in power to Hurricane Andrew (1992), but four times larger. The area of hurricane-force winds extended well over 150 miles from the eye of the storm, requiring hurricane warnings from south Florida to Massachusetts. Weather conditions during the evacuation were clear, and road conditions were dry. However, there were numerous traffic-related problems during the evacuation.

CONSEQUENCES

More than two million people in Florida evacuated in response to Hurricane Floyd. Approximately 665,969 residents were evacuated from their homes and businesses in central Florida. There were no injuries or deaths associated with the evacuation or the hurricane in Florida. However, there were 56 deaths in other states, mostly caused by drowning from freshwater floods. Hurricane Floyd caused only minor property damage as it skirted the state of Florida. The estimated total cost of evacuation related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high and political boundaries were crossed. The command, control, and coordination process could best be described as pre-planned. The decision to evacuate was made by the County Board of Commissioners, and there were no problems with the decision-making process.

Communications
An EOC was used but there was no ICP. Communication between field emergency responders and the EOC was by radio, and there were no problems with communications.

Notification and Warning
Senior local officials were notified by telephone. The time that elapsed between the discovery of the incident and the mobilization of response personnel was approximately six days. The time that elapsed between the start of the hazard and the decision to evacuate was 132 hours. It took approximately 22 hours to complete the evacuation. There were no problems with notification of emergency personnel or senior local officials. Radio and television broadcasts, police and fire department PA systems, and a reverse-911 telephone service notified the public. The evacuation took place all at once, and there were no problems regarding warning and subsequent citizen action.

Traffic Movement and Control
Evacuees were not given specific instructions about where to go when they evacuated. Many hospitals and assisted living facilities were evacuated. Road conditions before the evacuation were dry, and all major roadways were available to evacuees. Some people spontaneously evacuated and some people refused to evacuate. Major traffic problems were encountered but there were no traffic accidents. Reverse-laning was not used.

Congregate Care Centers
The Red Cross, Salvation Army, and local agencies set up congregate care centers at schools and churches. About four to nine percent of the evacuees used the congregate care centers. There were shadow evacuations, which did have an impact on traffic, but did not impact congregate care center capacity.

Law Enforcement
Local police secured the area following the evacuation. There were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry
The county commissioner for local law enforcement authorized re-entry. There were no special controls during the re-entry process. Insurance companies compensated evacuees for their expenses. There were no major problems during re-entry.

INVESTIGATOR COMMENTS

County and state coordination and the public's prior knowledge of the hazard and evacuations are factors that made the evacuation work well. Some lessons learned form the evacuation were:

- People need to be better informed about who does not need to evacuate.
- Congregate Care Centers need to be visible and made more public.
- A better system needs to be developed to communicate with people on the road.

Some solutions that Florida has developed to address these problems are:

- The community now has a system that counts and monitors the amount of traffic across the state.
- Florida's public radio can now broadcast evacuation updates.
- The community now has a plan that can implement reverse-laning.
- The community now has an evacuation liaison team.
- Transportation models were developed to show evacuation transportation information systems, and their impact on surrounding states and regions.
- The federal highway is now included in Florida's evacuations.
- The community now has a state web site.

CONTACT INFORMATION AND REFERENCES

Contacts

State of Florida, All Hazards Planning Manager, Division of Emergency Management, (Meeting, August 26, 2003)

References

Dumont, Robert. "The Legacy of Hurricane Floyd-Inland Flooding and a Massive Evacuation." <http://www.ofcm.gov/fp-fy01/pdf/sec1.pdf>

Federal Highway Administration (U.S.). "Evacuation Traffic Information System, Southeast Hurricane Evacuation Study." 2003.
<http://www.fhwaetis.com/etis/Report_Links/floyd_rpt.htm> (April 2003).

Florida Department of Transportation. "Governor's Hurricane Evacuation Task Force Report." <http://www11.myflorida.com/publicinformationoffice/EvacuationStudy/HurricaneTaskForceReport.doc> (June 2003).

North Carolina Shore and Beach (U.S.). "Beach Nourishment for Hurricane Protection: North Carolina Project Performance In Hurricanes Dennis and Floyd." 2000. <http://www.ncshoreandbeach.org/Dennis-Floyd-Study.htm> (April 2003).

Hosock, H. "Safe But Annoyed: The Hurricane Floyd Evacuation in Florida." Case 1652. Kennedy School of Government Case Programs, Harvard University, Boston, Massachusetts.

The Disaster Center. "Hurricane Floyd Reports." <http://www.disastercenter.com/hurricf9.htm> (June 2003).

Mims Fire, Mims, Florida, July 1998, ID #146

Summary

Rank Value: 67
Number Evacuated: 16,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Suburban

INTRODUCTION

In July 1998 a wildfire spread throughout Florida, damaging homes and causing numerous evacuations. Fires burned near the city of Mims in Brevard County, and in Volusia and Flagler counties to the north. Approximately 16,000 people were evacuated from Mims and Brevard County, some on more than one occasion.

COMMUNITY CONTEXT

General
Mims, Florida, is a suburban community with a population of approximately 9,147 people and covers an area of 66.6 km^2 (25.7 mi^2). Approximately 16,000 people were evacuated from Mims and Brevard County. Ethnicity, nationality, and age were not important factors in the evacuation.

The town of Mims is unincorporated. The main economic base is industry from the nearby Kennedy Space Center. Tourism to the Kennedy Space Center attracts large numbers of non-residents to the area. The nearest nuclear power plant is located more than 80 km (50 mi) away.

History of Emergencies
The community is more prone to natural hazards than the average town and has had experience with wildfires and hurricanes in the past. The community has experienced large-scale evacuations in the last 10 years, although they were smaller than the evacuations during this event. The community had not had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan that was used in this emergency and the plan included an evacuation section. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan. The plan did comply with state requirements.

Training
The community provides training to emergency response personnel regularly. Joint training between industry and government is regularly conducted; however, this is limited to high-hazard targets.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation had not been previously tested in full-scale exercises.

Community Awareness
The community had a low level of awareness about the local hazards and about evacuation procedures. It has a low level of awareness about wildfires. The community also had a low level of awareness about the alerting methods used in this evacuation.

THREAT CONDITIONS

In July 1998, a wildfire in Brevard County near the town of Mims spread rapidly through the area. There were three or four fires ongoing and then a big blowup when the fires converged. Most of the evacuations occurred over a four-day period. Officials initially issued a mandatory evacuation order in Mims for about 2,000 homes. The evacuation order was lifted as sea breezes steered the fire away, but winds switched again at nightfall, sending the fire back toward the neighborhoods. About 250 homes were evacuated for a second time. In Brevard County, more than 4,000 people were evacuated, some for the third time. Approximately 16,000 people were ultimately evacuated from the area. Weather conditions were breezy with sea breezes shifting direction. The area was very rural and very wooded, causing a difficult time for firefighters.

The roads were dry and clear except for the smoky haze that covered much of the area. There were no unusual circumstances that occurred other than the wildfires.

CONSEQUENCES

In July 1998, wildfires had scorched large areas in Brevard County around Mims during a severe drought. A number of cars and barns were destroyed, and there were reports of at least four houses burned.

Flames injured at least five firefighters in Brevard County, three with second-degree burns. Another 12 firefighters were injured using tools for fighting the fires. Numerous firefighters were treated for heat exhaustion. One police officer was injured during the evacuation when a man used his vehicle to run over the officer, who was trying to dissuade people from going back to their homes.

There were no fatalities from the wildfires or the evacuations. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local, state, and federal agencies was moderate, and political boundaries were crossed during this event. Response from Patrick Air Force Base and Kennedy Space Center was good; however, other federal agencies were late to the scene. The command, control, and coordination processes could best be described as pre-planned; however, the plan was changed or altered each day. The decision to evacuate was made by the fire chief. There were problems with the decision-making process. Many teams were exhausted, and there was a shortage of personnel to support the evacuations.

Communications
An EOC and an ICP were used in this emergency. Communication between field emergency responders and the ICP was primarily by cell phone. There were problems with communications. The radios failed very early when a microwave tower was lost due to the amount of smoke in the area. There were also too many frequencies in use by the various agencies when the radios did work.

Notification and Warning
Senior local officials were notified of the event by telephone. Emergency responders were notified of the fire by a passing airplane about four days before it endangered residents. There were no problems with notification of emergency personnel or senior local officials. The time between discovery of the incident and mobilization of response personnel was planned around the movement of the fire. The time elapsed between the start of the hazard and the decision to evacuate was four days. Initial evacuations were completed within approximately six hours. Subsequent evacuations varied depending on the size of the area.

The initial evacuation did occur all at once and was expanded as the fire spread. The public was notified by radio and television broadcasts, police going door-to-door, and police and firefighters using PA systems. Although there were no problems with warning the public, some citizens tried to stay and fight the fires. They were unable to do so when the fire burned down power poles, cutting power to the wells and to the water systems.

Traffic Movement and Control
Evacuees were initially just told to get out. However, there were very limited choices in direction. No special institutions were evacuated. Road conditions during the evacuation were dry and visibility was limited by the smoke. Interstate 95 was shut down between Mims and New Smyrna Beach and a 25.6 km (16 mi) stretch of U.S. 1 along the coast was also closed. The closure of these roads created additional traffic problems in the area. Reverse laning was not used. Some minor accidents occurred during the evacuation. Some people did evacuate before being told to do so, and others refused to evacuate.

Congregate Care Centers
The Red Cross established congregate care centers in schools. It is unknown how many evacuees reported to the congregate care centers; however, only six people showed up at the Mims Elementary School. There were shadow evacuations, which had a minor impact on traffic. Shadow evacuations did not impact the congregate care center capacities.

Law Enforcement
The police and Florida Highway Patrol secured the evacuation area, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
The chairman of the county commission authorized re-entry, and no special controls were used during re-entry. Evacuees were not compensated for their expenses. There were some major problems with re-entry when evacuees returned to the area to find no utilities or water. Additionally, many evacuees went sightseeing and got into dangerous areas.

INVESTIGATOR COMMENTS

The evacuation worked well because the size of the fire was manageable. Evacuation problems could have been reduced with preplanning for the residents on traffic flow and direction. Lessons learned included the fact that the evacuation had not been considered until after the fires were in the vicinity of residences and this could have been discussed and planned earlier. Additionally, there could have been better cooperation among the emergency vehicles from the various agencies.

CONTACT INFORMATION AND REFERENCES

Contacts

Brevard County Assistant Fire Chief
(321) 633-2056
(Personal Communication, 7/30/03)

Brevard County Fire Department
(321) 633-2056
(Personal Communication, 7/30/03)

<u>References</u>

"Homes spared, evacuation order lifted, but battle against fire not over." *Associated Press*. July 1998.

"Wildfire burns homes; evacuations again ordered in Florida." *Associated Press*. July 1998.

American Storage and Warehouse Company, Charlotte, North Carolina, September 2002, ID #74

Summary

Rank Value: 64
Number Evacuated: 1,000
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Urban
Comments: In an EPZ

INTRODUCTION

A chemical that produces noxious fumes spilled from storage drums at the American Storage and Warehouse Company in west Charlotte, North Carolina, on the evening of September 17, 2002. Approximately 1,000 residents were forced to evacuate their homes and businesses for more than four hours. Approximately twenty drums of thiourea dioxide, a stripping agent used in textile dyeing, had reacted and released dangerous vapors into the air. There were no deaths, but twelve people were treated at the hospital for breathing problems.

COMMUNITY CONTEXT

General
Charlotte is a major city in North Carolina near the border with South Carolina. It has a total population of 540,828 people. Approximately 1,000 residents (<1% of the population) were evacuated within a 2.6 km (1 mi) radius of the storage facility in west Charlotte. Land use in the area is primarily residential and industrial. The total area of Charlotte is 629 km^2 (243 mi^2) and the evacuated area was 8.13 km^2 (3.14 mi^2). The population density of the area during the evacuation was medium. Ethnicity, nationality, and age were not important factors in the evacuation.

Charlotte has a mayoral form of government and its main economic base is financial services. Business attracts a large number of non-residents. The evacuated area was located within the Emergency Planning Zone (EPZ) of the McGuire Nuclear Power Plant in North Carolina and the Catawba Nuclear Power Plant in South Carolina. North Carolina has three commercial nuclear power plants.

History of Emergencies
Charlotte is no more prone to hazards than the average U.S. city. The community had very little experience with the hazard that led to this evacuation, only a chemical fire in 1981. However, the community had experienced hurricane-related evacuations in the previous ten years. The community did not have previous experience with the alerting mechanism used in this

evacuation because the reverse-911 automated phone notification system is not used during hurricane evacuations.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. The plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1. However, it did not contain an ETE.

Training
Training is provided to emergency response personnel and joint training between industry and government is regularly conducted.

Drills and Exercises
Charlotte's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in a full-scale field exercise. The exercise performed immediately before this evacuation was a tabletop exercise.

Community Awareness
The level of community awareness of local hazards and of evacuation procedures was high, but the community's awareness about the hazard that caused this evacuation was low, and familiarity with the alerting methods used was average.

THREAT CONDITIONS

The threat condition leading to this evacuation was a chemical spill at the American Storage and Warehouse Company in west Charlotte on September 17, 2002. The incident was reported at 6:30 p.m. by people who saw smoke coming from the building and called 911. About twenty drums of thiourea dioxide, a stripping agent used in textile dyeing, had reacted and released dangerous vapors into the air but did not cause a fire. Weather conditions were cool, fair, and dry, and the roads were dry. No unusual circumstances occurred during this incident.

CONSEQUENCES

One thousand residents were evacuated from their homes and businesses. No deaths were associated with the incident but twelve people, including five firefighters, five police officers, one TV news cameraman, and one resident, were treated at the hospital for breathing problems. The estimated total cost of evacuation-related expenses is negligible.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. Political boundaries were not crossed. The command, control and coordination processes could best be described as pre-planned. The Charlotte police chief made the decision to evacuate and there were no problems with decision-making process.

Communications

An EOC was not used but there was an ICP. Communication among field emergency responders and the ICP was by radio. There were no problems with communication.

Notification and Warning

Senior local officials were notified of the incident through the Emergency Management's telephone calling tree and emergency responders were notified through the 911 phone system. There were no problems with notification of emergency personnel or senior local officials. The time that elapsed between discovery of the incident and mobilization of response personnel was less than fifteen minutes and the decision to evacuate was made in ten minutes. It took approximately twenty minutes to complete the evacuation. The public was notified through several means, including a police/fire PA system, a reverse-911 automated phone system, and emergency personnel going door to door. The evacuation took place all at once and there were no problems regarding warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were given instructions about where to go to seek a congregate care center but were not told to use specific routes. No special institutions were evacuated. Road conditions before the evacuation were dry and there were no traffic accidents or traffic problems, and all major roadways were available to evacuees. Reverse-laning was not used. Some people evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers

The American Red Cross set up a congregate care center at Harding University High School and about a dozen people showed up, or approximately 1.5% of evacuees. There were shadow evacuations but this did not impact traffic or congregate care center capacity.

Law Enforcement

Police secured the area following the evacuation and no instances of looting or vandalism or any problems with law enforcement occurred.

Re-Entry

At 10:45 p.m. on September 17, more than four hours since the start of the emergency, responders allowed evacuees to return to their homes. There were no special controls during the re-entry process. Evacuees were not compensated for their expenses. No major problems during re-entry occurred.

INVESTIGATOR COMMENTS

According to the Charlotte Hazmat Captain, the reverse-911 automated phone notification system contributed to the success of the evacuation. However, the evacuation was difficult because the evacuation area was so large.

CONTACT INFORMATION AND REFERENCES

Contacts

Charlotte Hazmat Captain
(704) 336-2461
(Personal Communication, 7/8/03)

References

Church World Service Emergency Response Program. "Toxic Spills \'Scary\'." September 18, 2002. <http://www.cwserp.org/technological disasters/nes.php?newsId=12> (April 9, 2003).

CSX Train Derailment and Fire, Baltimore, Maryland, July 18, 2001, ID #96

Summary

Rank Value: 64
Number Evacuated: 10,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Urban

INTRODUCTION

At 3:07 p.m. on Wednesday, July 18, 2001, a CSX Transportation train traveling from Hamlet, North Carolina, to Oak Island, New Jersey, derailed in the Howard Street Tunnel under the streets of Baltimore, Maryland. The train was carrying a variety of freight and hazardous materials with three locomotives and sixty cars. The 2.4 km (1.5 mi) long train derailed approximately in the middle of the 4.8 km (3 mi) long Howard Street Tunnel. Complicating the scenario was the subsequent rupture in a 100 cm (40 in) water main that ran directly above the tunnel. The flooding hampered extinguishing efforts, collapsed several city streets, knocked out electricity to about 1,200 Baltimore customers, and flooded nearby buildings. The crash also interrupted a major line associated with the internet and an MCI WorldCom fiber optic telephone line.

After the derailment, city officials closed down entrances to the city from all major highways. The baseball game between the Baltimore Orioles and the Texas Rangers at nearby Camden Yards was postponed and the stadium was evacuated. In addition, pedestrians were evacuated from the area and local residents were requested to shelter in place. It is estimated that as many as 10,000 people were evacuated from the area with no reports of injuries resulting from the evacuation. It took almost an hour for the Baltimore Fire Department to be notified of the event, which has been an issue and likely contributed to the difficulty of extinguishing the fire and controlling the situation.

COMMUNITY CONTEXT

General
Baltimore, Maryland is an urban community with a population of approximately 650,000 people. The city covers an area of 238.5 km^2 (92.1 mi^2). It has a very diverse economic base including industry, government, commercial, retail, and all forms of business services. On July 18, 2001, as many as 10,000 people were evacuated from the downtown area in the vicinity of the Howard Street Tunnel. The area was moderately congested at the time of the incident because baseball games were scheduled at Camden Yards. There was a day/night double header in which two games are played on the same day, but not back to back. The early game had been completed and most fans had left the area. The players, concessionaires, and stadium workers were

evacuated. Between 2,500 and 5,000 fans remained when police officials evacuated the facility. The remaining community area was not evacuated, but sheltered in place. Thus, the actual percentage of the community that was evacuated is small since many of the evacuees were not residents of the area.

The evacuation area was primarily associated with the stadium and pedestrians in the vicinity totaling about five square blocks. Ethnicity, nationality, and age were not important factors in the evacuation. The city is located approximately 121 km (75 mi) from a commercial nuclear power plant, the Calvert Cliffs Reactors 1 and 2, which are approximately 65 km (40 mi) south of Annapolis, Maryland.

History of Emergencies

The area is no more prone to hazards than average for a city of this size. However, as a large city, evacuations do occur, including those from floods, fires, bomb threats, and chemical releases. The community did not have any prior experience with the combined fire and hazardous materials inside a train tunnel.

The community had experienced minor evacuations in the previous ten years and had experience with the alerting mechanism used in this evacuation, police notifying people in the area to evacuate. However, the majority of the evacuation was from the stadium, which does not adequately represent members of the community, as these were players, fans, and workers in the area.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness, as described below.

Planning

Baltimore did have an emergency plan that was used in the incident. The plan contained three pages on evacuations, but not enough detail to provide a working blueprint for evacuations. The fire marshal who heads the mostly volunteer committee that produced the plan, said the committee had been unable to fill several gaps in the plan because of lack of budget. According to the plan, this was a Level III event requiring public notification to evacuate or shelter in place. The stadium and pedestrians in the area were evacuated while the residents of the area were requested to shelter in place.

The plans probably did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and it is unknown if they contained evacuation time estimates. There have been many complaints about the adequacy of the plan with regard to the evacuation process.

Training

Training is provided to emergency response personnel and includes joint training with the railroad industry.

Drills and Exercises
Approximately six weeks before the incident, a full-scale drill was conducted with Baltimore emergency response teams using a MARC train in an Amtrak Tunnel. The Baltimore emergency response personnel also conducted drills in a Metro tunnel. These were passenger train drills, not hazmat train incident drills, but did acquaint personnel with tunnel environments. Approximately three years earlier, training was conducted on a train and truck hazardous materials collision.

Community Awareness
The community's level of awareness regarding local hazards and evacuation procedures was likely low. The community's level of awareness about the hazard that caused the evacuation and about the alerting methods used was also low.

THREAT CONDITIONS

At 3:07 p.m. on July 18, 2001, a CSX freight train derailed in the Howard Street Tunnel and caught fire. The 2.4 km (1.5 mi) long train was carrying a variety of freight and hazardous materials and derailed approximately in the middle of the 4.8 km (3 mi) long Howard Street Tunnel. Complicating the situation was the break of a 100 cm (40 in) water line that flooded the area and hampered fire fighting. For the first time since installing them in 1952, the city activated its civil defense sirens at 5:45 p.m. to warn citizens of the impending danger from the derailment and fires. The incident occurred on a warm dry day in between games of a Baltimore Orioles day/night double header at rush hour in downtown Baltimore.

CONSEQUENCES

The fire and flood that followed caused the evacuation of Camden Yards and the B&O Warehouse area. Up to 5,000 fans filled the stadium along with approximately 2,000 employees, including players and additional pedestrians in the area. The evacuation downtown at rush hour was a complete traffic disaster. Block after block of commuters sat in bumper-to-bumper traffic keeping abreast of the situation through cellular phones or the radio.

According to the City of Baltimore Emergency Management Plan, a public information announcement must be made to the public during a Level III emergency. In the early stages of the incident, the incident was determined to be a Level III emergency and the Emergency Management Director urged that a public announcement be made over radio and television to alert citizens and to initiate a shelter in place advisory. In the general area surrounding Mount Royal Station, citizens were offered the choice to leave or shelter in place. Since there was some concern over the residual effects of smoke to persons around the tunnel portals, an evacuation order to pedestrians was broadcast.

The city of Baltimore issued a liberal leave policy for employees, as did the state of Maryland at State Center. As utility workers, police, and firefighters labored on Howard Street, two large office buildings and several other businesses along the road were shut down. The downtown business district and Howard Street especially, took a huge economic hit from the train fire. In total, more than 10,000 people may have been evacuated in the event. At least twenty-two people, including two firefighters with chest pains, were treated at area hospitals, most for respiratory or eye irritation. None of these injuries were attributed directly to the evacuation. The estimated total cost of the actual evacuation was not determined.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. Only a few political boundaries were crossed, including city/county involvement with runoff entering the harbor. Baltimore has a Local Emergency Planning Committee (LEPC) that includes the BFD to provide community awareness and interagency cooperation. The success of this incident has been directly related to the interagency cooperation and coordination of agencies and resources. A few of the agencies involved included the Baltimore Fire, Police, and Emergency Management Departments, Maryland Department of Environment, CSX Transportation, Baltimore County Fire Department, and the U.S. Coast Guard.

The command, control and coordination processes could best be described as preplanned. The BFD made the decision to evacuate and there were no problems with the decision-making process.

Communications

The city of Baltimore has a consolidated Communications Center with an 800 MHz fire, police, and public services frequency system. This system provided outstanding performance to the fire service during the Howard Street Tunnel incident. The incident commander believed that communications and radio capabilites of the Baltimore Fire Department were the most important features of the incident's success.

Notification and Warning

There were problems with notification of the event reaching the fire department, as it took almost an hour for the fire department to be notified. However, once they were notified and responded, the emergency management plan was activated and communication proceeded smoothly. The mayor was called as he was attending another event and ordered the roads closed.

Emergency response personnel mobilized immediately. The decision to evacuate was made after the fire department reached the scene more than an hour after the fire started. It is difficult to estimate the time to complete the evacuation as many of the people were stuck in traffic for hours. Police notified the public to evacuate by informing stadium management, and the police/fire PA system was used to notify pedestrians in the area. Police and firefighters going door-to-door notified some residents to shelter in place. The evacuation took place all at once and there were no special problems regarding warning; however, there were significant traffic problems.

Traffic Movement and Control

State highway officials closed all major roadways into the city in the hours following the accident at the request of fire and police. Approximately 200 highway workers were stationed at the city line to turn back motorists, and roadblocks were set up. All traffic coming from the downtown area was rerouted away from potentially dangerous areas. The changes in traffic routes cause rush hour gridlocks and even affected the light rail transportation in the city. By 11:30 p.m. all major roads had been reopened.

Evacuees were given specific instructions about where to go when they evacuated and were told to use specific routes that were designated by police barricades and policemen directing traffic. Road conditions were dry and there were no reports of anyone refusing to evacuate.

Congregate Care Centers

Congregate care centers were not available. Shadow evacuations likely occurred; however, this is difficult to estimate because most people in the area were provided the option to evacuate or shelter in place.

Law Enforcement

The area was secured by the police, and there were no instances of looting or vandalism. No problems with law enforcement were identified.

Re-Entry

The downtown streets were reopened by 11:30 p.m. with the exception of Howard Street. As this is a commercial area, re-entry was not a problem. Businesses in the area opened again the next day. However, businesses within a few blocks of the event were forced to stay closed because of the flooding and smoke, and games at Camden Yards were postponed for a few days.

INVESTIGATOR COMMENTS

The incident, including the evacuation, was considered a success because of the excellent performance of the city's communication system and the coordination and cooperation of authorities. The main problem with the evacuation was traffic control. Had the incident been reported immediately, evacuation would have occurred closer to 3:30 p.m., and much of rush hour may have been missed.

CONTACTS AND REFERENCES

Maryland Emergency Management Agency
State Emergency Operations Center

Toll Free 1-877-6362-872
<http://www.mema.state.md.us/main.html>

References

Baltimore County, Maryland Website. "Emergency Operations Plan." February, 2000. <http://resources.co.ba.md.us/Documents/Imported_Documents/e/eop.pdf> (June 2003).

BMD News. "Train fire, toxic cargo shut city." July 19, 2001. <http://www.geocities.com/CapeCanaveral/Hall/9861/BMDnews.htm> (June 2003).

CNN. "Baltimore Still Feels Train Fire's Effects." July 19, 2001. <www.cnn.com/2001/US/07/19/train.fire/> (April 28, 2003).

FEMA. "CSX Tunnel Fire." July 2001. <http://www.usfa.fema.gov/downloads/pdf/publications/tr-140.pdf> (June 2003).

SunSpot.net. "Baseball fans and commuters held hostage by road closings." July 19, 2001. <http://www.baltimoresun.com/technology/balte.md.scene19jul19,0,4361107.story?coll=bal-technology-headlines> (June 2003).

SunSpot.net. "Chronology: With a rumble, chaos." July 21, 2001. <http://www.baltimoresun.com/technology/bal-te.md.accident21jul21,0,7229827.story?coll=bal-tehnology-headlines> (June 2003).

The Bull Sheet. "Howard Street Tunnel Fire." July 18, 2001. <http://www.bullsheet.com/news/tunnelfire.html> (June 2003).

The Daily Ardmoreite. "Freight Train Derails forcing postponement." July 19, 2001. <http://www.ardmoreite.com/stories/071901/spo_orioles.shtml> (June 2003).

The WBAL Channel.com. "Progress made in tunnel fire." July 19, 2001. <http://www.thewbalchannel.com/News/879713/detail.html> (June 2003).

The WBAL Channel.com. "Train derails; hazardous chemicals on board." July 19, 2001. <http://www.thewbalchannel.com/News/878827/detail.html> (June 2003).

US Fire Administration. "CSX Tunnel Fire." <http://www.usfa.fema.gov/applications/publications/tr140.cfm> (June 2003).

USA Today Sports. "Rangers vs. Orioles." July 19, 2001. <http://www.usatoday.com/sports/scores101/101200/101200303.htm> (June 2003).

Waltham Local Emergency Planning Committee. "Officials to improve city emergency plan." July 27, 2001.
<http://www.walthamlepc.org/news/baltimore/Baltimore2.htm> (June 2003).

World Trade Center, Lower Manhattan, September 11, 2001, ID #126

Summary

Rank Value: 64
Number Evacuated: 300,000
Category: Malevolent Act
Specific Type: Malevolent Act
Community: Urban

INTRODUCTION

On September 11, 2001, 300,000 people were evacuated from lower Manhattan following an attack on the World Trade Center (WTC). The attack involved the hijacking of two fully fueled passenger jets, which were used as flying bombs, crashing into each of the twin towers of the WTC and ultimately killing 2,823 people. In addition to the loss of life, the twin towers, along with several neighboring buildings, subsequently collapsed. The evacuation included more than 8,000 children in the vicinity of Ground Zero. Ferries and tugboats were used to evacuate people to Liberty State Park in New Jersey. Rescue and recovery took months, with the cleanup continuing through May 2002. The total cost of the evacuation was millions of dollars.

COMMUNITY CONTEXT

General
The WTC brought together businesses and government agencies involved in foreign trade. It was a complex of several buildings around a central plaza, near the foot of Manhattan in New York City. Each of the towers had 110 stories. About 50,000 people worked in the WTC, with offices of 430 businesses from twenty-six different countries. One of the world's largest gold depositories was stored underneath the WTC, and was owned by a group of commercial banks.

Manhattan is one of the five boroughs that form New York City. It consists mainly of a small island between the Hudson River to the west, the East River to the east, and the Harlem River to the northeast, connected by bridges and tunnels to New Jersey (west), the Bronx (northeast) and Brooklyn and Queens on Long Island (east and south). Manhattan is 21.5 km (13.4 mi) long and has an area of 59 km^2 (22.8 mi^2). Approximately 300,000 people (or 20% of the population of Manhattan) were ordered to evacuate after the adjacent WTC towers collapsed. Age was a factor in the evacuation, since more than 8,000 children were evacuated from all types of schools, ranging from day care to high schools and from fully mobile to multiply handicapped children.

The community's main economic base is business/financial, commercial/retail, and tourism, and the evacuated area was densely populated with business workers from surrounding areas.

The Indian Point Nuclear Power Plant is in Westchester County, New York, just 39 km (24 mi) north of the New York City boundary and 56 km (35 mi) north of mid-town Manhattan. The Indian Point Nuclear Power Plant has twenty million people living within an 80 km (50 mi) radius.

History of Emergencies
Lower Manhattan is no more prone to natural or technological hazards than the average U.S. city. However, a malevolent act on February 26, 1993, led to an evacuation; a bomb exploded in the underground garage of the WTC North Tower, opening a 30 m (98 ft) hole through four sublevels of concrete. Six people were killed and more than a thousand were injured. Primarily due to the 1993 incident, residents and workers in lower Manhattan had previous experience with the alerting mechanisms used in the 2001 evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The New York City Fire Department (FDNY) had a written emergency plan with an evacuation section, and it was used in this emergency. It is unknown whether the FDNY plan conformed to the requirements of NUREG-0654/FEMA-REP-1, Rev. 1. Individual businesses, including the WTC towers, also had their own evacuation plan; however, it is unknown whether these plans were used in this emergency.

Training
Training of emergency response personnel, including joint training between industry and government, is regularly conducted.

Drills and Exercises
Emergency drills and full-scale field exercises are regularly conducted, and the plan used in this emergency was previously tested in a full-scale exercise. However, the type of exercise conducted immediately prior to this evacuation is unknown. Evacuation drills have been regularly conducted at the WTC since the 1993 bombing incident.

Community Awareness
The community likely had an average awareness of local hazards and of the hazard (i.e., malevolent act) that led to this evacuation. Evacuation drills had become routine following the 1993 WTC bombing and therefore, the community probably had a high level of awareness about evacuation procedures and the alerting methods used in this evacuation.

THREAT CONDITIONS

The WTC attack was an act of malevolence. The weather was dry and clear that day. At 8:46 a.m. American Airlines Flight 11 (a fully fueled Boeing 767) crashed into the North Tower of the World Trade Center, between floors ninety-four and ninety-eight. At 9:02 a.m. United Airlines Flight 175 (another fully fueled Boeing 767) crashed into the south side of the South Tower, between floors seventy-eight and eighty-four. The South Tower began to collapse soon after it was hit, followed by the North Tower. Shortly after the jets hit, at least twenty people, primarily in the north tower, trapped by fire and smoke in the upper floors, jumped to their deaths. No form of airborne evacuation was attempted because the smoke was too dense for a successful landing on the roof of either tower. People immediately evacuated in whatever manner possible. At 10:13 a.m. thousands were evacuated from the United Nations complex in New York. At approximately 10:48 a.m., New York City Mayor Rudolph Giuliani officially ordered the evacuation of lower Manhattan.

CONSEQUENCES

Approximately 300,000 people were evacuated from lower Manhattan. A total of 2,823 people died and thousands more were injured. However, the deaths and injuries that occurred during the evacuation could be directly attributed to the attack and not to the evacuation itself. The total cost of the evacuation was millions of dollars.

EMERGENCY RESPONSE

Although the community was extremely well prepared for an emergency, it is difficult to prepare for an emergency of this magnitude. This could very well have been a once in a lifetime event. As such, there were several problems identified during the emergency response and the FDNY, the New York Police Department (NYPD), and other responders are working to rectify those problems.

Decision Making

The level of cooperation among local, state, and federal agencies was extremely high; however, it was not without problems. Throughout the response, the FDNY and the NYPD rarely coordinated command and control functions and rarely exchanged information related to command and control. Because of the magnitude of the incident, FDNY sought aid from Westchester and Nassau Counties. Command, control and coordination processes could best be described as pre-planned. The mayor of New York City ordered the evacuation of lower Manhattan, and there were no problems with the decision-making process.

Communications

An EOC and ICP were used during this emergency. Communication between field emergency responders and ICP was by radio. Cell phones and regular phone lines were all jammed and not useable. The FDNY's response to the attacks of September 11 began at 8:46 a.m. and by 8:50

a.m., an ICP was established in the lobby of WTC 1 (also called the South Tower). At approximately 9:00 a.m., the Incident Commander moved the ICP from the lobby of WTC 1 to the far side of West Street (an eight-lane highway) opposite WTC 1, because of the increasing risk from falling debris within and around the lobby and other safety concerns.

A number of communication difficulties hindered FDNY chief officers as they coordinated the response. The portable radios that were used by the FDNY on September 11 do not work reliably in high-rise buildings without having their signals amplified and rebroadcast by a repeater system. The World Trade Center had such a system, but chief officers deemed it inoperable early in the response after they tested it in the lobby of WTC 1.

Radio communications between chief officers in the lobby of WTC 1 and the units they sent into the building were sporadic. The chiefs were able to get through to some units sometimes, but not others. Some units acknowledged receiving radio communications some times, but not others. This left the chiefs not knowing whether their messages failed to get through, whether their units failed to acknowledge because they were busy with rescue operations, or whether the units did acknowledge, but the acknowledgement did not get through. Because information about civilians in distress continued to reach the operations post in the lobby, the chief officers decided to continue their attempts to evacuate and rescue civilians, despite the communications difficulties.

In attempts to improve their communications, chief officers tried to deploy the department's mobile repeater and give units "standpipe phones" that could be connected to boxes along the building's standpipe system. These were all ineffective.

The collapse of WTC 1 at 9:59 a.m. killed many civilians and first responders and destroyed the ICP on West Street and the Field Communications Unit. The collapse weakened the command and control structure as fire and EMS chiefs at the ICP, including the Incident Commander, sought shelter in nearby structures.

Notification and Warning

Emergency responders were notified of the incident through the 911 phone/dispatch system. There were no problems with notification of emergency personnel or senior local officials. The whole world knew about this event, which unfolded in the international media with live coverage. The time that elapsed between discovery of the incident and mobilization of response personnel was approximately two minutes. The mayor of New York City ordered the evacuation of lower Manhattan at 10:48 a.m., approximately two hours after the start of the incident.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated. Many people evacuated on foot and walked to ferries that transported them to Liberty State Park in New Jersey. Mariners began evacuation proceedings immediately following the attacks, moving unprecedented numbers of people to safety. One company, New York Waterway, carried more than 160,000 people, while Seastreak America set up a decontamination center at its terminal in addition to evacuating people off Manhattan.

For those who did evacuate via roadways, there were no adverse weather conditions to affect road conditions. However, there was traffic congestion and gridlock in the area. Reverse-laning was not used since it would hamper the incoming emergency vehicles. People in the immediate vicinity of the incident began evacuating immediately and no one refused to evacuate.

Numerous special facilities that handle children – from day care to high school seniors, from fully mobile to multiply handicapped – were safely evacuated from the vicinity of Ground Zero in lower Manhattan. More than 8,000 children were evacuated.

Congregate Care Centers

Congregate care centers were used and were managed by the American Red Cross. Public buildings were used as congregate care centers and many evacuated to Liberty State Park in New Jersey. Others left their workplaces in lower Manhattan and returned to their homes, which were outside of the evacuated area. It is unknown how many people went to the congregate care centers. There were no known shadow evacuations.

Law Enforcement

Police and national guardsmen secured the area following the evacuation. However, looting and vandalism did occur. In addition, some people took advantage of the incident and committed fraud.

Re-Entry

Re-entry was authorized by the mayor and was a controlled phased re-entry. Most people were allowed to return to their homes; however, some businesses remained closed for several weeks and some never reopened. There were no major problems during re-entry, although some businesses were completely destroyed in the tragedy. Several funds were set up to help the victims.

CONTACT INFORMATION AND REFERENCES

Contacts

District Office for New York City Fire Department
(718) 999-2457

References

CNN. "September 11: Chronology of terror." September 12, 2001. <www.cnn.com/2001/US/09/11/chronology.attack/> (June 2003).

Lehmuller, P. and A. Switzer. "September 11: An Elementary School at Ground Zero." PRINCIPAL Magazine, March 2002. <http://www.naesp.org/comm/p0302c.htm> (June 2003).

Wikipedia. "September 11, 2001, Terrorist Attack/Timeline September 11." <http://www.wikipedia.org/wiki/September_11,_2001_Terrorist_Attack/Timeline_September_11> (June 2003).

"FDNY Fire Operations Response on September 11," New York City Fire Department. <http://www.nyc.gov/html/fdny/pdf/mck_report/fire_operations_response.pdf>

"McKinsey Report - Increasing FDNY's Preparedness," New York City Fire Department. <http://home.nyc.gov/html/fdny/html/mck_report/toc.shtml>

Centennial Olympic Park, Atlanta, Georgia, July 27, 1996, ID #124

Summary

Rank Value: 64
Number Evacuated: ~60,000
Category: Malevolent Act
Specific Type: Malevolent Act
Community: Urban

INTRODUCTION

The Centennial Olympic Park bombing was a malevolent act that took place on July 27, 1996, in Atlanta, Georgia, during the 1996 Summer Olympics. An early morning blast forced the evacuation of approximately 60,000 people from the crowded park in downtown Atlanta. One woman was killed from bomb shrapnel that struck her in the head, and another person, a cameraman, died from a heart attack while running to cover the blast. The blast injured 111 others. However, there were no injuries or deaths associated with the evacuation and no unusual circumstances or special problems that occurred during the evacuation.

COMMUNITY CONTEXT

General
Atlanta, Georgia, is an urban city that was the host of the 1996 Summer Olympic Games. It has a total population of 416,474 residents and has a total area of 343 km^2 (132 mi^2). Approximately 60,000 (14% of the total population) were evacuated from a 1-mi^2 area. Population density during the evacuation was high and ethnicity, nationality, or age were not important factors.

Land use in the area is mainly commercial, and Atlanta has a mayoral form of government. The community's main economic base is tourism and it attracts a large number of non-residents to the area. Atlanta is more than fifty miles away from the nearest commercial nuclear power plant, which is in Georgia.

History of Emergencies
Atlanta is more prone to hazards that the average U.S. city because of its numerous railroads and major highways. It is also in a tornado-prone area. The community did not have experience with the hazard that led to this evacuation, although it did have experience with evacuations and with the alerting mechanisms used.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan that contained an evacuation section and was the plan used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if it contained an ETE.

Training
Training is provided to emergency response personnel and joint training between industry and government is regularly conducted.

Drills and Exercise
The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in a full-scale field exercise, and a full-scale field exercise and a tabletop exercise were performed immediately before this evacuation.

Community Awareness
The level of community awareness about local hazards and about the hazard that led to this evacuation was high. The level of community awareness about evacuation procedures and about the alerting methods used was medium.

THREAT CONDITIONS

The threat conditions leading to this evacuation consisted of a malevolent act that took place on July 27, 1996, in Atlanta, Georgia, during the 1996 Summer Olympics. An early-morning blast forced the evacuation of approximately 60,000 people from the crowded park in downtown Atlanta. According to CNN News, the attack happened as follows: At 12:58 a.m., a security guard found an unattended bag beneath a sound control tower and he alerted the bomb disposal team. Then at 1:07 a.m., a male called 911 warning that the bag would explode in thirty minutes. At 1:08 a.m., bomb experts identified wires and a pipe within the bag and began to evacuate park visitors. At 1:20 a.m., the bomb exploded. Downtown Atlanta was sealed off at 2 a.m.

A few hours after the bombing, Richard Jewell was named as the prime suspect, but it was later discovered that Eric Robert Rudolph was to blame. Weather conditions were warm and clear and road conditions were dry. There were no unusual circumstances or special problems that occurred during the evacuation.

CONSEQUENCES

On July 27, 1996, in Atlanta, Georgia, a bombing occurred in the crowded Centennial Olympic Park. One woman was killed from bomb shrapnel that struck her in the head and another person, a cameraman, died from a heart attack while running to cover the blast. The blast injured 111 others. However, no injuries or deaths associated with the evacuation occurred, and no unusual circumstances or special problems occurred during the evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation between local, state, and federal agencies was high and political boundaries were crossed. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by venue authorities and the state EOC. There were no problems with the decision-making process.

Communication

An EOC and an ICP were used in this emergency. Communication between field emergency responders and the EOC was by radio and cell phone, and there were no problems with communications.

Notification and Warning

Senior local officials were made aware of the incident by means of a notification tree, and local police and a 911 phone call notified emergency responders. The time that elapsed between the discovery of the incident and mobilization of response personnel was less than fifteen minutes. The time between the start of the hazard and the decision to evacuate was ten minutes. The evacuation happened all at once and took 55 minutes to complete. There was no problem with notification of emergency personnel or senior local officials. The public was notified by emergency personnel telling evacuees face to face. There were no special problems regarding warning or subsequent citizen action.

Traffic Movement and Control

Evacuees were not given specific instructions about where to go when they evacuated or specific routes to use. There were no special institutions evacuated. Road conditions before the evacuation were dry and no special traffic problems were encountered. Reverse-laning was not used and there were no traffic accidents during the evacuation. No one evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers

Congregate care centers were not used. There were shadow evacuations but they did not impact traffic.

Law Enforcement

Police secured the area following the evacuation to prevent looting and vandalism. There were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry

A joint decision of city, state, and Olympic committees authorized re-entry. There were no special controls during the re-entry process. Evacuees were not compensated for their expenses and no major problems occurred during re-entry.

INVESTIGATOR COMMENTS

The proximity of the blast and getting everyone to cooperate were factors that made the evacuation work well.

CONTACT INFORMATION AND REFERENCES

Contacts

Georgia Emergency Management Agency Public Affairs Officer
(404) 635-7022
Personal Contact 9/8/03

References

<http://www,wikipedia.org/wiki/Centennial_Olympic_Park_bombing>
<http://www.emergency.com/olymsec.htm>
<http://www.wikipedia.org/w/wiki.phtml?title=Atlanta%2C_Georgia&printable=yes>
<http://atlanta.fbi.gov/rudolph/bombsite2>
<http://www.securitysolutions.com>

Gaylord Tank Car Failure, Bogalusa, Louisiana, October 23, 1995, ID #18

Summary

Rank Value: 62
Number Evacuated: 3,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

On October 23, 1995, a railroad tank car at the Gaylord Chemical Corporation Plant in Bogalusa, Louisiana, exploded, releasing poisonous and corrosive nitrogen tetroxide vapors. Approximately 3,000 people were evacuated between October 23 and October 24 because of the vapor cloud, and 4,710 people were treated for irritated eyes and sore throats at local hospitals; 81 people were admitted.

COMMUNITY CONTEXT

General
Bogalusa, Louisiana, is a suburban parish of 13,365 people based on the 2000 Census (14,280 people based on the 1990 census). It covers an area of 24.7 km^2 (9.5 mi^2). Approximately 3,000 people, or slightly more than 20% of the population, were evacuated as a result of the tank car failure at Gaylord Chemical Corporation on October 23, 1995. The evacuated area was primarily residential and covered 8.1 km^2 (3.14 mi^2). The population density at the time of the evacuation was average (medium). Ethnicity, nationality, and age were not important factors in evacuation.

Bogalusa is a manufacturing and trading center situated on the Pearl River. It has a mayoral form of government. There are no special characteristics that attract a large number of non-residents. Bogalusa is approximately 145 km (90 mi) from the River Bend Nuclear Power Plant and 113 km (70 mi) from the Waterford Nuclear Power Plant, which are both in Louisiana.

History of Emergencies
Because it is a manufacturing center, the city may be slightly more prone to technological hazards, and it is within a hurricane-prone state, making it more prone to natural disasters than the average U.S. city. The community did not have any prior experience with the hazard that led to this evacuation and had not experienced any evacuations in the previous 10 years. Bogalusa residents did not have previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Bogalusa does not have a written emergency plan. The Gaylord Chemical Plant's emergency response plan was the one in place. The plan likely did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and the Bogalusa Fire Department does participate in this plan. Although Louisiana passed a state law in 1989 designed to force petrochemical companies and local emergency planning committees (LEPCs) to work together to plan for worst-case accidents, that law was never implemented because the Department of Environmental Quality was still working on the regulation.

Training
Training is provided to emergency response personnel, but joint training between industry and government is not conducted.

Drills and Exercises
Bogalusa's emergency response agencies do not regularly conduct emergency drills and exercises.

Community Awareness
The level of community awareness about local hazards, evacuation procedures, and about the hazard that caused this evacuation was low. The community probably had an average awareness about the alerting methods used.

THREAT CONDITIONS

The threat condition leading to the evacuation was a release of poisonous and corrosive vapors from a failed tank car at the Gaylord Chemical Plant. Around 3:55 p.m. on October 23, 1995, yellow-brown vapors began leaking from a railroad tank car that contained a mixture of nitrogen tetroxide and water. Plant personnel notified emergency response agencies, and Bogalusa fire personnel arrived at the scene around 4:30 p.m. and set up fire hoses to help suppress the vapors.

At about 4:45 p.m., the tank car exploded, resulting in one end of the tank car jacket being torn away and thrown about 106.7 m (350 ft). The tank car was then propelled 10.7 m (35 ft) down the track and derailed at a track bumping block, releasing a large reddish-brown vapor cloud. Vapors continued to be released for another 36 hours until the chemical reaction within the tank was brought under control through neutralization and dilution.

It was cloudy and windy but the road conditions were dry. However, the emergency response and ensuing evacuations encountered several special problems. The response was hampered by the absence of the fire chief, who was being treated at the hospital, and the fact that the explosion cut off telephone service in most of Bogalusa. In addition, the streets were jammed with frightened residents attempting to leave. Emergency medical facilities were taxed to the limit by injured residents and rescuers, most suffering from burned eyes, irritated skin and difficulty breathing. In addition, one of the two hospitals available to treat victims was located inside the evacuation zone.

CONSEQUENCES

Approximately 3,000 people, or slightly more than 20% of the population, were evacuated. There were no deaths or injuries related to the evacuation itself; however, 4,710 people were treated at local hospitals and 81 people were admitted because of the vapor cloud consisting of nitrogen tetroxide gas, which is poisonous when inhaled. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation between local, state, and federal agencies was high. The incident involved the state police, two federal agencies, the National Transportation Safety Board (NTSB) and the Occupational Safety & Health Administration (OSHA), and hazmat teams from Slidell, Louisiana, and Mobil Oil in Chalmette, Louisiana. Political boundaries were not crossed. The command, control and coordination processes could best be described as ad hoc. The fire chief made the decision to evacuate just before being taken to the hospital to be treated for inhalation problems. There were no problems in the decision-making process.

Communications

An EOC, including an ICP, was used in this emergency. The Louisiana State Police assumed command of the incident, as dictated by state law, and the incident commander initiated the mutual aid system. Because Bogalusa is part of a mutual aid system, the fire department has no hazmat team and no chemical protective equipment. The Bogalusa Fire Department does participate in Gaylord's emergency response plan. Hazmat teams from Slidell and Mobil Oil in Chalmette were called to the scene. A command center was established, but was moved twice because of shifting winds. Field emergency responders communicated via radio since the explosion cut off telephone service in much of Bogalusa. There were problems with communications because the field responders and EOC were on different radio frequencies.

Notification and Warning

Senior local officials were called and paged and the governor declared a state of emergency. Emergency personnel were notified through the 911 system. There were no problems with notification. Emergency response personnel mobilized to the scene within 15 minutes of discovery of the incident, and the decision to evacuate was made between 15 and 30 minutes from the start of the hazard. There were at least two, and possibly three, stages to the evacuation, although the details are vague. The first stage of the evacuation involved 3,000 people within a 2.6 km (1 mi) radius and took 1.5 hours to complete. According to published reports, additional residents were evacuated 24 hours after the initial evacuation (i.e., Stage 2 on October 24). The public was notified by officers who went door-to-door and by a police/fire PA system, as well as by radio and television broadcasts. There were no special problems regarding warning and subsequent citizen action. Citizens were reportedly very cooperative.

Traffic Movement and Control
The Bogalusa fire and police departments set up roadblocks when they arrived on the scene and immediately made plans for an evacuation. The streets were jammed with frightened residents attempting to leave. Evacuees were not told to use specific routes and it is unknown if they were told where to go. No special institutions were evacuated.

No major roadways were unavailable and reverse laning was not used. Some people spontaneously evacuated before being told to do so when they saw the "mushroom cloud." There were no traffic accidents during the evacuations. There were a few instances of people refusing to evacuate.

Congregate Care Centers
Congregate care centers managed by the Red Cross were used as were churches. The percentage of evacuees who went to congregate care centers is not known. Evacuation congregate care centers had to be moved at least once due to changing wind direction. There were some shadow evacuations but this did not impact traffic and it is unknown if it impacted congregate care center capacity.

Law Enforcement
The evacuated area was secured by police. There were 600–700 law enforcement officers on the scene, and there were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry
The state police chief authorized re-entry on the morning of October 25, 1995, two days after the start of the hazard. There were no special controls on re-entry and no problems associated with re-entry. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

The Bogalusa Fire Department showed a high level of professionalism in its response to the incident. They secured the scene, called for help, gathered information, and assisted the IC. In addition, the alerting mechanisms were effective.

The Bogalusa Fire Department felt that notification of the incident could have been move timely. In addition, the Fire Department had no hazmat team and no chemical protective equipment. The department does participate in Gaylord Chemical Plant's emergency response plan.

Although Louisiana passed a state law in 1989 to force petrochemical companies and LEPCs to work together to plan for worst-case accidents, that law has never been implemented because the Department of Environmental Quality is still working on the regulation.

CONTACT INFORMATION AND REFERENCES

Contacts

Bogalusa, Louisiana Fire Chief
Bogalusa, Louisiana Police Chief
Local American Red Cross
(985) 732-6217 (phone)
(Personal Communication, 6/27/03)

References

Ayers, Shirley. "Rocket Fuel Explosion Releases Toxic Cloud, Thousands Injured." *Dispatch.* Volume VII, No. 1. Spring 1996. <http://www.efilmgroup.com/Dispatch/dis2.html> (June 2003).

Encyclopedia (U.S.), "Bogalusa." <http://www.encyclopedia.com/html/B/Bogalusa.asp> (June 2003).

National Transportation Safety Board (U.S.) (NTSB). HZB-98-01, "Tank Car Failure and Release of Poisonous and Corrosive Vapors, Gaylord Chemical Corporation, Bogalusa, Louisiana." NTSB: Washington, D.C. October 1995.

Union Pacific Railroad, Eunice, Louisiana, May 27, 2000, ID #30

Summary

Rank Value: 62
Number Evacuated: 2,000–3,500
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

On May 27, 2000, at least 2,000, and potentially as many as 3,500, residents of Eunice, Louisiana, were evacuated from their homes after a Union Pacific Railroad train derailed on the edge of town, sparking several blasts that sent fireballs into the sky. Thirty-two of the train's 113 cars derailed, including several tank cars loaded with hazardous chemicals that included acrylic acid and dichloropropane. No injuries were reported. The fire burned for several days, hampering cleanup and investigation efforts. Residents were allowed to begin returning to their homes after five days.

COMMUNITY CONTEXT

General

Eunice, Louisiana, located approximately 120.7 km (75 mi) west of Baton Rouge, is classified as suburban although it is a combination of residential areas, manufacturing plants, and retail outlets. It has a total population of 11,500 and covers an area of 12.1 km^2 (4.7 mi^2). Between 2,000 and 3,500 residents (or between 17% and 30% of the population) were ordered to evacuate on May 27, 2000, after a train containing hazardous cargo derailed and caught fire at the edge of town. The evacuation area was between 7.8 and 31.1 km^2 (3 and 12 mi^2). The population density at the time of the evacuation was average. Ethnicity, nationality, and age were not important factors in the evacuation.

Eunice is a small city with a mayoral form of government. The main economic base is manufacturing and industry (petroleum). There are no special characteristics that would attract a large number of non-residents (although there is a Cajun Music Hall of Fame). The nearest commercial nuclear power plant is over 80 km (50 mi) away. The state of Louisiana has two commercial nuclear power plants.

History of Emergencies

Compared to similar communities, Eunice is more prone to technological hazards because of the petroleum industry in the area and more prone to natural disasters, such as hurricanes. The community did not have any experience with the hazard that led to this evacuation and it is unknown if there were any evacuations in the previous 10 years or if the community had previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Eunice has a written emergency plan with an evacuation section, and it was used in this emergency. However, the plan is not written to the rigor of NUREG-0654/FEMA-REP-1, Rev. 1, and it contains no ETE.

Training
Emergency responders receive training on a routine basis. Firefighters, for example, receive a minimum of twenty hours of training per month, which includes emergency drills, exercises, and full-scale field exercises. Joint training is conducted with the state police and the EPA on a routine basis.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises, and the emergency plan used in this evacuation was previously tested in a full-scale field exercise. The exercise performed immediately before this evacuation was likely a full-scale field exercise.

Community Awareness
The community's awareness of local hazards and of evacuation procedures was likely no higher than average. The level of awareness concerning the hazard that caused this evacuation was low, while the level of community awareness about the alerting methods used was average.

THREAT CONDITIONS

On May 27, 2000, a Union Pacific Railroad train containing hazardous cargo derailed and caught fire at the edge of Eunice, Louisiana. The evacuation of between 2,000 and 3,500 residents occurred on a Saturday morning under clear and dry weather conditions. Roads were also clear and dry, and there were no unusual circumstances that occurred during this incident.

According to the Eunice fire chief, the fire was contained within the area where 32 boxcars derailed. The fire jumped from boxcar to boxcar. One hour after the derailment, there was a major explosion, the cause of which was undetermined. The explosion was followed by a miniature mushroom cloud that hung in the air for a long time. Within the cloud, were green, blue, lavender, and other rainbow colors (from chemicals). One-and-one-half hours later (i.e., 2.5 hours from the initial derailment) there was a second (bigger) explosion which was probably a propane tank, the heat from which was felt 2.4 km (1.5 mi) away. The fires continued for four to five days following the derailment. Some fires/explosions were intentionally set to burn off chemicals (e.g., cyanide, acrylic acids). Wood and grass along the railroad tracks continued to burn for five days following the derailment. Fires were always contained within that area (i.e., no homes burned).

CONSEQUENCES

The derailment of the Union Pacific Railroad train on May 27, 2000, forced the evacuation of between 2,000 and 3,500 residents. There were no deaths or injuries caused by the accident or the evacuation. The estimated total cost of evacuation-related expenses was approximately $200,000.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. Political boundaries were not crossed. The command, control and coordination processes could best be described as ad hoc. The decision to evacuate was made by the police chief and there were no problems in the decision-making process.

Communications

An EOC, including an ICP, was used in this emergency. The Louisiana State Police assumed command of the incident, as dictated by state law. Field emergency responders communicated via cell phone and pager. No problems were identified with communications.

Notification and Warning

It is unknown how senior local officials were notified of the incident; however, everyone in Eunice was aware of the incident and there were no problems with notification of emergency personnel or senior local officials. Emergency responders were notified through 911 dispatch. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the decision to evacuate was made in two minutes. The police went door-to-door to notify residents to evacuate. A police/fire PA system was also used. There were no special problems regarding warning and subsequent citizen action, although some people refused to evacuate and some people were evacuated more than once. The evacuation occurred in three stages, as described in the next paragraph.

According to a state policeman, the evacuation occurred in three stages. In the first stage, approximately 200 people were evacuated within a few blocks of the derailment. The first stage of the evacuation was completed in approximately 45 minutes. The second stage of the evacuation occurred within one hour of the derailment and included approximately 1,500 people within a 2.6 km (1 mi) radius of the accident. It took over two hours to complete this evacuation. The final stage of the evacuation involved 2,000 people and was initiated within two hours of the accident. It included residents within a 3.2 km (2 mi) radius from the derailment.

The final stage of the evacuation was 95% complete by the following day (i.e., 24 hours later). Some people refused to comply with the evacuation order.

Traffic Movement and Control

When ordered to evacuate, evacuees were told to go to three specific hotels designated by Union Pacific Railroad. Evacuees were told to use specific routes and police directed traffic. No special institutions were evacuated. Road conditions before the evacuation were dry and no major roadways were unavailable for use. No special traffic problems were encountered and no traffic accidents occurred. Since the evacuation was initiated immediately, there was no time for spontaneous evacuations. Reverse-laning likely was not used. Some people refused to evacuate.

Congregate Care Centers

Congregate care centers were not used. However, the Union Pacific Railroad put up 550 families in hotels, filling up rooms up to 64 km (40 mi) away. The Union Pacific Railroad also made arrangements to feed pets that were left behind during the evacuations. There were no shadow evacuations.

Law Enforcement

Police secured the evacuated area and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry

The police chief, in collaboration with state officials, authorized re-entry. The evacuation order was lifted on Thursday afternoon (i.e., five days following derailment) and people outside of a 2.6 km (1 mi) radius of the derailment were allowed to return to their homes. It was a controlled phased re-entry. No major problems were identified during re-entry. The Union Pacific Railroad compensated evacuees for their expenses.

INVESTIGATOR COMMENTS

The timing of the incident, the fact that it happened on a Saturday morning when everyone was at home, facilitated evacuation of residents. In addition, the quick response of emergency responders and the high level of preparedness of the police and other officials made the evacuation work well.

CONTACT INFORMATION AND REFERENCES

Contacts

Eunice Local Police
(Personal Communication, May 31, 2000)

Eunice Fire Chief
(Personal Communication, June 29, 2000)

Acting Eunice Fire Chief
(Personal Communications, June 20 and 24, 2003)

References

"Cars Explode After Train Derails." *Reuters Ltd.* May 28, 2000.

"Fire Ignites After Freight Train Derails in Louisiana." *Associated Press.* May 28, 2000.

Louisiana Office of Emergency Preparedness. "State of Louisiana Emergency Operations Plan Supplement 1A." January 2000.
<http://www.loep.state.la.us/Plans/EOPSupplement1a.pdf> (June 2003).

Louisiana Office of Emergency Preparedness. "State of Louisiana Emergency Operations Plan Supplement 1B." January 2000.
<http://www.loep.state.la.us/Plans/EOPSupplement1b.pdf > (June 2003).

"Train Derails." *Associated Press*. May 29, 2000.

Brandon Pipeline Rupture, Florida, May 27, 2003, ID #235

Summary

Rank Value: 62
Number Evacuated: 2,000
Category: Technological Hazard
Specific Type: Pipeline Rupture
Community: Suburban

INTRODUCTION

An anhydrous ammonia leak from a ruptured underground pipeline owned by Tampa Pipeline Corp. forced the evacuation of more than 2,000 children from an elementary school and middle school southeast of downtown Tampa. Nearby residents were not evacuated but were advised to stay inside.

COMMUNITY CONTEXT

General
Brandon, Florida, is a suburban community with a population of approximately 78,000 people; it covers an area of 75.9 km^2 (29.3 mi^2). Approximately 2,000 people, or 2.5%, of the population, were evacuated from a 5.1 km^2 (2 mi^2) area during this incident. The land use in the area was mainly for schools and the population density of the area was low. Ethnicity and nationality were not important factors in the evacuation; however, age was a factor as most of the evacuees were schoolchildren.

The community has a county commission form of government, and has a limited economic base, as the town is a bedroom community. Tourism attracts a large number of non-residents, or "snowbirds," to the area. The nearest nuclear power plant is Crystal River, located more than 80 km (50 mi) away. Florida has nuclear power plants.

History of Emergencies
The community is more prone to hazards than average and has had experience with ammonia leaks in the past on a smaller scale. The community also has experienced industrial facility incidents and hurricanes and has experienced large-scale evacuations in the last 10 years. The community has not had previous experience with alerting only schools.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in full-scale field exercises and in tabletop exercises.

Community Awareness
The community had a medium level awareness of the local hazards and a high level of awareness of evacuation procedures. It had a medium level of awareness about hazardous materials in general and no awareness about the alerting methods used in this evacuation.

THREAT CONDITIONS

On May 27, 2003, an underground pipeline owned by Tampa Pipeline Corp. ruptured and leaked anhydrous ammonia. Nearby residents were advised to stay inside, and traffic was detoured around the leak, which happened on a main thoroughfare near an upscale development of approximately 1,200 homes. An elementary school and a middle school in the area required evacuation. It was early in the morning at approximately 7 a.m. on a hot day with a light fog in the area. The roads were dry and clear and no unusual circumstances occurred during this event.

CONSEQUENCES

Approximately 2,000 people within a 5.1 km^2 (2 mi^2) area were evacuated from two schools after ammonia leaked from a ruptured pipeline. The evacuees were primarily children from the two schools. The remaining residents in the area were advised to shelter in place and stay in their homes. There were no fatalities or injuries from the incident or the evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local and state agencies was high, and political boundaries were not crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Fire Department Incident Commander, and there were no problems with the decision-making process.

Communications

An EOC was not used in this event; however, an ICP was established. Communication between field emergency responders and the ICP was primarily by radio and face to face. There were no problems with communications during the event.

Notification and Warning

Senior local officials were notified of the incident by a telephone tree and e-mail. The emergency responders were notified through a 911 telephone call from the school. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes, and the initial decision to evacuate was made approximately 30 minutes after the notification of the incident. It took less than one hour to complete the evacuation.

The two schools were the only facilities evacuated, and they were notified directly by the police. The evacuation took place all at once and there were no problems with warning and subsequent citizen action. No one refused to evacuate.

Traffic Movement and Control

Evacuees were given instructions on where to go. The schools were the only special institutions evacuated. Road conditions during the evacuation were dry and no traffic accidents or traffic-related problems occurred during the event. One road in the area was closed, creating a moderate traffic problem. Reverse-laning was not used.

Congregate Care Centers

Congregate care centers were established at local schools for this emergency and were managed by the school administration. All of the evacuees, 100%, went to the congregate care centers. There were some shadow evacuations where people left the area because of the odor. Some of these people went to a local campground. These shadow evacuations had no impact on the congregate care centers.

Law Enforcement

Police and the sheriff secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry

Re-entry was authorized by the fire chief and there were no special controls. Evacuees were not compensated for their expenses. There were no problems reported during re-entry.

INVESTIGATOR COMMENTS

Preplanning efforts contributed to the success of this evacuation. It was learned that improvements could be made in notifying the public officials.

CONTACT INFORMATION AND REFERENCES

Contacts

Hillsborough County Fire Rescue
Special Operations Chief
(813) 272-6600
(Personal Communication, 8/6/03)

References

"Tampa ammonia leak disrupts schools, traffic." *Associated Press*. May 28, 2003.

Mathis Farm Supply Store, Slocumb, Alabama, February 11, 2003, ID #75

<u>Summary</u>

Rank Value: 62
Number Evacuated: 3,500
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Rural

INTRODUCTION

On February 11, 2003, a fire at a farm supply store housing dangerous chemicals prompted the evacuation of about 3,500 people within a 3.2 km (2 mi) radius of the site in Slocomb, Alabama. One school and two senior citizen centers had to be evacuated. The evacuated area was located at least 32.2 km (20 mi) from the Joseph M. Farley Nuclear Power Plant located near Dothan, Alabama.

COMMUNITY CONTEXT

<u>General</u>
Slocumb, Alabama, is a rural community with a population of around 4,200 people. Approximately 3,500 people, or 83% of the population, were evacuated in the middle of the day. The evacuated area was primarily residential and included a school and two senior citizen centers. Population density was high during the evacuation. The city of Slocumb covers approximately 23.3 km^2 (9 mi^2) and the evacuated area was approximately 32.6 km^2 (12.6 mi^2). Ethnicity, nationality, and age were not important factors in the evacuation.

Slocumb has a mayoral form of government and its main economic base is farming.

The schools in Slocumb attract other people from around the county. Alabama has two commercial nuclear power plants; one is in the northern part of state, 16.1 km (10 mi) northwest of Decatur, and the other is 29 km (18 mi) southeast of Dothan, or at least 32.2 km (20 mi) from the site of this evacuation.

<u>History of Emergencies</u>
Slocumb is no more prone to hazards than the average U.S. city. The community has not had any experience with the hazard that led to this evacuation nor experienced any evacuations in the previous 10 years.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and did not contain an ETE.

Training
The city of Slocumb provides training to its emergency response personnel. However, joint training between industry and government is not regularly conducted.

Drills and Exercises
Slocumb's emergency response agencies regularly conduct emergency drills and exercises. However, the emergency plan used in this evacuation had not been previously tested in a full-scale field exercise.

Community Awareness
Residents of Slocumb had a low awareness of local hazards and of the hazard that caused this evacuation. The community's awareness about evacuation procedures and about the alerting methods used was average.

THREAT CONDITIONS

A fire at the Mathis Farm Supply in Slocumb, Alabama, at approximately 11:00 a.m. on Tuesday, February 11, 2003, prompted the evacuation of about 3,500 people. The Mathis Farm Supply, located a few miles from the Florida line, contained numerous fertilizer products. The evacuation proceeded with no unusual circumstances. It was sunny but windy that day and the road conditions were good.

CONSEQUENCES

Approximately 3,500 people were evacuated from Slocumb, Alabama, after the fire broke out at the Mathis Farm Supply. There were no reported deaths or injuries resulting from the fire or the subsequent evacuation. Schoolchildren were taken to a high school stadium and an elementary school gym, and congregate care centers were opened at two churches. The total estimated cost of evacuation-related expenses and property damages was approximately $10,000 to $15,000.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was very high. No political boundaries were crossed during this evacuation. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the mayor, based on the Hazmat team's assessment of the situation. There were no problems in the decision-making process.

Communications

There was an ICP but no EOC used in this emergency. Emergency communication was via radio and communication was a problem because emergency personnel were on different radio frequencies.

Notification and Warning

Senior local officials were notified of the incident by radio and telephone, and emergency responders were notified by pager and radio, following report of the incident through the 911 emergency system. There were no problems with notification of emergency personnel or senior local officials. Response personnel mobilized to the scene in less than 15 minutes, and the decision to evacuate was made in 20 minutes. It took one hour to complete the evacuation. The public was notified of the evacuation by sirens and by door-to-door notification. The evacuation was staged by location. There were no special problems regarding warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated and were told to use specific routes. However, these routes were not specifically marked. Reverse-laning was not used. One school and two senior citizen centers were evacuated. Road conditions before the evacuation were dry. Major roadways were available for use, and no special traffic problems or accidents occurred during the evacuation. No one evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers

Congregate care centers were managed by the Red Cross and by volunteers. Congregate care centers included a high-school stadium and an elementary school gym, and two congregate care centers located at churches. The percentage of evacuees that went to congregate care centers is unknown. There were no shadow evacuations.

Law Enforcement

Police secured the evacuated area following the evacuation, and there were no instances of looting or vandalism or any other problems with law enforcement.

Re-Entry
Re-entry was authorized by Slocumb's mayor and there were no special controls during the re-entry process. Evacuees were not compensated for their expenses. There were no major problems during re-entry.

INVESTIGATOR COMMENTS

According to the Slocumb fire chief, the coordination among agencies contributed to the success of the evacuation. In addition, one of the lessons learned is that it is difficult to get information on chemical mixtures (referring here to the hazmat response and not to the evacuation).

CONTACT INFORMATION AND REFERENCES

Contacts

Slocumb Fire Chief
(334) 684-2257
(Personal Communication, 7/7/03)

References
Chemical Incidents Report Center. "Fire at Farm Supply Store." February 11, 2003. <www.chemsafety.gov/circ/post.cfm> (April 9, 2003).

Choctaw Maid Farm Poultry Plant, Forest, Mississippi, March 20, 2001, ID #4

Summary

Rank Value: 62
Number Evacuated: 2,000
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Rural

INTRODUCTION

On March 20, 2001, a fire started in a poultry processing plant in Forest, Mississippi. Approximately 2,000 people were evacuated from the town. The evacuation occurred in the downwind direction from the plant and included schools, businesses, residences, and the Scott County Jail covering an area of approximately 7.8 km^2 (3 mi^2). Three people were hospitalized from the event; no injuries were reported from the evacuation. During the course of the event a rainstorm moved in lowering the temperature and increasing winds.

COMMUNITY CONTEXT

General
The city of Forest, Mississippi, is a small urban community with a mayoral form of government. It has a population of approximately 5,900 people and covers an area of 33.7 km^2 (13 mi^2). Its main economic base is manufacturing and industry. On March 20, 2001, approximately 2,000 people were evacuated after a fire started in the Choctaw Maid Farm poultry plant.

The area was not congested at the time of the evacuation. According to the Forest fire chief, approximately 25% of the community was evacuated. The evacuation area was primarily industrial, commercial and residential. Ethnicity, nationality, and age were not important factors in the evacuation. The city is located more than 80 km (50 mi) from the nearest commercial nuclear power plant, the Grand Gulf Reactor.

History of Emergencies
The area is prone to similar hazards but this is the largest event in at least 15 years. The community had prior experience with the hazard that led to this evacuation, including an ammonia explosion at a poultry plant the previous year. As a result, the fire department was more prepared for this event. The Forest fire chief stated that this was the largest evacuation in the 15 years he had been in Forest. There have been a number of smaller evacuations in the community in the previous years and the same means of alerting people was used for this evacuation, including using the telephone for the schools and patrolmen going door to door to notify businesses and residences.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Forest had a written emergency plan that contained an evacuation section. However, the plan was under revision at the time. The plan conformed to federal guidelines and was used in this emergency. The plan probably did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, as it did not contain ETEs and routing information was based on town quadrants rather than the hazard or wind direction. The Forest fire department does use ETEs for evacuating schools. The ETE for the schools is 15 minutes and the schools were evacuated within the ETE.

According to the Forest chief of police, prior planning for evacuations was a major contributor to the success of this evacuation.

Training
Training is provided to emergency response personnel, and joint training between industry and government is conducted.

Drills and Exercises
The Forest Fire Department regularly conducts emergency drills and exercises with the schools. The Fire Department and Police Department conduct planning sessions and tabletop drills for evacuations.

Community Awareness
The community's level of awareness about local hazards was high. The community's level of awareness about the hazard that caused the evacuation and the alerting methods used was also high, although the size of the evacuation for this event was significantly larger than that of any previous evacuations.

THREAT CONDITIONS

The hazard that led to this evacuation was a fire at the Choctaw Maid Farm poultry plant. The incident occurred on a lightly overcast morning. However, during the course of the event, a rainstorm moved in lowering the temperature and increasing the wind speed. The evacuation was slightly hampered by the direction of the wind. The evacuation plan had segmented the town into quadrants and evacuation routes were based on the quadrants. However, the wind direction dictated the direction of evacuation traffic.

CONSEQUENCES

On the morning of March 20, 2001, a fire started at the Choctaw Maid Farm poultry plant, and a 911 emergency call was placed from the plant to the local Fire Department. The Fire Department was on scene within ten minutes. Evacuation of the plant was initiated before the arrival of the Fire Department. Evacuation of the Tyson plant across the street and of the downwind population was initiated immediately upon arrival of the Fire Department. There were three reported injuries and no fatalities associated with the incident. There were no injuries associated with the evacuation. Approximately 2,000 people were evacuated. The estimated total cost of the evacuation to the public was minimal.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. No political boundaries were crossed. The command, control and coordination processes could best be described as pre-planned. The Forest Fire Chief made the decision to evacuate jointly with the chief of police as they established command and control at the scene. There were no problems with the decision-making process.

Communications

An EOC was not used during this emergency but an ICP was used. Field emergency responders communicated via radio. According to the Forest Fire Chief, the greatest problem encountered in this event was with the radios and the overload of available frequencies. The emergency response team has four radio frequencies and all were inundated with communication during the event. The ICP made a field decision to limit select teams and individuals to designated frequencies to improve the communications. This resolved the problem, but did create very slight delays in communication when teams on one frequency needed to communicate with teams on another frequency. The local radio and cable television stations broadcasted emergency information, including traffic routes, and kept the public informed of the changing events.

Notification and Warning

Senior local officials and emergency responders were notified of the incident by phone. There were no problems with notification of emergency personnel or senior local officials. Emergency response personnel mobilized immediately. The decision to evacuate was made in less than 10 minutes and took approximately 45 minutes to complete. The public was notified to evacuate by police who went door to door and informed residents of the evacuation, where to go, and what direction to proceed. Schools were notified by telephone. The evacuation took place all at once, and there were no special problems regarding warning and subsequent citizen action. There were a few businesses that were missed during the evacuation, and a few residents refused to evacuate; however, these were minor and did not impact the evacuation or result in injury.

Traffic Movement and Control

Evacuees were given specific instructions from the patrol officers conducting the evacuation about where to go when they evacuated and were told to use specific routes that were designated by policemen directing traffic. The school and the Scott County Jail were evacuated and these evacuations went very well. Highway 80 is the major roadway through town and passes directly by the plant. This required that Highway 80 be shut down and traffic be re-routed on local side roads. There were no problems with re-routing the traffic, as the local roads were very adequate for the volume and size of the vehicles. There were no reported traffic accidents during the evacuation. No one evacuated before being told to do so, and very few individuals refused to evacuate.

Congregate Care Centers

Congregate care centers were not used in this event. There were no shadow evacuations.

Law Enforcement

The evacuated area was secured by the police, and there were no instances of looting or vandalism. No problems were identified with law enforcement.

Re-Entry

The Forest Fire Chief lifted the evacuation order after approximately five hours and there were no special controls in place during re-entry. Evacuees were not compensated for their expenses. There were no problems associated with re-entry.

INVESTIGATOR COMMENTS

As a result of this event and lessons learned, the Forest Fire Department has reevaluated its evacuation procedures and now organizes the evacuation based on wind direction. In addition, the city has installed sirens and educated the public on what to do if a siren is activated.

CONTACT INFORMATION AND REFERENCES

Contacts

Fire Chief
Forest Fire Department
(601) 469-1221
(Personal Communication, July 2003)

Chief of Police
Forest Police Department
(601) 469-4141
(Personal Communication, July 2003)

References

"How do you like your chicken?" *Associated Press*. March 21, 2001. <http://tspweb02.tsp.utexas.edu/webarchive/03-21-01/> (June 2003).

Truck Accident, Hugo, Oklahoma, August 18, 2000, ID #27

Summary

Rank Value: 60
Number Evacuated: 2,000–2,500
Category: Technological Hazard
Specific Type: Transportation Accident
Community: Suburban

INTRODUCTION

On August 18, 2000, a military truck carrying rockets flipped over on a highway ramp and spilled its load in Hugo, Oklahoma. Between 2,000 and 2,500 people within a 2.6 km^2 (1 mi^2) radius of the site were evacuated as a precaution even though the Oklahoma National Guard said the rockets were in no danger of exploding. Two National Guardsmen were injured in the incident, but there were no deaths or injuries during the subsequent evacuation.

COMMUNITY CONTEXT

General

Hugo is a suburban community with a population of 5,536 people. Between 2,000 and 2,500, or 36 to 45% of the city's population, were evacuated on August 18, 2000. The city of Hugo covers an area of 14.4 km^2 (5.6 mi^2) and the evacuated area covered an area of 8.1 km^2 (3.14 mi^2). The population density was medium during the evacuation. Land use in the evacuated area was residential and commercial. Ethnicity, nationality, and age were not important factors in the evacuation.

The community is run by a city manager; its main economic base is farming. However, Lake Hugo attracts a large number of non-residents. The nearest nuclear power plant is more than 80 km (50 mi) away and the state of Oklahoma does not have any commercial nuclear power plants.

History of Emergencies

The community is no more prone to hazards than average and had no prior experience with the hazard that led to this evacuation. Hugo has experienced no evacuations in the past ten years. However, the community did have previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan that included an evacuation section that was used in this emergency. It is unknown whether the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or whether it contained an ETE.

Training
The community provides training to emergency response-personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises but the emergency plan used in this evacuation was not previously tested in a full-scale evacuation.

Community Awareness
The community had an average level of awareness about local hazards and about evacuation procedures. The community also had an average level of awareness about the hazard that caused this evacuation and about the alerting methods used in this evacuation.

THREAT CONDITIONS

The threat condition leading to this evacuation was a truck accident that resulted in a load of military rockets spilling onto a highway ramp. Between 2,000 and 2,500 people were evacuated. The roads were dry and no unusual circumstances occurred during the incident.

CONSEQUENCES

Between 2,000 and 2,500 residents were evacuated. Two National Guardsmen were injured in the accident and there were no deaths or injuries in the subsequent evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local, state, and federal agencies was high. Political boundaries were not crossed. The command, control and coordination processes could best be described as ad hoc. The decision to evacuate was made by the Hugo Fire Chief and there were no problems with the decision-making process.

Communications

An EOC was not used; however, an ICP was used and communication between field emergency responders and the ICP was by radio and cell phone. There were no problems with communication.

Notification and Warning

It is unknown how senior local officials were notified of the incident. Emergency responders were notified through the 911 phone system. There were no problems with notification of emergency personnel. The elapsed time between the truck accident and mobilization of response personnel was less than fifteen minutes and the decision to evacuate was made approximately thirty minutes after the accident. It took approximately two hours to complete the evacuation. The public was notified by radio and television broadcasts and by emergency responders going door-to-door. The evacuation took place all at once. There were no special problems with warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they were notified to evacuate and they were told to use specific routes, which were designated by police roadblocks. Five special institutions were evacuated, including one school, two day care centers and two housing projects. Road conditions before the evacuation were dry and there were no traffic accidents, no traffic problems, and major roadways were available to evacuees. Reverse - laning was not used. No one evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers

Congregate care centers managed by Civil Defense were used. Congregate care centers consisted of schools and churches. It is unknown what percentage of evacuees went to the congregate care centers. There were no shadow evacuations.

Law Enforcement

Hugo Police secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry

The Hugo fire chief authorized re-entry and there were no special controls during re-entry. Evacuees were not compensated for their expenses. There were no problems during re-entry.

INVESTIGATOR COMMENTS

According to the Hugo first assistant fire chief, the evacuation was successful due to preparedness and agency coordination. There were no problems encountered during the evacuation.

CONTACT INFORMATION AND REFERENCES

Contact
Hugo Fire Department
First Assistant Fire Chief
(580) 326-7106
(Personal Communication, 7/14/03)

References

"Military Truck Flips, Spills Rockets onto Road." *Associated Press.* August 18, 2000.

"Military Truck Overturns, Spilling Load of Rockets." *Associated Press.* August 17, 2000.

Oklahoma Emergency Management. "State of Oklahoma Emergency Operations Plan." June 2001. <http://www.odcem.state.ok.us/pte/EOP2002.pdf> (June 2003).

Proctor & Gamble Factory, Iowa City, Iowa, July 22, 1999, ID #25

Summary

Rank Value: 60
Number Evacuated: 5,000
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Urban

INTRODUCTION

On July 22, 1999, at about 10:00 a.m., a corrosive chemical known as chlorosulfonic acid spilled while being loaded at a Proctor & Gamble Factory that makes shampoo and toothpaste located in Iowa City, Iowa. The spilled acid formed a vaporous cloud that began drifting on the wind. As a result, 5,000 residents were evacuated and two police officers were treated at a hospital and released. There were no deaths or injuries associated with the evacuation.

COMMUNITY CONTEXT

General
Approximately 5,000 people on the southeast side of Iowa City, population 62,380, were evacuated (approximately 8% of the city's total population). Iowa City covers an area of 63.3 km^2 (24.4 mi^2), and the evacuated area was 2.6 km^2 (1 mi^2). The population density was medium during the evacuation. Land use in the evacuated area was residential and commercial. Age was an important factor in the evacuation since a large percentage of evacuees were children and special-needs population.

The community has a mayoral form of government and its main economic base is education (i.e., the University of Iowa). The University of Iowa attracts a large number of non-residents. The nearest nuclear power plant is the Duanne Arnold Nuclear Power Plant located 13 km (8 mi) northwest of Cedar Rapids and approximately 32 km (20 mi) north of Iowa City.

History of Emergencies
The community is more prone to natural disasters than average but not to technological hazards. Iowa City has experienced evacuations in the past 10 years resulting from tornadoes, floods, and storms. However, the community had no previous experience with the hazard that led to this evacuation. The community did have previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan, which was used in this emergency. However, it is unknown whether the plan had an evacuation section or if it conformed to NUREG-0654/FEMA-REP-1, Rev. 1.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises but the emergency plan used in this evacuation was not previously tested in a full-scale evacuation.

Community Awareness
The community has an average level of awareness about local hazards and evacuation procedures. However, awareness about the hazard that caused this evacuation (i.e., the chlorosulfonic acid spill) was low. The community had an average level of awareness about the alerting methods used in this evacuation.

THREAT CONDITIONS

The threat condition leading to this evacuation was a spill of chlorosulfonic acid at approximately 10 a.m. on July 22, 1999. The spill formed a vaporous cloud that began drifting with the wind. As a result, 5,000 residents were evacuated and two police officers were treated at a hospital and released. The roads were dry and clear and there were no unusual circumstances that occurred during the incident.

CONSEQUENCES

Approximately 5,000 residents were evacuated and two police officers were treated at a hospital and released. There were no deaths, but two injuries were associated with the incident; no deaths or injuries were associated with the evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high. Political boundaries were not crossed. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made jointly by the Iowa City fire and police chiefs, and there were no problems with the decision-making process.

Communications
An EOC was not used; however, an ICP was used and communication between field emergency responders and the ICP was by radio. There were no problems with this form of communication.

Notification and Warning
Senior local officials were notified of the incident by cell phone, and emergency responders were notified through the 911 phone system. There were no problems with notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the decision to evacuate was made approximately 45 minutes after discovery of the spill. It took approximately one hour to complete the evacuation. The public was notified by emergency responders going door to door. The evacuation was staged, section by section. The method of disseminating evacuation information to the residents was not totally effective and could have been better.

Traffic Movement and Control
Evacuees were given specific instructions about where to go but were not told to use specific routes; they were told which direction to go. Three special institutions were evacuated, including two day care centers and a handicapped facility. Road conditions before the evacuation were dry and there were no traffic accidents or traffic problems; major roadways were available to evacuees. Reverse-laning was not used. No one evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers
Congregate care centers were not used and there were no shadow evacuations.

Law Enforcement
Iowa City police secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
The Iowa city fire and police chiefs and an industry representative jointly authorized re-entry. There were no special controls during re-entry. Evacuees were not compensated for their expenses. No problems occurred during re-entry.

INVESTIGATOR COMMENTS

According to the Iowa City fire chief, the evacuation was successful because communication between industry and public safety personnel was effective. However, the lack of a formal evacuation system contributed to the evacuation's problems and was a lesson learned during this evacuation (i.e., that a formal evacuation system is needed).

CONTACT INFORMATION AND REFERENCES

<u>Contact</u>

Iowa City Fire Chief
(319) 356-5256
(Personal Communication, 7/14/03)

<u>References</u>

"5,000 Evacuated in Iowa due to Spill." *Associated Press.* July 22, 1999.

Cargill Chemical Plant, Maysville, Kentucky, January 4, 1998, ID #166

<u>Summary</u>

Rank Value: 58
Number Evacuated: 2,500
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

On January 4, 1998, approximately 2,500 people were evacuated because of a fire at the Cargill, Inc. Chemical Plant in Maysville, Kentucky. Communities were evacuated on both sides of the Ohio River, including Maysville, Kentucky, and Adams and Brown counties in Ohio. The Cargill Plant contained stockpiles of herbicides, pesticides, and 380 metric tons (420 tons) of ammonium nitrate, and residents were evacuated because of the potential for a large explosion. Authorities decided to let the fire burn out rather than fight it with water and risk washing toxic chemicals into the Ohio River, which is only 274 m (300 yd) away. No deaths or injuries were associated with the evacuation, and there was one injury associated with the fire but no deaths.

COMMUNITY CONTEXT

<u>General</u>
Approximately 2,500 people were evacuated from several residential (suburban) communities, including Maysville, Kentucky, and Adams and Brown counties across the Ohio River in Ohio. The evacuated area covered a 2.6 km (1 mile) radius or 8.1 km^2 (3.14 mi^2). The population density during the evacuation was medium. Ethnicity, nationality, and age were not important factors in the evacuation.

The region's main economic base is derived from both tourism and manufacturing. Tourism attracts a large number of non-residents. There are no commercial nuclear power plants within 80 km (50 mi) of the evacuated area, and there are no commercial power plants in Kentucky. However, Ohio has two commercial nuclear power plants.

<u>History of Emergencies</u>
Because of its manufacturing and industry, the area may be slightly more prone to technological hazards than the average U. S. city. The community had no prior experience with the hazard that led to this evacuation and no evacuations in the previous ten years, although residents had previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Mason County has a written emergency plan with an evacuation section that was used in this emergency. The plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, except it did not contain an ETE.

Training
Training is provided to emergency response personnel, and joint training is regularly conducted with industry and government.

Drills and Exercises
Emergency response agencies regularly conduct emergency drills and exercises; however, it is unknown whether or not the emergency plan used in this evacuation was previously tested in a full-scale field exercise.

Community Awareness
The level of community awareness of local hazards was average (medium). Awareness about evacuation procedures is low; but the community had a high level of awareness concerning the hazard that caused this evacuation. The residents were moderately familiar with the alerting methods used.

THREAT CONDITIONS

The threat condition leading to the evacuation was the burning of hazardous chemicals and the possibility of a large explosion. Around 2:30 a.m. on January 4, 1998, a Maysville police officer spotted the fire at the Cargill Chemical Plant. The plant contained stockpiles of herbicides, pesticides, and 380 metric tons (420 tons) of ammonium nitrate. The initial Maysville Police Department officers on the scene notified the Mason County Disaster and Emergency Services. By 3:05 a.m., 50 firefighters from nine Mason County area fire departments and two ambulance services arrived on the scene. Shortly thereafter, it was decided to pull back the emergency response personnel and let the fire burn itself down. The defensive stance was made because of the volatile nature of the chemicals involved and the risk of contamination given the proximity of the warehouse to the Ohio River. Road conditions and weather conditions during the evacuation are unknown. No unusual circumstances occurred during this incident other than the hazard itself.

CONSEQUENCES

As the fire at the Cargill Plant grew, approximately 2,500 people, or more than 27% of the population, were evacuated. There were no deaths or injuries related to the evacuation itself. There were no deaths directly related to the fire, but a firefighter did suffer a minor injury. The estimated cost to the public of the evacuation itself is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high and political boundaries were crossed. Several communities were evacuated, including those in Adams and Brown counties, Ohio, which are across the Ohio River from the plant. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Incident Commander who was the Kentucky State Fire Marshal. There were no problems with the decision-making process.

Communications

The Ohio EOC was activated, and an ICP was used. Communication between the field emergency responders and the EOC was by radio, and there were no problems with communication.

Notification and Warning

Senior local officials were notified of the incident by telephone. Local police saw the fire and notified emergency responders. There were no problems with notification of local officials or emergency personnel. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes. The decision to evacuate was made in less than 15 minutes. It is unknown how long it took to complete the evacuation. The public was notified by radio and television broadcasts, police/fire PA system, and by emergency personnel going door to door to notify residents. The evacuation occurred all at once and there were no special problems with warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated but were not told to use specific routes. One special institution (a senior citizen apartment building) was evacuated. Road conditions before the evacuation are unknown. No major roadways were unavailable for use and there were no special traffic problems. Some people spontaneously evacuated after seeing the fire. Reverse-laning was not used. There were no traffic accidents during the evacuations. It is unknown whether anyone refused to evacuate.

Congregate Care Centers

Congregate care centers were set up at local high schools in both Maysville, Kentucky, and Adams and Brown counties in Ohio and were managed by the Red Cross. A total of 437 people or 17.5% of the evacuees went to the congregate care centers. There were shadow evacuations but this did not impact traffic or congregate care center capacity.

Law Enforcement
The evacuated area was secured by the police; there were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry
The Kentucky State Fire Marshall authorized re-entry at 6:00 p.m. on January 4, 1998, approximately 15 hours after the start of the incident. No special controls were employed. It is unknown whether evacuees were compensated for their expenses. No major problems occurred during re-entry.

INVESTIGATOR COMMENTS

According to Maysville fire chief, the evacuation worked well because of the high level of cooperation between agencies and the emergency plan worked well.

The fact that the incident and the evacuation took place in the middle of the night created a slight problem.

CONTACT INFORMATION AND REFERENCES

Contact

Maysville Fire Chief
(606) 564-9411

References

CNN (U.S.), "Chemical Fire Forces Evacuations Along Ohio River." January 1998. <http://www.cnn.com/US/9801/04/plant.fire/> (June 2003).

FEMA News (U.S.), "Kentucky Fertilizer Plant Blaze Forces Evacuations." January 5, 1998. <http://www.fema.gov/nwz98/kyfr0105.shtm> (June 2003).

"Fertilizer Plant Fire." *Associated Press*. January 5, 1998.

Kentucky Emergency Management (U.S.), "Kentucky State Emergency Operations Plan." September 2002. <http://kyem.dma.state.ky.us/KY%20EOP/tableofcontents.htm> (June 2003).

Leonard, James. "Explosions, Fire at Fertilizer Plant Force Early Morning Evacuation." *Dispatch*, Volume VIII, No. 1. Fall 1998. <http://www.efilmgroup.com/dispatch/disviii4.html> (June 2003).

"Thousands Evacuated in Kentucky Fertilizer Plant Fire." *Associated Press*. January 5, 1998.

Cerro Grande Fire, Los Alamos, New Mexico, May 10, 2000, ID #107

Summary

Rank Value: 58
Number Evacuated: 12,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Suburban

INTRODUCTION

The Cerro Grande Fire, which began on May 4, 2000, was the largest, most destructive wildfire that New Mexico has ever known. Originally started as a prescribed burn in Bandelier National Monument, the wildfire ultimately burned 190 km^2 (47,000 acres) and caused the evacuation of thousands of people in Los Alamos County. As a result, a total of 12,000 people were evacuated from the town of Los Alamos on May 7 and May 10, and another 7,000 people were evacuated from the unincorporated community of White Rock on May 11 (see also ID #209). Hampering the evacuation effort was the fact that Los Alamos sits on a hill with only one main road out of the town. However, the evacuation proceeded smoothly and was accomplished twice as fast as predicted although this is mostly attributed to the fact that Los Alamos National Laboratories (LANL) and the public schools were all closed. If these institutions had all been open, the evacuation may have taken as long as 24 hours to complete (or twice as long as predicted). One special institution (the Los Alamos Medical Center) was evacuated. The evacuation of Los Alamos proceeded smoothly; however, several changes were made to the County Emergency Management Plan as a result of lessons learned.

COMMUNITY CONTEXT

General

On May 7, 2000, approximately 500 residences (~1,000 people) in Los Alamos were ordered to evacuate as wildfires neared their community. On May 10, 2000, the remaining population of Los Alamos was ordered to evacuate and there was generally good compliance with the evacuation order. A total of 12,000 residents (the total population) of Los Alamos were evacuated.

Los Alamos is generally a suburban area with small shopping centers and LANL. The size of the community and of the evacuated area is 28.1 km^2 (10.9 mi^2). The population density during the evacuation was low because LANL and the schools were closed. Los Alamos is a town run by seven county councilors. Its main economic base is LANL. There are no special characteristics that attract a large number of non-residents. There are no commercial nuclear power plants located within 80 km (50 mi) of Los Alamos and there are no commercial nuclear power plants in New Mexico.

History of Emergencies

Los Alamos is no more prone to technological hazards than the average community, although it is slightly more prone to natural disasters, specifically wildfires. Los Alamos County has had significant experience with the hazard that led to this evacuation, including a large fire in 1954, La Mesa Fire (1977), Dome Fire (1996), Lummis Fire (1997), Oso Fire (1998), and Guaje Fire (2000). However, the town of Los Alamos had not experienced any evacuations in the previous10 years and most likely had no prior experience with the alerting mechanism used in this evacuation, which was a reverse 911 telephone system.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

The community had a written emergency plan, which contained an evacuation section and it was used in this emergency. The Los Alamos County Emergency Management Plan generally conformed to NUREG-0654/FEMA-REP-1, Rev. 1, except that it did not contain an ETE. However, authorities estimated that it would take 12 hours to evacuate Los Alamos and the evacuation was accomplished in half that time.

Training

Training is provided to emergency response personnel, and joint training is regularly conducted with LANL.

Drills and Exercises

Los Alamos County's emergency response agencies regularly conduct emergency drills and exercises and the emergency plan used in this evacuation was previously tested in a full-scale field exercise. The exercise performed immediately before this evacuation was most likely a functional drill.

Community Awareness

The local community is highly aware of local hazards, especially of the hazard (i.e., wildfire) that caused this evacuation. However, the community's awareness about evacuation procedures and about the alerting method used in this evacuation was likely no higher than that of the average community.

THREAT CONDITIONS

The Cerro Grande Fire began as a prescribed burn on May 4, 2000, and quickly spread out of control. A total of 12,000 people were evacuated from Los Alamos. The evacuations occurred during the daytime. The weather was hot and dry and the roads were dry. The Los Alamos evacuation involved two unusual circumstances. First, a special institution (i.e., the Los Alamos

Medical Center) had to be evacuated. Second, Los Alamos sits on a hill with only one main road out of the town.

CONSEQUENCES

As the uncontrolled wildfire approached Los Alamos, the entire town was evacuated. First, approximately 1,000 people were evacuated on May 7 and another 11,000 were evacuated on May 10 for a total of 12,000 evacuees. There were no reported deaths or injuries due to either the wildfire or the evacuation although a few firefighters suffered minor injuries. The estimated cost to the public of the evacuation itself, and not of any damages associated with the wildfire, is several million dollars. Federal disaster aid was made available to families who had lost homes; however, there was no reimbursement for evacuation expenses since food and shelter was provided to those who chose to go to the congregate care centers.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was very high. Some of the local, state and federal agencies involved in this emergency include the U. S. Forest Service, National Park Service, Federal Emergency Management Agency, Los Alamos County, Santa Clara Pueblo and San Ildefonso Pueblo, state and local police, New Mexico National Guard, and firefighters and emergency personnel from all over the country. Political boundaries were not crossed. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Los Alamos Police Chief although other authorities influenced his decision. No problems were identified with the decision-making process even though there was no legal authority to order an evacuation.

Communications
Two EOCs were used during this evacuation, one maintained by LANL and the other maintained by Los Alamos County. This was confusing and did not work well. As a result, the County Emergency Management Plan has been re-written to have a Joint LANL/Los Alamos County EOC in future emergencies. Field emergency responders communicated with the EOC by cell phone/pagers and radios. However, the radios did not work well because Los Alamos County's various radio systems were designed for routine minimal operational demands. Interoperability within Los Alamos County and with out-of-town supporting services was a problem. Therefore, most of the communications took place using cell phones/pagers. Amateur ham radio operators were very effective in getting and passing on information.

Notification and Warning
Senior local officials were notified of the incident by telephone, the Community Alert Network System (CANS), which is a reverse 911 system that calls all of the numbers in its database and alerts the recipients of the hazard, the evacuation, and appropriate emergency procedures they should follow. Emergency responders were notified of the incident by cell phones and pagers

and personnel utilized phone trees to make sure all responders were notified. Because of the nature of this particular incident and the somewhat remote location, response personnel were not mobilized to the scene until over an hour after the start of the incident. A partial (and smaller) evacuation occurred three days following the start of the prescribed burn; however, the main evacuation took place five days from the start of the prescribed burn. The time to complete the main evacuation was four to six hours. There were no problems identified with the notification of emergency personnel or senior local officials. The public was notified by the CANS system described above.

The evacuation was staged; the first stage on May 7 involved approximately 1,000 people and the second stage (the main evacuation) involved 11,000 people. The CANS system was slow and it was later discovered to have an outdated database of telephone numbers. Therefore, it was not as effective in notifying the public as it could have been. It has since been replaced with the Emergency Preparedness Notification System, another reverse 911 system, which is operated by Qwest Communications.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated and were told to use three main routes that were designated with police barricades. The Los Alamos Police and the New Mexico National Guard manned roadblocks and assisted in the evacuation. The final route out of town is the one main road that goes down the hill out of Los Alamos. Reverse-laning was used. One special institution (the Los Alamos Medical Center) was evacuated early as a precaution. Road conditions before the evacuation were dry. No major roadways were unavailable for use due to construction or due to damage caused by the hazard, and there were no special traffic problems and no traffic accidents. In fact, the main evacuation on May 10 proceeded twice as fast as predicted. There were some instances of residents evacuating early after they saw the smoke in town. Some residents refused to evacuate and officials did not have the legal authority to force them to evacuate. The residents who stayed watered the areas surrounding their homes and their neighbors' homes to prevent them from burning.

Congregate Care Centers

Congregate care centers were used and were managed by local Red Cross personnel. A pre-planned congregate care center was set up at the White Rock Baptist Church; however, when White Rock was ordered evacuated the following day (May 11), new congregate care centers were opened at the Pojoaque High School, Santa Fe High School, and the Cities of Gold Casino in Pojoaque. Other congregate care centers were reportedly available in Glorieta and at the Pojoaque Gym. Most evacuees came to the congregate care centers for information and meals, but few clients needed sleeping facilities. Less than 10% of evacuees stayed at the congregate care centers. The vast majority of evacuees stayed with friends and relatives, in hotels, or in their own personal recreational vehicles. There were no shadow evacuations.

Law Enforcement
The Los Alamos Police Department, augmented by the Air National Guard Security Police and mutual aid departments, maintained intensive security patrols in burned and evacuated areas. There were no reported instances of looting or vandalism and no problems identified with law enforcement.

Re-Entry
On May 16, 2000, Los Alamos reopened except for the area west and north of Diamond Drive. The town had water and electricity but large areas did not have natural gas. Re-entry was authorized by the Los Alamos Emergency Manager and was accomplished with the assistance of the Los Alamos Police Department. The re-entry process was a controlled, phased re-entry because so many homes had been destroyed by the wildfire. Federal disaster aid was made available to families who had lost homes; however, there was no reimbursement for evacuation expenses since food and shelter was provided to those who chose to go to the congregate care centers.

INVESTIGATOR COMMENTS

The county's pre-incident planning was adequate but understandably did not anticipate the magnitude of a Cerro Grande-type incident.

As summarized from "The Cerro Grande Fire of 2000: Summary of Matters to be Considered by the Los Alamos County Council, December 16, 2002," relevant lessons learned include:

1. The operation of two EOCs did not work well and the County Emergency Management Plan has been rewritten to have a Joint LANL/County EOC. The revised plan was approved by Council in June 2001.

2. The automated telephone citizen notification system used, the Community Alert Network System (CANS), was not as effective as desired. CANS has been replaced with the Emergency Preparedness Notification System, operated by Qwest, and appears to be a better system.

3. Animal control, specifically care of pets when the town was evacuated, became a major issue. Tentative mutual aid agreements, prompted by the State Department of Agriculture, have been discussed by County Animal Control personnel and Santa Fe City and County.

4. Tracking and registering evacuees proved to be a big problem. Evacuees should be encouraged to register via internet on the County website or by telephone with a designated County office. The website should be configured to accept a large number of registrants, and to receive additional input from telephoned messages.

5. Donated food, clothing, services, and material exceeded needs and was uncontrolled.

6. The American Red Cross national response personnel were very difficult to work with and declined to coordinate any of their activities with the County. Local Red Cross personnel initially provided their usual good services, but were completely ignored by the national level team.

7. The County's various radio systems were designed for routine minimal operational demands. Interoperability within the County and with out-of-town supporting services was and continues to be a problem.

8. The Public Information Telephone Center was one of the most effective steps taken during the entire operation. Fifty phone lines were placed in operation within a matter of hours, and handled over 7,000 calls in the first day.

9. Emergency Management "news bulletins" proved to be a very effective means of getting timely updates to County officials, the media, and the public. These announcements addressed fire and law enforcement/security operations, status of utilities and other services, road closings and openings, volunteer operations, and store openings.

10. The County Joint Service Center was conceived to be the center for recovery operations by returning residents. All agencies were housed in one building to provide a "one-stop" service under management by the County. The operation was well received by residents.

11. The American Red Cross, and to a lesser extent, FEMA, were reluctant to be housed with any other agencies or with each other. Only strong direction by a county manager kept the Red Cross functioning as part of the Joint Service Center.

12. The decision to bring in managers from the city of Oakland (California), which had experienced a major conflagration in the recent past, was a good one. Their list of actions taken and advice was invaluable in ensuring all that should be done was done.

13. A major lesson learned was how to transition from emergency to recovery operations. This was accomplished by creating the Recovery Planning Group, which operated under the direction of the Emergency Manager. It was composed of department manager-level personnel, and met daily, usually for several hours. Its charter was to consider all problems from the residents' perspective. Second-level personnel continued staffing the EOC during the period the two groups overlapped.

14. County management was instrumental in getting the "Cerro Grande Fire Assistance Act" through Congress. This was a much needed piece of legislation that provided both short- and long-range relief to the county and its citizens.

CONTACT INFORMATION AND REFERENCES

<u>Contacts</u>

Emergency Management Coordinator
P.O. Box 30
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Los Alamos Medical Center
(505) 661-8900

<u>References</u>

Baker, D. "Northern N. M. Fire Burns Thousands of Acres, Forces Evacuations." *Associated Press.* May 31, 2000.

Los Alamos Community Pages. "Wildfire!" 2001. <http://www.losalamos.org/laarc/CerroGrandeFire-K5QIN.html> (June 2003).

Los Alamos County. "The Cerro Grande Fire of 2000: Summary of Matters to be Considered by the Los Alamos County Council." December 16, 2002. <http://www.lac-nm.us/vertical/Sites/{845D0DAE-A374-48AD-926F-F850E019F2CD}/uploads/{4883FE6F-492D-4973-A789-69175EDD4886}.PDF> (June 2003).

MacDonald, J. "Relief and Grief as Fire Evacuees Get Look at Homes." *Associated Press*. May 15, 2000.

Deadwood Fire, Deadwood, South Dakota, June 29, 2002, ID #213

Summary

Rank Value: 58
Number Evacuated: 15,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Suburban

INTRODUCTION

An 18.2 km^2 (4,500 acre) wildfire near Deadwood, South Dakota, forced the evacuation of 15,000 people on June 29, 2002. Deadwood, about 64 km (40 mi) northwest of Rapid City, is home to about 80 casinos and attracts thousands of tourists to its casinos on summer days. Many of the evacuees were gamblers rather than local residents. The population of Deadwood is only 1,380 people. Three special institutions were evacuated, including a nursing home, the county jail and the Deadwood hospital. Only the nursing home evacuation was of any major consequence, and ambulances and special-lift vans from other towns were used to transport the elderly. The Deadwood hospital only had three patients. In addition to Deadwood, half of the town of Lead and the Boulder Canyon Country Club were later evacuated.

COMMUNITY CONTEXT

General

Deadwood, a small suburban community of only 1,380 people, is about 64.4 km (40 mi) northwest of Rapid City, South Dakota. It attracts thousands of tourists to its eighty casinos, and the local population swells during the summer months. Population density was high during this evacuation. On June 29, 2002, 15,000 people were evacuated. This represented the entire community. Ethnicity, nationality, and age were not important factors in the evacuation.

Deadwood is a city with a mayoral form of government. Its main economic base is tourism, which attracts a large number of non-residents. Deadwood is more than 80 km (50 mi) from the nearest commercial nuclear power plant and there are no nuclear power plants in the state of South Dakota.

History of Emergencies

Deadwood is more prone to natural disasters than average. Wildfires are frequent in the surrounding areas and the community has had prior experience with them. However, the last evacuation of Deadwood was for a wildfire in 1959. The community did not have previous experience with the alerting mechanism used (door to door).

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Lawrence County has a written emergency plan with an evacuation section, the "spirit" of which was followed in this emergency. The wildfire spread so fast that there was not a lot of time to "open the book." The Lawrence County Emergency Plan is currently being revised. The plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, in most aspects, except it did not contain an ETE.

Training
Training is provided to emergency response personnel. The local emergency planning committee includes members from industry and government, and joint training is conducted with emergency response personnel.

Drills and Exercises
The emergency response agencies regularly conduct emergency drills and exercises. A minimum of one drill is required each year, and two drills were conducted in 2002. The emergency plan used in this evacuation was previously tested in a full-scale field exercise.

Community Awareness
The residents of Deadwood are highly aware of local hazards (i.e., wildfires). They are moderately familiar with evacuation procedures and they would have been highly aware of the alerting methods used in this evacuation since it was just door-to-door notification.

THREAT CONDITIONS

The threat leading to the evacuation was a wildfire that started at about 2 p.m. on June 29, 2002, about a mile south of Lead, which is 4.8 km (3 mi) from Deadwood. The cause of the fire is unknown, but lightning was reported in the area the previous night. Hot, windy conditions in the northern Black Hills made the situation worse. The temperatures soared as high as 43.3°C (110°F).

The fire spread very rapidly and took out all of the power, as well as destroying cell phone towers. Therefore, telephones, cell phones, and televisions could not be used, and emergency personnel had to rely on radios. In addition, all notification had to be done door to door. Although the media reported that civilian use of cell phones jammed the communication system, the emergency management manager reported that the communication failure was caused by destruction of the cell phone towers in the fire.

CONSEQUENCES

Approximately 15,000 people were evacuated due to the Deadwood Fire. There were no deaths or injuries resulting from either the fire or the evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. Political boundaries were not crossed. Command, control and coordination processes could best be described as pre-planned. Unofficially, the emergency manager ordered the evacuation. However, officially the evacuation order came from the governor. There were no problems with the decision-making process.

Communications

An EOC and an ICP were used in this emergency. Communication between field emergency responders and the EOC was by radio. All other communication methods were down because of the fire, but, according to the emergency manager, this was not a major problem for them because they usually communicate by radio. Although the media reported that civilian use of cell phones jammed the communication system, the emergency management manager reported that the communication failure was due to destruction of cell phone towers in the fire.

Notification and Warning

Senior local officials were notified of the incident when emergency personnel knocked on their door. Emergency responders were notified by radio dispatch. There were no problems with notification. Response personnel mobilized to the scene within two minutes of discovery of the incident. The decision to evacuate was made within 30 minutes of discovery of the incident. The main evacuation took about 40 minutes to complete. The public was notified by emergency personnel who went door to door. The evacuation was staged. The nursing home was evacuated early as a precaution; next the main evacuation took place in Deadwood; later, half of Lead and the Boulder Canyon Country Club were evacuated. There were no special problems with warning or subsequent citizen action.

Traffic Movement and Control

People were told to head north toward Spear Fish when they evacuated; however, they were not told what routes to take. They were told that congregate care centers were set up at Black Hills State University in Spear Fish and the former armory in Lead. Three special institutions were evacuated, a nursing home, the county courthouse, including the county jail, and the Deadwood Hospital. Only the first one, the nursing home, required much in the way of special arrangements. The Deadwood Hospital, for example, only had three patients. The nursing home, however, was evacuated early as a precaution. Ambulances and special-lift vans were used to evacuate the elderly. In addition, a trolley system from Black Hills was used to evacuate the elderly.

Road conditions were clear and dry; however, Route 385 was eliminated as an evacuation route after the fire jumped it. There were traffic jams that the media reported as significant but they were not significant according to the emergency manager. That manager said that traffic was still moving even though it was bumper to bumper, and there were no traffic accidents. There was no time for spontaneous evacuations. Reverse-laning was used. Only a few people refused to evacuate, including a hotel operator and his employee.

Congregate Care Centers

Congregate care centers included the former armory in Lead and the sports and fitness center at Black Hills State University in Spear Fish. The American Red Cross managed the congregate care centers. Only a few hundred people (less than 5%) registered at the congregate care centers. There were no shadow evacuations.

Law Enforcement

The State Highway Patrol (police) secured the area following the evacuations. They went house to house to make sure all of the doors were locked. There were no instances of looting or vandalism, and no problems with law enforcement.

Re-Entry

The Federal Firefighting Team authorized re-entry. No special controls were used during re-entry; however, law enforcement accompanied those who had lost their homes in the fire. Evacuees were not compensated for their expenses. No major problems occurred during re-entry.

CONTACT INFORMATION AND REFERENCES

Contacts

Lawrence County Emergency Manager
(605) 578-2122
(Personal Communication, June 30, 2003)

References

Kafka, J. "Black Hills towns evacuated as wildfire burns on hillsides above them." *Associated Press*. July 1, 2002.

Kafka, J. "Residents of Black Hills gambling town ordered to evacuate as fire approaches." *Associated Press*. June 30, 2002.

Cerro Grande Fire, White Rock, New Mexico, May 11, 2000, ID #209

Summary

Rank Value: 58
Number Evacuated: 7,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Suburban

INTRODUCTION

The Cerro Grande Fire, which began on May 4, 2000, was the largest, most destructive wildfire that New Mexico has ever known. Originally started as a prescribed burn in Bandelier National Monument, the wildfire ultimately burned 190 km^2 (47,000 acres) and caused the evacuations of thousands of people in Los Alamos County. As a result, 7,000 people were evacuated from the unincorporated community of White Rock, New Mexico on May 11. Previously, 12,000 people had been evacuated from the town of Los Alamos on May 7 and May 10 (See also ID #107). The White Rock evacuation did not go well. Hampering the evacuation effort was the fact that White Rock had swollen in size by at least 1,000 people who came from Los Alamos the day before seeking shelter. Several changes were made to the Los Alamos County Emergency Management Plan as a result of lessons learned during the evacuations. One major change was that White Rock was subdivided into three notification zones and three specific evacuation zones in order to relieve congestion and improve evacuation times.

COMMUNITY CONTEXT

General

On the evening of May 11, 2000, approximately 7,000 people in White Rock, New Mexico were ordered to evacuate as wildfires neared their community. White Rock is a small, unincorporated community located near Los Alamos. The size of the community and of the evacuated area is 18.6 km^2 (7.2 mi^2). The population density during the evacuation was high. White Rock is a bedroom community to Los Alamos and the main economic base is LANL. There are no special characteristics that attract a large number of non-residents; however there were a high number of non-residents in White Rock on the day of the evacuation because evacuees from Los Alamos came to the congregate care center set up at the White Rock Baptist Church. There are no commercial nuclear power plants located within 80 km (50 mi) of White Rock and there are no such plants in New Mexico.

History of Emergencies

White Rock is no more prone to technological hazards than the average community, although it is slightly more prone to natural disasters, specifically wildfires. Los Alamos County has had significant experience with the hazard that led to this evacuation. Residents were well aware of the significance of the Cerro Grande Fire and had witnessed the evacuation of Los Alamos the previous day (See also ID #107). In addition, the community has witnessed several large fires over the last 36 years, including a large fire in 1954, La Mesa Fire (1977), Dome Fire (1996), Lummis Fire (1997), Oso Fire (1998), and Guaje Fire (2000). However, White Rock had not experienced any evacuations in the previous 10 years and likely had no prior experience with the alerting mechanism used in this evacuation, which was a reverse 911 telephone system.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan, which contained an evacuation section and it was used in this emergency. The Los Alamos County Emergency Management Plan generally conformed to NUREG-0654/FEMA-REP-1, Rev. 1, except that it did not contain an ETE.

Training
Training is provided to emergency response personnel, and joint training is regularly conducted with LANL.

Drills and Exercises
Los Alamos County's emergency response agencies regularly conduct emergency drills and exercises, and the emergency plan used in this evacuation was previously tested in a full-scale field exercise. The exercise performed immediately prior to this evacuation was most likely a functional drill.

Community Awareness
The local community is highly aware of local hazards, especially of the hazard (wildfires) that caused this evacuation. However, the community's awareness of evacuation procedures and of the alerting method used in this evacuation was likely no higher than that of the average community.

THREAT CONDITIONS

The Cerro Grande Fire began as a prescribed burn on May 4, 2000. A total of 7,000 people were evacuated from White Rock. The evacuations occurred during the night and proceeded slowly. The weather was hot and dry and the roads were dry. The White Rock evacuation had one unusual circumstance; the town had swollen in size due to evacuees from Los Alamos who had sought shelter in White Rock. This increased the population by at least 1,000 people.

CONSEQUENCES

On May 11, 2000, as the uncontrolled wildfire approached White Rock, the entire town of 6,000 people plus the 1,000 evacuees from Los Alamos were evacuated for a total of 7,000 evacuees. There were no reported deaths or injuries resulting from either the wildfire or the evacuation. The estimated cost to the public of the evacuation itself, and not of any damages associated with the wildfire, is several million dollars. Federal disaster aid was made available to families who had lost homes; however, there was no reimbursement for evacuation expenses since food and shelter was provided to those who chose to go to the congregate care centers.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was very high. Some of the local, state and federal agencies involved in this emergency include the U.S. Forest Service, National Park Service, Federal Emergency Management Agency, Los Alamos County, Santa Clara Pueblo and San Ildefonso Pueblo, state and local police, New Mexico National Guard, and firefighters and emergency personnel from all over the country. Political boundaries were not crossed. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Los Alamos Police Chief, although other authorities influenced his decision. No problems were identified with the decision-making process, even though there was no legal authority to order an evacuation.

Communications

The same two EOCs that were used for the Los Alamos emergency (See also ID #107) were used for the White Rock evacuation. This included one EOC maintained by LANL and the other maintained by Los Alamos County. This was confusing and did not work well. As a result, the County Emergency Management Plan has been re-written to have a Joint LANL/County EOC in future emergencies. Field emergency responders communicated with the EOC by cell phone/pagers and radios. However, the radios did not work well because the county's various radio systems were designed for routine minimal operational demands. Interoperability within the county and with out-of-town supporting services was a problem. Therefore, most of the communications took place using cell phones/pagers. Amateur ham radio operators were very effective in getting and passing on information.

Notification and Warning

White Rock does not have any senior local officials. It is a small, unincorporated community. However, senior county officials and emergency responders were notified of the incident by cell phones and pagers and personnel utilized phone trees to make sure all responders were notified. Response personnel were not mobilized to the scene until over an hour after the start of the incident. The evacuation took several hours to complete (much longer than the evacuation of Los Alamos the previous day). There were no problems identified with the notification of emergency personnel. The evacuation took place all at once on May 11, 2000, and approximately 7,000 people were evacuated. The public was notified of the incident by telephone, using the Community Alert Network System (CANS), which is a reverse 911 system that calls all of the numbers in its database and alerts the recipients of the hazard, the evacuation, and appropriate emergency procedures to follow. The CANS system was found to have an outdated database of telephone numbers and was not as effective in notifying the public as it could have been. It has since been replaced with the Emergency Preparedness Notification System, another reverse 911 system, which is operated by Qwest Communications.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated and were told to use three main routes that were designated with police barricades. The Los Alamos police and the New Mexico National Guard manned roadblocks and assisted in the evacuation. Road conditions prior to the evacuation were dry. No major roadways were under construction and therefore unavailable and none were damaged by the hazard. Traffic was heavy because the population of White Rock had swollen in the previous 24 hours with evacuees from Los Alamos who had sought shelter there. However, no traffic accidents were reported. If there were any instances of spontaneous early evacuations, they were negligible. No one refused to evacuate.

Congregate Care Centers

Congregate care centers were used and were managed by local Red Cross personnel. Congregate care centers were set up at the Pojoaque High School, Santa Fe High School, and the Cities of Gold Casino in Pojoaque. Other congregate care centers were reportedly available in Glorieta and at the Pojoaque Gym. Most evacuees came to the congregate care centers for information and meals, but few clients needed sleeping facilities. Less than 10% of evacuees stayed at the congregate care centers. The vast majority of evacuees stayed with friends and relatives, in hotels, or in their own personal recreational vehicles. There were no shadow evacuations.

Law Enforcement

The Police Department, augmented by the Air National Guard Security Police and mutual aid departments, maintained intensive security patrols in burned and evacuated areas. There were no reported instances of looting or vandalism, and no problems were identified with law enforcement.

Re-Entry

On May 14, 2000, White Rock was re-opened to residents. Re-entry was authorized by the Los Alamos County Emergency Manager and was accomplished with the assistance of the Police Department. There were no special controls during the re-entry process because, unlike Los Alamos (See also ID #107), none of the homes in White Rock had been destroyed by the wildfire. Federal disaster aid was made available to families who had lost homes; however, there was no reimbursement for evacuation expenses since food and shelter was provided to those who chose to go to the congregate care centers.

INVESTIGATOR COMMENTS

The county's pre-incident planning was adequate but understandably did not anticipate the magnitude of a Cerro Grande-type incident. One major change to the plan was that White Rock was subdivided into three notification zones and three specific evacuation zones in order to relieve congestion and improve evacuation times.

As summarized from "The Cerro Grande Fire of 2000: Summary of Matters to be Considered by the Los Alamos County Council, December 16, 2002," relevant lessons learned include:

1. The operation of two EOCs did not work well and the County Emergency Management Plan has been rewritten to have a Joint LANL/County EOC. The revised plan was approved by Council in June 2001

2. The automated telephone citizen notification system used, the Community Alert Network System (CANS), was not as effective as desired. CANS has been replaced with the Emergency Preparedness Notification System, operated by Qwest, and appears to be a better system.

3. Animal control, specifically care of pets when the town was evacuated, became a major issue. Tentative Mutual Aid agreements, prompted by the State Department of Agriculture, have been discussed by County Animal Control personnel and Santa Fe City and County.

4. Tracking and registering evacuees proved to be a big problem. Evacuees should be encouraged to register via internet on the county website or by telephone with a designated county office. The website should be configured to accept a large number of registrants, and to receive additional input from telephoned messages.

5. Donated food, clothing, services, and material exceeded needs and was uncontrolled.

6. The American Red Cross national response personnel were very difficult to work with and declined to coordinate any of their activities with the county. Local Red Cross personnel initially provided their usual good services, but were completely ignored by the national level team.

7. The county's various radio systems were designed for routine minimal operational demands. Interoperability within the county and with out-of-town supporting services was and continues to be a problem.

8. The Public Information Telephone Center was one of most effective steps taken during the entire operation. Fifty phone lines were placed in operation within a matter of hours, and handled over 7,000 calls in the first day.

9. Emergency Management "news bulletins" proved to be a very effective means of getting timely updates to county officials, the media, and the public. These announcements addressed fire and law enforcement/security operations, status of utilities and other services, road closings and openings, volunteer operations, and store openings.

10. The County Joint Service Center was conceived to be the center for recovery operations by returning residents. All agencies were housed in one building to provide a "one-stop" service under management by the county. The operation was well received by residents.

11. The American Red Cross, and to a lesser extent, FEMA, were reluctant to be housed with any other agencies or with each other. Only strong direction by a county manager kept the Red Cross functioning as part of the Joint Service Center.

12. The decision to bring in managers from the city of Oakland (California), which had experienced a major conflagration in the recent past, was a good one. Their list of actions taken and advice was invaluable in ensuring all that should be done was done.

13. A major lesson learned was how to transition from emergency to recovery operations. This was accomplished by creating the Recovery Planning Group, which operated under the direction of the Emergency Manager. It was composed of department manager-level personnel, and met daily, usually for several hours. Its charter was to consider all problems from the residents' perspective. Second-level personnel continued staffing the EOC during the period the two groups overlapped.

14. County management was instrumental in getting the "Cerro Grande Fire Assistance Act" through Congress. This was a much needed piece of legislation that provided both short and long-range relief to the county and its citizens.

CONTACT INFORMATION AND REFERENCES

Contacts

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Los Alamos, NM
(505) 662-8228

Chief, Emergency Operations Bureau
Office of Emergency Services & Security
13 Bataan Blvd.
Santa Fe, NM 87504-1628
(505) 476-9622

<u>References</u>

Koidin, M. "Three Days away, White Rock's 7,000 Residents Return Home." *Associated Press*. May 15, 2000.

Los Alamos County. "The Cerro Grande Fire of 2000: Summary of Matters to be Considered by the Los Alamos County Council." December 16, 2002. <http://www.lac-nm.us/vertical/Sites/{845D0DAE-A374-48AD-926F-F850E019F2CD}/uploads/{4883FE6F-492D-4973-A789-69175EDD4886}.PDF> (June 2003).

Hayman Blaze, Douglas County, Colorado, June 2002, ID #119

<u>Summary</u>

Rank Value: 56
Number Evacuated: 5,500
Category: Natural Disaster
Specific Type: Wildfire
Community: Rural

INTRODUCTION

The Hayman Wildfire in Douglas County, Colorado, forced the evacuations of more than 40,000 residents who lived just southwest of Denver. The fire began from an illegal campfire in Pike National Forest, about 10 km (6 mi) northwest of Lake George. Fire investigators believe the fire was ignited by underground coal that had been burning since the 1970s. Different sections of the fire were spreading in Park, Jefferson, and Douglas counties, spurring evacuations in Deckers, Trumbull, the Wigwam Creek area, as well as areas west of Colorado Highway 67.

Six congregate care centers were set up by the American Red Cross in Woodland Park, Lake George, Littleton, Highlands Ranch, Colorado Springs, and Castle Rock for at least 3,000 residents previously evacuated. Two other congregate care centers were opened to house 270 travelers stranded when a 111-km (69-mi) long section of I-70 was closed Sunday because of approaching flames and heavy smoke.

COMMUNITY CONTEXT

<u>General</u>
Douglas County is a suburban county in Colorado located in the southern region of the state. It has a total population of 175,766 people. Approximately 5,500 people (3% of the population) from the city of Castle Rock in Douglas County were evacuated. Land use in the evacuation area was primarily residential. The total area of Douglas County is 2,183 km^2 (843 mi^2) and the evacuated area was 155 km^2 (60 mi^2). The population density of the area during the evacuation was medium. Ethnicity, nationality, and age were not important factors in the evacuation.

Douglas County has a commission and board form of government and its main economic base is tourism. Tourism and people traveling on Interstate 67 attract a large number of non-residents to the area. The nearest commercial nuclear power plant is more than 80 km (50 mi) away.

<u>History of Emergencies</u>
Douglas County is no more prone to hazards than the average U.S. county. The community had previous experience with the hazard that led to this evacuation and had experienced evacuations

in the previous ten years. The community also had previous experience with the alerting mechanisms used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan, but it did not contain a specific evacuation section and was the plan used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if it contained an ETE.

Training
Training is provided to emergency response personnel but joint training between industry and government is not regularly conducted.

Drills and Exercises
Douglas County's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was not previously tested in a full- scale field exercise, but was tested in sections.

Community Awareness
The level of community awareness of local hazards was medium. The level of community awareness of evacuation procedures was also medium, and the level of awareness about the hazard that caused the evacuation was low. The level of community awareness about alternate methods used in this evacuation was medium.

THREAT CONDITIONS

The threat condition leading to this evacuation was a wildfire that began on June 4, 2002, at approximately 4 p.m. in Pike National Forest and burned more than 100,000 acres before it was completely contained on July 2, 2002. Weather conditions were clear and dry and the roads were dry. There were no unusual circumstances that occurred during this incident other than the hazard itself.

CONSEQUENCES

Approximately 5,500 people were evacuated from their homes and businesses beginning on June 4, 2002, and were allowed to return on July 2, 2002. There were no deaths or injuries caused by the hazard or by the evacuation. The estimated total costs of evacuation related expenses incurred by the public are unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation between local, state, and federal agencies was high. Five political boundaries were crossed which included county, national, and forest boundaries. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was first made by the sheriff and emergency manager of Douglas County and then became federal jurisdiction. There were problems with the decision making process because there were two different evacuation commands issued.

Communication

An EOC was used along with an ICP. Communication between field emergency responders and EOC was by radio, telephone, and cell phone. There were no problems with communication.

Notification and Warning

Senior local officials and emergency responders were notified by telephone. The elapsed time between the discovery of the incident and the mobilization of response personnel is unknown. The elapsed time between the start of the hazard, the decision to evacuate, and the total time it took to complete the evacuation is unknown because the evacuation was staged over the course of a month. There were no problems with notification of emergency personnel or senior local officials. The public was notified by radio and television broadcasts, a reverse 911 system, and by emergency responders going door to door. There were no special problems regarding warning and subsequent citizen actions.

Traffic Movement and Control

Evacuees were given specific routes and directions about where to go. These routes were designated by roadblocks and there were access limitations. There were no special institutions evacuated. Road conditions prior to the evacuation were dry and Highway 67 was unavailable due to the fire. Reverse-laning was not used. No special traffic problems were encountered and no traffic accidents occurred. Some people spontaneously evacuated and others refused to evacuate.

Congregate Care Centers

The American Red Cross set up six congregate care centers in Woodland Park, Lake George, Littleton, Colorado Springs, Highlands Ranch, and Castle Rock for 3000 residents. It is unknown what percentage of evacuees used the congregate care centers. There were shadow evacuations but this did not impact traffic or congregate care center capacity.

Law Enforcement

The police secured the area following the evacuation and there were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry
Incident management teams authorized re-entry through a controlled phase based on the fire's location. Evacuees were not compensated for their expenses and there were no major problems during re-entry.

INVESTIGATOR COMMENTS

Pre-designated evacuations, trigger points, telephone notification systems, and the public's prior knowledge of the hazard contributed to the success of the evacuation. Reoccupation issues about when and how evacuees could return home made the evacuation difficult.

CONTACT INFORMATION AND REFERENCES

Contacts

Douglas County Emergency Services Coordinator
(303) 660-7589
8/20/03

References

Long, C. Disaster Relief News Stories. "Hayman Wildfire Breaks Lines." June 18, 2002.

Long, C. Disaster Relief News Stories. "Hayman Fire 30% Contained." June 15, 2002.

Wikipedia, The Free Encyclopedia. "Douglas County, Colorado.

<http://www.thechamplainchanel.com/news/1506760/detail.html>

<http://www.cnn.com/2002/US/06/17/colorado.fires/>

Hamilton, J. "Forrest Service Employee Charged with Staring Fire." *Associated Press. Portsmith Herald.* Castle Rock, Colorado.

Railroad Accident, Flora, Mississippi, July 18, 1997, ID #198

Summary

Rank Value: 56
Number Evacuated: 6,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Rural

INTRODUCTION

On July 18, 1997, 6,000 residents were evacuated from their homes in Flora and an area five miles north of Flora after 11 tank cars derailed in the middle of the night. Two of the tank cars carried 159,110 L (35,000 gal) of chloroprene, a chemical used to create the synthetic rubber neoprene. No deaths or injuries were associated with the derailment or the evacuation.

COMMUNITY CONTEXT

General
The entire town of Flora, Mississippi, population 1,546, and an area five miles to the north were evacuated (a total of 6,000 people were evacuated). The town of Flora covers an area of 8.8 km^2 (3.4 mi^2), and the evacuated area covered an area of 38.8 km^2 (15 mi^2). The population density was medium during the evacuation. Land use in the evacuated area is residential, commercial, and agricultural. Ethnicity, nationality, and age were not important factors in the evacuation.

The community has a mayoral form of government and its main economic base is agricultural. There is a petrified forest that attracts a large number of tourists. The nearest nuclear power plant is more than 80 km (50 mi) away. Mississippi has one commercial nuclear power plant, Grand Gulf 1, located 40 km (25 mi) south of Vicksburg.

History of Emergencies
The community is no more prone to hazards than average, although it has had experience with derailments and evacuations in the past. In 1995 a car and train accident led to an evacuation. However, the community had no previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

The community did not have a written emergency plan.

Training

The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises

The community's emergency response agencies do not regularly conduct emergency drills or exercises.

Community Awareness

The community has a low level of awareness of local hazards and of the hazard that caused this evacuation (i.e., the chloroprene spill). However, the community has a high level of awareness about evacuation procedures and the alerting methods used in this evacuation.

THREAT CONDITIONS

The threat condition leading to this evacuation was the derailment of a train carrying 159,113 L (35,000 gal) of chloroprene at 3:00 a.m. on July 18, 1997. The roads were dry and clear and there were no unusual circumstances that occurred during the derailment, other than the fact that it occurred in the middle of the night.

CONSEQUENCES

Approximately 6,000 people in a 39 km^2 (15 mi^2) area were evacuated from their homes after a train carrying 159,110 L (35,000 gal) of chloroprene derailed in Flora, Mississippi. No deaths or injuries were associated with the derailment or the evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high, particularly between the Game and Fish Department and the State Highway Patrol. Political boundaries were crossed. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made jointly by the Flora Fire and Police Chiefs and there were no problems with the decision-making process.

Communications

There was an EOC and an ICP during this emergency. Communication between field emergency responders and the EOC was by radio and cell phone. There were no problems with this form of communication.

Notification and Warning

Senior local officials were notified of the incident by telephone and emergency responders were notified through the 911 phone system. There were no problems with notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes, and the decision to evacuate was made approximately 20 minutes after the derailment. It took approximately 1.5 hours to complete the evacuation. The public was notified by police/fire Public Address (PA) system. The evacuation took place all at once and there were no special problems regarding warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were not given specific instructions about where to go but were told to use specific routes designated by roadblocks and manned police patrols. No special institutions were evacuated. Road conditions before the evacuation were dry and there were no traffic accidents and no traffic problems; major roadways were available to evacuees. Reverse-laning was not used. No one evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers

Congregate care centers were not used and there were no shadow evacuations.

Law Enforcement

The State Highway Patrol and the Game and Fish Department secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry

The Flora fire and police chiefs jointly authorized re-entry two days after the derailment occurred. There were no special controls during re-entry and no problems with the re-entry. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

According to the Flora police chief, the evacuation was successful because of cooperation of evacuees.

CONTACT INFORMATION AND REFERENCES

Contacts

Flora Police Chief
(601) 879-8871
(Personal Communication, 7/8/03)

References

"Evacuation Order Lifted for Area around Derailment." *Associated Press*. July 20, 1997.

Flagler County, Florida, Evacuation, July 1998, ID #99

Summary

Rank Value: 53
Number Evacuated: 45,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Suburban

INTRODUCTION

In July 1998, a wildfire started in Flagler County, Florida and spread rapidly through the area. Fires burned in Brevard, Volusia, and Flagler counties and through the neighboring towns of Bunnel and Palm Coast, damaging and destroying homes. At least 150 homes were damaged or destroyed, and more than 800 km^2 (500 mi^2) were blackened. Approximately 45,000 people were evacuated from the area.

COMMUNITY CONTEXT

General
Flagler County, Florida, is a suburban community with a population of approximately 49,832 and it covers an area of 1,478 km^2 (571 mi^2). Approximately 45,000 people, almost 100% of the population, were evacuated from Flagler County. Ethnicity, nationality, and age were not important factors in the evacuation.

The county has a county commission form of government, and the main economic base is commercial and retail services. Tourism to Daytona Beach attracts large numbers of non-residents to the area. The nearest nuclear power plant is more than 80 km (50 mi) away.

History of Emergencies
The area is more prone to natural hazards than the average county, and the county has had experience with wildfires in the past. The community had not experienced large-scale evacuations in the last 10 years; however, there was a large-scale evacuation in 1985. The community had had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

The community had a written emergency plan that was used in this emergency and the plan included an evacuation section. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and there was no ETE in the plan.

Training

The community provides training to emergency response personnel, and joint training between industry and government is regularly conducted.

Drills and Exercises

The community's emergency response agencies regularly conduct emergency drills and exercises; however, the emergency plan had not been previously tested in full-scale exercises.

Community Awareness

The community has implemented a public awareness program and therefore has a high level of awareness of the local hazards and of evacuation procedures. It has a low level of awareness about wildfires and a medium level of awareness about the alerting methods used in this evacuation.

THREAT CONDITIONS

In July 1998, a wildfire in Flagler County, Florida, spread rapidly through the area. Fires also burned in Brevard and Volusia counties and through the neighboring towns of Bunnel and Palm Coast, placing approximately 120,000 people under evacuation orders. The Flagler County fire was noticed immediately after it started; however, no planes were available to fight the fire because they were tied up with other fires in the state. In Flagler County, approximately 45,000 people were ultimately evacuated. The evacuations occurred during the day when weather conditions were dry and hot with gusty winds that hampered firefighters' efforts to control the blaze. The roads were dry and clear except for the smoky haze that covered much of the area, causing motorists to use headlights in midday as visibility was cut to one-quarter mile. Three fires converging on each other, combined with the large number of evacuees, caused significant traffic issues. Traffic was bumper to bumper, and people were told to turn around when the fires shifted directions.

CONSEQUENCES

Beginning around June 1, 1998, some 2,000 wildfires scorched more than 450,000 acres in Florida during a severe drought. Nearly 200 homes were damaged or destroyed and approximately 55 people, many of them firefighters, were injured. Flagler County was the worst hit with fires in July where the fires damaged or destroyed at least 150 homes and blackened more than 800 km^2 (500 mi^2) and caused the evacuation of approximately 45,000 people. During the event, three evacuations took place, and the third evacuation, on July 2, 1998, at approximately 3 p.m., was an order to evacuate the entire county.

There were no fatalities from the wildfires, but four people were injured in Flagler County. There were no fatalities or injuries as a result of the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was moderate, and political boundaries were crossed in this event. The command, control, and coordination processes could best be described as ad hoc. The decision to evacuate was made by the governor, and there were no problems with the decision-making process.

Communications

An EOC and an ICP were used in this emergency. Communication between field emergency responders and the ICP was by radio, telephone, cell phone, and citizen ban (CB) radios. There were problems with having too many frequencies for communications during the event.

Notification and Warning

Senior local officials were notified of the event by pager and cell phone. Emergency responders were aware of the fire when it started but could not immediately get to the fire due to the lighting. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes. Emergency responders could see the fire, but there were no aircraft available to fight the fire as they were tied up on other fires in the state. The initial decision to evacuate was made approximately seven days after the fire started. The entire evacuation was completed within approximately 8 hours.

The evacuation occurred all at once and the public was notified by police going door to door, using PA systems, and by radio and television broadcasts. There were no problems with warning and subsequent citizen action. Some people evacuated before being told to do so, and others refused to evacuate. One individual refused to evacuate in Ormond Beach. Flames ultimately surrounded his house, requiring him to be evacuated by helicopter.

Traffic Movement and Control

Evacuees were given instructions on where to go and were told which routes to use. These routes were designated by hurricane evacuation route signs. There were special institutions evacuated, including the Flagler Palm Coast High School, the County Jail, a hospital and a 60-bed nursing home. Road conditions during the evacuation were dry and visibility was limited by smoke. Approximately 100 miles of Interstate 95 and portions of Interstate 10 were closed, hampering traffic movement. As winds shifted and three fires converged, people were stopped and redirected, causing even greater traffic problems and bumper-to-bumper conditions. Some minor traffic accidents were reported during the event and there were reports of people running out of gas. Reverse-laning was not used.

Congregate Care Centers
The Red Cross established 40 congregate care centers, primarily in schools. Approximately 4,800 people or 10% of the evacuees reported to the congregate care centers. Some of these congregate care centers had to be relocated as the fire encroached on the area. There were reports of individuals traveling well outside of the evacuation limits to ensure that they were out of harm's way. There were shadow evacuations where people from outside Flagler County also evacuated; however, these did not impact the congregate care center capacities or traffic. Many evacuees went to the homes of friends or relatives, as well as to hotels, and even to the Daytona Speedway and Gainesville Fairgrounds to seek shelter.

Law Enforcement
Approximately 1,500 National Guard were brought in to assist police with security following the evacuation. There were some instances of looting, but no instances of vandalism. There were reports of individuals violating curfew and then daring the police to arrest them stating that they would prefer to be taken to jail where it was safe.

Re-Entry
The Chairman of the County Commission authorized re-entry; there were no special controls during re-entry. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

The evacuation worked reasonably well because of the attention the county pays to fires. However, problems included the road closures that hampered the evacuation routes and too many frequencies used for communications. The public's prior knowledge of evacuations stemming from hurricanes and the public awareness education program both contributed to the success of the evacuation.

CONTACT INFORMATION AND REFERENCES

Contacts

Flagler County Fire Department
Emergency Management Division Chief
(386) 437-7831
(Personal Communication, 7/21/03)

References
"Like a war zone." *Associated Press.* Mike Schneider. 7/4/98

Louisiana State University Anthrax Hoax, Alexandria, Louisiana, October 29, 2001, ID #1

Summary

Rank Value: 51
Number Evacuated: 2,000
Category: Malevolent Act
Specific Type: Malevolent Act
Community: Suburban

INTRODUCTION

On October 29, 2001, 2,000 people at Louisiana State University at Alexandria (LSUA) were evacuated after a phone call from a caller who claimed that anthrax had been planted in the school's ventilation system. All nine buildings on campus were evacuated because the caller did not specify which buildings had been contaminated. LSUA has no residence halls and it was a calm and orderly evacuation. The incident was later revealed to be a hoax.

COMMUNITY CONTEXT

General

LSUA is located 11 km (7 mi) south of the city of Alexandria, Louisiana. Alexandria is a suburban community with a population of approximately 46,342 people and covers an area of 69.9 km^2 (27 mi^2). Approximately 2,000 people, or 4.3%, of the population were evacuated from a 1.3 km^2 (0.5 mi^2) area during this incident. The land use in the area is mainly schools and the population density of the area was low. Ethnicity, nationality and age were not important factors in the evacuation.

The university is located just outside of Alexandria and is run by a commission in Rapides Parish. The main economic base of the city is agriculture. The university attracts a large number of non-residents to the area. The nearest nuclear power plant is River Bend located more than 80 km (50 mi) away.

History of Emergencies

The community is more prone to hazards than average and has had experience with highway and rail accidents in the past along with tornadoes. The community has not had experience with anthrax in the past and has not experienced large-scale evacuations in the last 10 years. The community has had previous experience with the alerting methods used at the school, which included use of the local intercom and alarms.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan for the campus with an evacuation section that was used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and there was no ETE in the plan.

Training
The community provides training to emergency response personnel; however, this training does not include training about emergencies involving anthrax. Joint training is regularly conducted, on an annual basis, between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in full-scale field exercises and in tabletop exercises.

Community Awareness
The community has a medium level awareness of the local hazards and a low level of awareness of evacuation procedures. It has a low level of awareness of anthrax in general, and medium awareness of the alerting methods used in this evacuation.

THREAT CONDITIONS

On October 29, 2001, an anonymous call was placed to Louisiana State University at Alexandria (LSUA) from a caller who claimed that anthrax had been placed in the school's ventilation system. The caller did not identify where the anthrax had been placed, requiring the entire campus to be evacuated. The call occurred at 8:15 a.m. during the early morning classes before many students had arrived on campus. The roads were dry and clear on a warm morning, and there were no unusual circumstances that occurred during this event.

CONSEQUENCES

The anthrax threat was later revealed to be a hoax; however, the false report resulted in the evacuation of approximately 2,000 people, or 4.3%, of the population from a 1.3 km^2 (0.5 mi^2) area. All nine buildings on campus were evacuated because the caller did not specify which buildings had been contaminated. A special team was called in to take samples, and classes were suspended until samples demonstrated that the facilities were not contaminated. No fatalities or injuries from the incident or the evacuation occurred. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation between local and state agencies was moderate, and political boundaries were not crossed in this event. The command, control, and coordination processes could best be described as ad hoc for the onsite response and pre-planned for the EOC operations. The decision to evacuate was made by the school Chancellor, and there were no problems with the decision-making process.

Communications

An EOC was used in this event, and an ICP was established in the field. Communication between field emergency responders and the ICP was primarily by radio. There were problems with communications during the event becasue local and state police used different radio frequencies.

Notification and Warning

Senior local officials were notified of the incident by telephone. The emergency responders were notified through a 911 telephone call from the school. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes, and the decision to evacuate the first building was made approximately 15 minutes after the notification of the incident. Approximately 30 minutes later, it was decided to evacuate the rest of the campus. It took less than one hour to complete the evacuation.

Every building that makes up LSU campus was evacuated, and the school made the decision to evacuate. The evacuation took place quickly, but was considered a staged event. There were no problems with warning and subsequent citizen action. No one refused to evacuate.

Traffic Movement and Control

Evacuees were given instructions to get off campus. There was no need to designate transportation routes. The school is a special institution. Road conditions during the evacuation were dry, and no traffic accidents or traffic-related problems occurred during the event. Reverse-laning was not used.

Congregate Care Centers

Congregate care centers were not established for this emergency, and there were no shadow evacuations.

Law Enforcement

Police, the sheriff, state police and campus police secured the area following the evacuation, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
Re-entry was authorized by the Louisiana State Police Hazmat unit, and there were no special controls for re-entry. Evacuees were not compensated for their expenses. There were no problems reported during re-entry.

INVESTIGATOR COMMENTS

Public awareness of the threat from recent events in the United States helped make this evacuation work well. The emergency responders' lack of knowledge of the chemical and biological contamination was a problem. The public's prior knowledge of evacuations also contributed to the success of the evacuation.

CONTACT INFORMATION AND REFERENCES

Contacts

Director
Rapides Parish Office of Emergency Preparedness
(318) 445-0186
(Personal Communication, 8/19/03)

References

Hamilton, K. "Local universities affected by threat of anthrax." Louisiana Wildcat College. November 2, 2001.

Railcar Leak, Sterling Heights, Michigan, March 2000, ID #58

Summary

Rank Value: 51
Number Evacuated: 2,400
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

On March 20, 2000, a railcar carrying hydrochloric acid was found leaking in the CONRAIL yard in Sterling Heights, Michigan. Approximately 2,400 people within a six-block area were evacuated from their businesses and homes.

COMMUNITY CONTEXT

General
The city of Sterling Heights, Michigan, is a suburban community with a population of approximately 124,471 people and covers an area of 95 km^2 (36.8 mi^2). Approximately 2,400 people, or 2% of the population, were evacuated from a 1.3 km^2 (0.5 mi^2) area during this incident. Ethnicity, nationality, and age were not important factors in the evacuation.

The community has a city council form of government with a city manager. Its main economic base is manufacturing. There are a large number of manufacturing facilities in the area that attract large numbers of non-residents. The nearest nuclear power plant is located more than 80 km (50 mi) away.

History of Emergencies
The area is more prone to hazards than the average city, although the city has not had experience with leaking railcars in the past. The community has experienced large-scale evacuations in the last ten years and has had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

The community had a written emergency plan with an evacuation section; however, the plan was not used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan.

Training

The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises

The community's emergency response agencies regularly conduct emergency drills and exercises, and the emergency plan had been previously tested in tabletop and full-scale exercises. In February 2000 General Dynamics Land Systems, a company evacuated during this event, conducted a tabletop exercise with Sterling Heights emergency response personnel and government officials.

Community Awareness

The community has a medium level awareness of the local hazards and a low level of awareness of evacuation procedures. It has a medium level of awareness of hazardous materials in general, and with the alerting methods used in this evacuation.

THREAT CONDITIONS

The threat conditions leading to this evacuation consisted of a leak in a railcar and subsequent plume of hydrochloric acid on March 20, 2000, at approximately 8:30 a.m. Weather conditions were dry and winds were out of the east at approximately 8 kmph (5 mph). The roads were dry and clear and no unusual circumstances occurred during the event.

CONSEQUENCES

Approximately 2,400 people within a 1.3 km^2 (0.5 mi^2) area were evacuated from their businesses and homes after a railcar was discovered leaking hydrochloric acid in Sterling Heights, Michigan. There were no fatalities or injuries from the incident or the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high, and political boundaries were not crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Sterling Heights Fire Department IC, and there were no problems with the decision-making process. Some of the agencies involved in the evacuation and response included the Sterling Heights police, fire and public works departments, EPA, Department of Transportation, Macomb County Health Department, and PVS Transportation, Inc.

Communications
An EOC was not used, but there was an ICP used in this emergency. Communication between field emergency responders and the ICP was by radio. There were no problems with communications during the event.

Notification and Warning
Senior local officials were notified of the incident by telephone, and emergency responders were notified through the 911 phone system. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the initial decision to evacuate was made at 9:40 a.m., approximately one hour after the discovery of the leak when the fire department and PVS Chemical and Transportation organization completed their assessment. At 10:40 a.m., the IC assessed the scenario once more and ordered the evacuation of additional manufacturing facilities, including General Dynamics Land Systems, which employs approximately 1,400 people. The entire evacuation was completed by 11:20 a.m.

The public was notified by a public address system and police going door to door. The evacuation was staged and completed within approximately 1.5 hours. It is unlikely that anyone evacuated before being told to do so, and some people refused to evacuate.

Traffic Movement and Control
Evacuees were given instructions on where to go and were told which routes to use. These routes were designated by police barricade. There were no special institutions evacuated. Road conditions during the evacuation were dry, and no traffic accidents or traffic related problems occurred during the event. Reverse-laning was not used.

Congregate Care Centers
There were no congregate care centers established in this event and people were told to go home. There were no shadow evacuations.

Law Enforcement
Police and private security secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
The EPA monitored the air and, in coordination with the Sterling Heights Fire Department Chief, authorized reentry at approximately 8:00 p.m. There were no special controls during re-entry and evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

According to the Sterling Heights fire chief, the evacuation worked well because of the high level of cooperation between industry and response personnel.

CONTACT INFORMATION AND REFERENCES

Contacts
Sterling Heights Fire Department
Chief of Operations
(586) 446-2991
(Personal Communication, 7/30/03)

References
Sterling Heights Fire Department Incident Report #00-01670.

Jones, Radford. Anticipating the Worst of Times; April 2001.
<http://www.securitymanagement.com/library/001021.html>

Grand Trunk Derailment, Potterville, Michigan, May 27, 2002, ID #70

Summary

Rank Value: 51
Number Evacuated: 2,200
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

On May 27, 2002, the Grand Trunk train derailed in Potterville, Michigan, sending 35 of 58 cars off the tracks. The train had nine cars of propane, two of which were leaking, and two cars of sulfuric acid. The entire town of Potterville, approximately 2,200 people, was evacuated from a 4.8 km^2 (1.9 mi^2) area for five days.

COMMUNITY CONTEXT

General

The town of Potterville, Michigan, is a suburban community with a population of approximately 2,200 people. The entire town was evacuated as a result of the train derailment and release of hazardous materials. The town covers an area of 4.8 km^2 (1.9 mi^2) and 100% of the area was evacuated. Ethnicity, nationality, and age were not important factors in the evacuation.

The community has a town council and town manager form of government with a mayor. Its main economic base is retail trade. There are no special characteristics that attract large numbers of visitors. The nearest nuclear power plant is Palisades, located more than 80 km (50 mi) away.

History of Emergencies

The area is more prone to hazards than average with two railroad tracks running through town and heavy rail traffic in the area. Although the emergency response teams were aware of the potential for railroad cargo to be hazardous, the residents, in general, were unaware of the potential hazards. The community had not experienced large-scale evacuations in the last ten years. It is unknown whether the community had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, and there was no ETE in the plan.

Training
Training is provided to emergency response personnel and training is conducted jointly with the railroad.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises; however, the emergency plan used in this evacuation had not been previously tested in a full-scale exercise.

Community Awareness
The community has a medium level of awareness about the local hazards associated with the railroad. However, it has a low level of awareness about hazardous material leaks, evacuations, and the alerting methods used.

THREAT CONDITIONS

The threat conditions leading to this evacuation included the derailment of 35 cars from the Grand Trunk train. Nine of these cars carried propane and two of the cars carried sulfuric acid. The accident occurred around noon. The roads were dry and clear, and there were no unusual circumstances that occurred during the derailment.

CONSEQUENCES

The entire town of Potterville, Michigan, covering an area of 4.8 km^2 (1.9 mi^2) was evacuated when two of the propane cars leaked in the accident. There were no fatalities or injuries from the accident or the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high. Political boundaries were not crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the fire chief, and there were no problems with the decision-making process.

Communications
An EOC was not used but there was an ICP used in this emergency. Communication between field emergency responders and the ICP was by radio. There were problems with having too many frequencies to manage communications during the event.

Notification and Warning
Senior local officials of this small town were immediately aware of the incident, as everyone responded. Emergency responders were notified through the 911 phone system. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the decision to evacuate was made approximately 10 minutes after the derailment. It took approximately one hour to evacuate the town. The public was notified by a public address system and police going door to door. The evacuation took place all at once and only one person refused to evacuate.

Traffic Movement and Control
Evacuees were given instructions on where to go for congregate care centers and were told which routes to use. These routes were designated using roadblocks. There were no special institutions evacuated. Road conditions during the evacuation were dry and no traffic accidents or traffic-related problems occurred during the event. Reverse laning was not used, and no one evacuated before receiving the evacuation notice.

Congregate Care Centers
A congregate care center was set up at the Sheriff's Office and approximately 90 individuals, 4% of the population, went to the congregate care center. However, most of these people left and went to hotels when they were informed that Canadian National would reimburse residents for hotel rooms. There were no shadow evacuations.

Law Enforcement
Police secured the area following the evacuation, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
Re-entry was allowed after a joint decision by the police chief, fire chief, and mayor. The re-entry process was controlled and phased and there were no problems with re-entry. Evacuees were compensated for food and hotel rooms by Canadian National.

CONTACT INFORMATION AND REFERENCES

Contacts

Potterville Fire Chief
(517) 231-3653
(Personal Communication, 7/23/03)

References

"Potterville, Michigan." *Associated Press* 2002.
<http://archive.ap.org/cgi-bin/display.cgi?id=3fld42cb213efMpqaweb1P11018&doc=print>

"Hundreds forced from homes in Michigan after train derailment." *Associated Press*. May 28, 2002.

"Town of 2,200 Emptied for Derailment" *Associated Press*. May 28, 2002.

"Track Crack Caused Mich. Derailment." *Associated Press*. July 1, 2002.

Railcar Fire, Oshkosh, Wisconsin, December 2000, ID #97

Summary

Rank Value: 51
Number Evacuated: 2,300
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

On December 16, 2000, a release of sulfur dioxide from a railcar that caught fire caused an evacuation of approximately 2,300 people in Oshkosh, Wisconsin. The railcar, leased by Hydrite Chemical Company, released a vapor cloud that forced the evacuation of about 750 homes, the Oshkosh Truck Corporation Service Center, and the Lake Air Shopping Mall. It also forced the shutdown of 2.6 km (1 mi) of Highway 45.

COMMUNITY CONTEXT

General
The town of Oshkosh, Wisconsin, is a suburban community with a population of approximately 3,234 people and covers an area of 158 km^2 (61 mi^2). Approximately 2,300 people, or 71%, of the population were evacuated from a 5.2 km^2 (2 mi^2) area during this incident. Ethnicity and nationality were not important factors in the evacuation; however, age was an important factor with a number of elderly residents with special needs.

The town has a town council form of government, and the main economic base is manufacturing. Tourism attracts a large number of non-residents in the summer months. The nearest nuclear power plant is Point Beach 2 located near Manitowoc, Wisconsin, approximately 83 km (52 mi) away. Wisconsin has two commercial nuclear power plants.

History of Emergencies
The community is more prone to hazards than average, and the town has had experience with chemical leaks from manufacturing plants in the past. The community has experienced large-scale evacuations in the last 10 years; however, the community has not had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises; however, the emergency plan used in this evacuation was not previously tested in full-scale exercises.

Community Awareness
The community has a high level of awareness about the local hazards and a low level of awareness about evacuation procedures. It has a medium level of awareness about hazardous materials in general, and with the alerting methods used in this evacuation.

THREAT CONDITIONS

On December 16, 2000, a release of sulfur dioxide from a railcar that caught fire caused an evacuation in Oshkosh, Wisconsin. The railcar released a vapor cloud that forced the evacuation of about 750 homes, the Oshkosh Truck Corporation Service Center, and the Lake Air Shopping Mall and forced the shutdown of a portion of Highway 45. Weather conditions were cold, snow was falling, and the winds were shifting during the event. The roads were wet and icy.

CONSEQUENCES

Approximately 2,300 people within a 5.2 km^2 (2 mi^2) area were evacuated from their businesses and homes after a railcar containing approximately 310,000 kg (141,000 lb) of sulfur dioxide caught fire. There were no fatalities or injuries from the incident or the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high, and political boundaries were not crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Oshkosh Fire Chief, and there were no problems with the decision-making process.

Communications
An EOC and an ICP were used in this emergency. Communication among field emergency responders and the ICP was by radio and cell phone. There were no problems with communications during the event.

Notification and Warning
Senior local officials were notified of the incident by telephone in accordance with the EOC plan and emergency responders were notified through the 911 phone system. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes, and the initial decision to evacuate was made less than 30 minutes after the fire department reached the scene. It took approximately three hours to complete the evacuation, which started with a local area and expanded to approximately 2,300 people.

The public was notified by radio and television broadcasts, by police going door to door, and with a reverse 911 system. The evacuation was staged and completed within approximately three hours. Some people did evacuate before being told to do so, and some people refused to evacuate.

Traffic Movement and Control
Evacuees were given instructions on where to go and were told which routes to use. These routes were designated by police barricades. There were no special institutions evacuated. Road conditions during the evacuation were wet, but no traffic accidents or traffic-related problems occurred during the event. Reverse-laning was not used.

Congregate Care Centers
Congregate care centers were established at local schools for this emergency and were managed by the Red Cross. There were shadow evacuations; however, this did not have an impact on congregate care center capacity or the evacuation.

Law Enforcement
Police and the sheriff secured the area following the evacuation, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
Re-entry was authorized as a joint decision among the EPA, Department of Natural Resources, and the Fire Chief. Re-entry was controlled and took longer than expected because the EPA wanted to monitor each household before allowing re-entry. Evacuees were compensated for their expenses.

INVESTIGATOR COMMENTS

The cooperation of citizens and multiple means of notification were helpful in making this evacuation a success. It was learned that the radio and cable interrupt did not work very well. The fact that some residents, especially those close to the site, had prior knowledge of hazards helped in this evacuation.

CONTACT INFORMATION

<u>Contacts</u>

Oshkosh Fire Chief
(920) 236-5240

Norfolk Southern Railway Derailment, Farragut, Tennessee, September 15, 2002, ID #73

Summary

Rank Value: 51
Number Evacuated: 3,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

On September 15, 2002, a train derailed in Farragut, Tennessee, just south of Knoxville, and spilled more than 45,460 L (10,000 gal) of sulfuric acid. Approximately 3,000 people were evacuated within a 9.6 km^2 (3.7 mi^2) evacuation zone, and another 8,000 people were under a voluntary evacuation notice. The evacuation occurred in a rural area of Tennessee in the Turkey Creek and Farragut communities. There were no fatalities from the accident and only minor injuries, which included skin and lung irritation from exposure to the sulfuric acid.

COMMUNITY CONTEXT

General
Farragut is an affluent suburb of Knoxville located in Knox County, Tennessee. The town of Farragut is a suburban community with a mayoral form of government. It has a population of approximately 17,720 people and covers an area of 42.1 km^2 (16.2 mi^2). Its main economic base is government employment, retail trade, and manufacturing.

On September 15, 2002, approximately 3,000 people were evacuated in a 2.1 km (1.3 mi) rectangular grid, totaling approximately 9.6 km^2 (3.7 mi^2), after a train derailment in the community of Farragut. The area was lightly congested at the time of the evacuation. The Rural/Metro Fire Department has estimated, based on census data and rough calculations, that there were approximately 8,700 people in the region that was evacuated, equating to approximately 35% of the area being evacuated.

The evacuation area was primarily residential (suburban area). Ethnicity, nationality, and age were not important factors in the evacuation. Knoxville is more than 80 km (50 mi) from the nearest commercial nuclear power plant, the Watts Bar 1 in Spring City, Tennessee. Oak Ridge National Laboratory, which has nuclear reactor facilities, is approximately 32 km (20 mi) northwest of the evacuation but was not involved in the event.

History of Emergencies
The area is likely no more prone to hazards than average. Although the emergency response teams were aware of the potential for railroad cargo to be hazardous, the residents, in general, were unaware of the potential hazards. The emergency response teams have had some experience with small chemical spills and railcars off track, but this was the first large-scale event in the community.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Knoxville County has an active emergency response plan that was developed to meet the *Superfund Amendments and Reauthorization Act* (SARA) *Title III requirements*. The plan addresses evacuations in a general sense but does not specify routing or have evacuation time estimates and does not conform to NUREG-0654/ FEMA-REP-1, Rev. 1. As part of the SARA Title III requirements, the community was required to establish a Local Emergency Planning Committee (LEPC). The Knox County LEPC is an active organization with representatives from the area law enforcement, fire protection, and railroad personnel. The working relationship of this committee contributed to the success of this evacuation.

Training
Training is provided to emergency response personnel. Training is conducted jointly with the railroad, and a few months before the event, site training was conducted at the Norfolk Southern switchyard. Most training was directed toward problems at the switchyard and was not directly related to train derailment. In addition, the incident command structure for emergency response was practiced at least annually.

Drills and Exercises
The Knox County emergency response agencies regularly conduct emergency drills and exercises and had previously tested their emergency procedures in full-scale field exercises in the Norfolk Southern switchyard facility. These drills included hazmat practice, but were not focused on train derailments.

Community Awareness
The community does not have chemical plants or manufacturing facilities in the area. The community's level of awareness of local hazards and evacuation procedures was low. The community's level of awareness about the hazard that caused the evacuation and about the alerting methods used was also low.

THREAT CONDITIONS

On September 15, 2002, a Norfolk Southern train derailed as it was en route from Allentown, Pennsylvania, to Birmingham, Alabama. The train had 141 cars and three locomotives, of which 24 cars and two locomotives derailed. More than 45,461 L (10,000 gal) of sulfuric acid spilled from a ruptured tank, forming a heavy cloud of hazardous gas that spread over the area. Some of the acid leaked into Ft. Loudoun Lake along the Tennessee River and reacted violently. The incident and the evacuation took place in the middle of the morning. It was overcast outside, and the roads were clear and dry.

During the initial response, emergency personnel were placing soda ash on the spill. This approach was not effective, and officials with Norfolk Southern Railway called in a Pittsburg clean-up crew that specialized in sulfuric acid.

CONSEQUENCES

Approximately 20 evacuees and one emergency worker complained of minor skin and lung irritation and were taken to the hospital as a result of the sulfuric acid leaking from the train derailment. There were no fatalities associated with the incident. Approximately 3,000 people were evacuated within a 2.1 km (1.3 mi) rectangular grid downwind of the incident, and another 8,000 people were put on voluntary evacuation notice. Seven public schools in the Knox County school system were cancelled because of the incident. There were multiple agencies involved in the evacuation and no cumulative costs were compiled for this event.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was very good. Some of the onsite agencies included the EPA, U.S. Coast Guard, FBI, the Farragut Fire Marshal, the Rural/County Fire Chief, and the Knox County Sheriff. The train derailment occurred near the border of Farragut and Knox Counties. However, many of these agencies work together routinely and have interagency training so the response was not impacted by the location. The command, control and coordination processes could best be described as pre-planned and followed the written emergency plan. The Rural/Metro fire chief made the decision to evacuate, and there were no problems with the decision-making process.

Communications

The Knox County Sheriff's Office EOC was utilized as the central command. An ICP was established approximately 0.8 km (0.5 mi) from the incident to coordinate activities. Field emergency responders communicated via radio and cell phone, and there were no problems identified with communications. There were multiple cell phones available onsite making cell phones the preferred means to communicate with the EOC.

Notification and Warning
The train derailment was originally reported through the local 911 emergency system. Senior local officials were notified by the Farragut Fire Marshal. Emergency responders were notified of the incident by phone and mobilized immediately. There were no problems with notification of emergency personnel or senior local officials.

The decision to evacuate was made within approximately 45 minutes of the event. After notice to evacuate, it took approximately two hours to complete the evacuation of the area. The public was notified to evacuate through use of a reverse 911 call-back system and through the use of patrolmen going door to door in some areas. The evacuation took place all at once with very infrequent incidents of residents refusing to leave. One area of the evacuation was in an area with a high concentration of the sulfuric acid. The hazmat team had to go to approximately four residences in that area and evacuate invalids using an ambulance. There was also a bike tour sponsored by the Multiple Sclerosis Society that had cyclists traveling near the affected area. The bike tour officials were alerted and called off the remaining portion of the tour.

Traffic Movement and Control
Evacuees were informed of the congregate care center locations when the evacuation notice was given. However, most of the residents in this affluent neighborhood chose to go to friends, relatives, or hotels rather than to congregate care centers. Specific routes were designated by police barricades and policemen directing traffic. No special institutions were evacuated. Most of the roads in the area are two lanes; conditions were dry, traffic moved smoothly, and the evacuation proceeded well. Some people evacuated before receiving notice, and many people were in church at the time and just stayed out of the area.

Congregate Care Centers
The Red Cross immediately established four congregate care centers. These included the Tokesbury Methodist Church, Blount Christian Church, Beardon High School and the Red Cross facility. Two of the congregate care centers closed at 9 p.m. the first evening. The remaining two congregate care centers closed the following morning as people were allowed to go home. There were 200 people registered at the congregate care centers, representing less than 7% of the evacuated population. There was no obvious impact from shadow evacuations.

Law Enforcement
Local law enforcement brought in additional crews to patrol the evacuated area, and there were no instances of looting or vandalism. No problems were identified with law enforcement.

Re-Entry
Re-entry was allowed after a joint decision by the incident commander and emergency response officials on September 16, 2002, with re-entry to some areas being allowed on September 17, 2002. The media was used to inform residents that it was safe to return and there were no special controls in place during re-entry. Norfolk Southern established a hot line to reimburse evacuees for their expenses. There were no problems associated with re-entry.

INVESTIGATOR COMMENTS

According to the Rural/Metro fire chief, the evacuation worked well because of the high level of cooperation among agencies established through the LEPC, the planning efforts of the emergency management team, and the training program for the emergency response personnel. He did state that it is important to inform residents of how long they would be gone to allow them to gather medicines, take pets, and turn off appliances. In this evacuation, emergency personnel did not inform residents of the duration and had to make some special trips into the evacuation zone to retrieve pets and medicine.

CONTACT INFORMATION AND REFERENCES

Contacts

Farragut Fire Marshal
(865) 675-2384
(Personal Communication, July 2003)

Rural/Metro Fire Chief
(865) 531-2058
(Personal Communication, July 2003)

References

American Red Cross News. "Thousands evacuated after Tennessee train derailment." September 16, 2002. <http://www.nyredcross.org/news/2002/020916_derailment.asp> (June 2003).

Bender, Annett. "Knoxville churches affected by tanker spill." *The Call.* September 27, 2002. <http://www.holstonconference.com/thecall/archives/09-27-02/02_sept27_derailment.html> (June 2003).

Disaster Relief. "Thousands evacuated after Tennessee train derailment." September 16, 2002. <http://www.disasterrelief.org/Disasters/020916TennTrain/> (June 2003).

Jacobs, Don and J. J. Stanbaugh. "Toxic Fumes force Thousands to Flee." *News-Sentinel.* September 16, 2002. <http://www.stevequayle.com/News.alert/America_General/020916.TN.toxic.fumes.html> (June 2003).

The Jefferson City News Tribune Online Edition. "Thousands flee after train derails, acid spilled near Knoxville, Tenn." September 16, 2002. <http://newstribune.com/stories/091602/wor_0916020051.asp> (June 2003).

WBIR.com. "Neighborhoods evacuated after train derails spilling sulfuric acid." September 16, 2002. <http://www.wbir.com/News/news.asp?ID=9183> (June 2003).

Pipeline Rupture, North Attleboro, Massachusetts, December 9, 1995, ID #19

<u>Summary</u>

Rank Value: 49
Number Evacuated: 40,000
Category: Technological Hazard
Specific Type: Pipeline Rupture
Community: Suburban

INTRODUCTION

On December 9, 1995, a 40 cm (16 in) natural gas main was ruptured after being hit at a nearby construction site by a bulldozer. Approximately 40,000 people were evacuated within a 2.6 km (1 mi) radius of the incident in North Attleboro, Massachusetts, including 25,000 from Emerald Square Mall, 15,000 from surrounding strip malls, and several hundred nearby homes. The evacuation occurred in a highly congested area with a lot of pedestrian traffic. There were minor injuries to the bulldozer operator and no fatalities associated with the incident.

COMMUNITY CONTEXT

<u>General</u>
The town of North Attleboro, Massachusetts, is an affluent suburban community with a mayoral form of government. It has a population of approximately 27,000 people and covers an area of 49.3 km^2 (19 mi^2). Its main economic base is retail, which attracts a large number of non-residents to area stores and strip malls. On December 9, 2003, approximately 40,000 people were evacuated from an 8.1 km^2 (3.14 mi^2) area after a natural gas main was ruptured. Approximately 25,000 people were evacuated from Emerald Square Mall and 15,000 people were evacuated from the surrounding strip malls and from the several hundred nearby homes. The area was highly congested at the time of the evacuation. It is difficult to determine precisely what percentage of the community was evacuated, since many of the evacuees from the mall were not residents of the area. It is estimated that approximately one-quarter of the residents were evacuated. However, as much as one-half of the people present in the community at the time, including both visitors and residents, were evacuated. The evacuation area was primarily commercial/retail. Ethnicity, nationality, and age were not important factors in the evacuation. The town is located approximately 40 to 48 km (25 to 30 mi) from a commercial nuclear power plant, the Pilgrim 1 Boiling Water Reactor at the Energy Nuclear Power Plant in Plymouth, Massachusetts.

<u>History of Emergencies</u>
The area is likely no more prone to hazards than average. The community did not have any prior experience with the hazard that led to this evacuation. The local fire chief stated that he had "not seen anything like this in twenty years." The community had not experienced any evacuations in

the previous 10 years, and it is unknown whether the community had any prior experience with the alerting mechanism used in this evacuation.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

North Attleboro had a written emergency plan that contained an evacuation section. In addition, the Emerald Square Mall had an evacuation plan. Both plans were used in this emergency. The plans probably did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and it is unknown if they contained evacuation time estimates.

Training

Training is provided to emergency response personnel and joint training between industry and government is conducted annually.

Drills and Exercises

North Attleboro's emergency response agencies regularly conduct emergency drills and exercises but had not previously tested their emergency procedures in a full-scale field exercise. Immediately before this evacuation, they likely performed a "mock disaster drill" (i.e., a functional drill).

Community Awareness

The community's level of awareness about local hazards and about evacuation procedures was likely average. The community's level of awareness about the hazard that caused the evacuation and the alerting methods used was probably average.

THREAT CONDITIONS

The hazard that led to this evacuation was the rupture of a 40-cm (16-in) natural gas pipeline belonging to Algonguin Natural Gas. The gas main was struck by a bulldozer operator who was working at a construction site near a Wal-Mart Store. The incident occurred on a cold and snowy Saturday during the height of the Christmas shopping season. Several eyewitnesses commented that it sounded like a jet taking off. The incident and the evacuation took place in the middle of the afternoon. It was cold outside and the roads were wet. The evacuation was slightly hampered by both the snowstorm and the high level of pedestrian traffic. The local newspaper reported that it resembled a war scene.

CONSEQUENCES

On December 9, 1995, at approximately 1:20 p.m. a 40-cm (16-inch) natural gas main was ruptured and within 10 minutes an evacuation was initiated. There was one reported injury (to the bulldozer operator) and no fatalities associated with the incident. Approximately 40,000 people were evacuated within a one-mile radius. The estimated total cost of the evacuation to the pubic was minimal.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. However, no political boundaries were crossed. The command, control and coordination processes could best be described as ad hoc. The North Attleboro fire chief made the decision to evacuate, and there were no problems with the decision-making process.

Communications

An EOC, including an ICP, was used in this emergency. Field emergency responders communicated via radio and no problems were identified with communications.

Notification and Warning

Senior local officials and emergency responders were notified of the incident by phone. There were no problems with notification of emergency personnel or senior local officials. Emergency response personnel mobilized immediately. The decision to evacuate was made in less than 10 minutes. It took up to one hour to complete the evacuation. The public was notified to evacuate by fire engine sirens and a police/fire PA system. The evacuation took place all at once, and there were no special problems regarding warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated and were told to use specific routes that were designated by police barricades and policemen directing traffic. No special institutions were evacuated. Road conditions were wet and snowy. Some major roadways were unavailable because of the hazard. However, traffic moved relatively smoothly and the evacuation proceeded faster than expected. There was no time for people to evacuate before being told to do so. Traffic was reverse-laned and there were no reported traffic accidents during the evacuation. No one refused to evacuate.

Congregate Care Centers

Three congregate care centers were used. It is unknown who managed those congregate care centers, but it may have been response personnel. High schools were used as congregate care centers and the length of stay was less than 2.5 hours. It is unknown what percentage of the evacuees went to congregate care centers. Presumably, all of the out-of-town shoppers would have gone home, leaving only the local residents to go to the congregate care centers. Therefore, it was a very low percentage. There were no shadow evacuations.

Law Enforcement
The area was secured by the police, and there were no instances of looting or vandalism. No problems were identified with law enforcement.

Re-Entry
The North Attleboro fire chief lifted the evacuation order after 1.5 hours and there were no special controls in place during re-entry. However the stores remained closed. Evacuees were not compensated for their expenses. There were no problems associated with re-entry.

CONTACT INFORMATION AND REFERENCES

Contacts

North Attleboro Fire Chief (former)
North Attleboro Fire Department
50 Elm Street
P.O. Box 904
North Attleboro, MA 02761
(508) 699-0140 (phone)
(508) 643-0296 (fax)

References

"Mall Evacuated." *Associated Press.* December 9, 1995.

Skerner, S. "Thousands Flee After Explosion at NA Gas Line." *The Sun Chronicle.* December 10, 1995.

Twin City Foods Plant, Arlington, Washington, May 12, 2002, ID #69

Summary

Rank Value: 49
Number Evacuated: 1,500
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

On May 12, 2002 (Mother's Day), there was an ammonia spill at the Twin City Foods Plant in Arlington, Washington. The spill prompted authorities to evacuate approximately 1,500 people within a 2.6 km^2 (1 mi^2) area. Two individuals suffered minor injuries from the accident. The leak was thought to be the result of an attempted theft of the ammonia for use in illegally making methamphetamine.

COMMUNITY CONTEXT

General
Arlington, Washington, is a city of approximately 11,713 people, based on the 2000 Census. On May 12, 2002, approximately 1,500 people, or slightly more than 12% of the population, were evacuated from a suburban community in Arlington because of the ammonia leak at the Twin City Foods Plant. Arlington is a small community approximately 90 miles north of Seattle. The city covers 19.6 km^2 (7.6 mi^2). The evacuated area covered 2.6 km^2 (1 mi^2). The population density during the evacuation was average (medium). Ethnicity, nationality, and age were not important factors in the evacuation.

Arlington has a mayoral form of government and its main economic base is manufacturing/ industry and commercial/retail/services. There are no special characteristics that attract large numbers of non-residents. There are no commercial nuclear power plants within 80 km (50 mi) of Arlington. The state of Washington does have a commercial nuclear power plant located in the southeastern portion of the state near Hanford.

History of Emergencies
Arlington is more prone to technological hazards than average because of the local industry, highway and rail, gas pipeline, etc. It is also more prone to natural disasters, including earthquakes and flooding. The community had no prior experience with the hazard that led to this evacuation; no evacuations in the previous ten years; and no previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Arlington has a written emergency plan that is based on the template provided in the Washington State Comprehensive Emergency Management Plan (CEMP). The Arlington plan was used in this emergency; however, it does not contain an evacuation section and does not conform to NUREG-0654/FEMA-REP-1, Rev. 1.

Training
Training is provided to emergency response personnel, and joint training between industry and government is regularly conducted.

Drills and Exercises
Arlington's emergency response agencies regularly conduct emergency drills and exercises but the emergency plan used in this evacuation was not previously tested in a full-scale field exercise.

Community Awareness
The level of community awareness of local hazards, with evacuation procedures, and of the alerting methods used is average (medium). The level of community awareness about the hazard that caused the evacuation was low.

THREAT CONDITIONS

The threat condition leading to the evacuation was a spill of ammonia at the Twin City Foods Plant. Around 12:30 p.m. on May 12, 2002, a passerby noticed an ammonia odor and called 911. Approximately 4,546 L (1,000 gal) of ammonia had been released. Ammonia is a toxic, reactive, and corrosive gas. In higher concentrations, ammonia can be fatal.

It was Mother's Day and the weather at the time of the incident was sunny, calm and warm and the roads were clear and dry. There were no unusual circumstances that occurred during this incident, other than the hazard.

CONSEQUENCES

Approximately 1,500 people, or slightly more than 12% of the population, were evacuated. There were no deaths or injuries due to the evacuation and no deaths related to the hazardous ammonia spill. However, two people were treated at the local hospital for eye and throat irritation. The estimated total cost of the evacuation to the pubic was approximately $20,000.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high. Multiple agencies were involved, including the Snohomish County Regional Hazmat Team, American Red Cross, State Police Patrol, and the Arlington Police and Fire Departments. Political boundaries were not crossed. Command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Incident Commander in coordination with the on-duty police and fire personnel. There were no problems associated with the decision-making process.

Communications
An EOC was not used. However, an ICP was used and communication between the field emergency responders and the ICP was via radio, cell phone, and face-to-face contact. There were no problems with communications.

Notification and Warning
Senior local officials were notified of the incident by pager and telephone. Emergency responders were notified through the 911 system. There were no problems with notification of either local officials or responders. Emergency response personnel mobilized within 15 minutes of discovery of the incident, and the decision to evacuate was made within 30 minutes of the start of the incident. It took approximately one hour to complete the evacuation. The public was notified by a Police/Fire PA System and by emergency personnel going door to door to notify residents to evacuate. The evacuation took place all at once. There were no special problems with warning and subsequent citizen action.

Traffic Movement and Control
Evacuees were told what congregate care centers to go to and which routes to take, which were designated by police barricades. No special institutions were evacuated. Road conditions prior to the evacuation were clear and dry; however, major roadways (State Routes 9 and 530) were unavailable for use because of the hazard. Some people evacuated before being told to do so. Reverse-laning was not used. There were no traffic accidents during the evacuations. Some people refused to evacuate.

Congregate Care Centers
Congregate care centers were managed by the Red Cross and included schools. However, there was a delay in the arrival of the Red Cross. Fewer than 20 people (or 1% of evacuees) registered at the congregate care centers. There were no shadow evacuations.

Law Enforcement
The evacuated area was secured by the police, and there were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry

The Arlington Fire Chief authorized re-entry approximately five hours after the start of the incident. There were no special controls associated with re-entry and no major problems with re-entry. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

According to the Arlington fire chief, the evacuation worked well because of the high level of cooperation among agencies and because the command system worked well.

CONTACT INFORMATION AND REFERENCES

Contacts

Arlington Fire Chief
(360) 403-3600
(Personal Communication, June 27, 2003)

References

Hadley, J. and C. McGann. "1,500 People Evacuated in Arlington during Ammonia Scare." *Seattle Post-Intelligencer*. May 13, 2002. <http://seattlepi.nwsource.com/local/70190_arlington13.shtml> (June 2003).

Washington State Comprehensive Emergency Management Plan (CEMP), Edition II, May 2002.

Train Derailment, Prichard, Alabama, March 25, 1994, ID #95

Summary

Rank Value: 49
Number Evacuated: 2,000
Category: Technological Hazard
Specific Type: Train Derailment
Community: Suburban

INTRODUCTION

On March 25, 1994, 13 cars from a train derailed in the early morning hours in Prichard, Alabama, spilling a tanker loaded with chlorine, a toxic chemical, and resulting in the evacuation of approximately 2,000 people. There were no deaths or injuries related to the incident.

COMMUNITY CONTEXT

General

Prichard is a city located in Mobile County, Alabama, with a population of 28,633 people. Approximately 2,000 residents (7% of the population) were evacuated. Land use in the area was primarily residential. The total area of Prichard is 66 km^2 (25.5 mi^2) and the evacuated area was 10.36 km^2 (4 mi^2). The population density of the area during the evacuation was high. Ethnicity, nationality, and age were not important factors in the evacuation.

Prichard has a mayoral form of government, and its main economic base is commercial services. There are no special characteristics that attract a large number of non-residents to the area. Prichard is approximately 200 miles away from the nearest commercial nuclear power plant, which is Farley Nuclear Power Plant.

History of Emergencies

Because Prichard has a major highway (I-65) running through it and because it is located in a hurricane-prone state, it is more prone to both natural disasters and technological hazards than the average U. S. city. It is unknown whether the community had prior experience with the type of hazard that led to this evacuation. The community had experienced evacuations in the previous 10 years, but they were on a much smaller scale. The community has also had previous experience with the alerting mechanisms that were used in this evacuation.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community did not have a written emergency plan.

Training
Training is provided to emergency response personnel and joint training between industry and government is conducted annually.

Drills and Exercises
The community's emergency response agencies do not regularly conduct emergency drills and exercises.

Community Awareness
The level of community awareness of local hazards was low and the level of community awareness regarding the hazard that caused this evacuation was also low. The level of community awareness about evacuation procedures was average as was the level of community awareness about the alerting methods used during the evacuation.

THREAT CONDITIONS

The threat conditions leading to this evacuation consisted of 13 train cars derailing, one of which spilled chlorine, a hazardous liquid. The derailment was believed to have been caused by negligence on the part of the rail operator.

CONSEQUENCES

Two thousand residents were evacuated from their homes and businesses on the evening of March 25, 1994. No deaths or injuries were associated with the hazard or with the evacuation. The estimated total cost of evacuation-related expenses incurred by the public is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local, state, and federal agencies was high. No political boundaries were crossed. The command, control, and coordination processes could best be described as ad hoc. The decision to evacuate was made by the Prichard fire chief and there were no problems with the decision making process.

Communications
An EOC was not used but a field ICP was used. Communication between field emergency responders and ICP was by radio. There were no problems with communication.

Notification and Warning
Senior local officials were notified of the incident through dispatch and phone trees. Emergency responders were notified of the incident through the 911 phone system. There were no problems with notification between senior local officials and emergency response personnel. The elapsed time between the discovery of the incident and the mobilization of response personnel was less than 15 minutes and the decision to evacuate was made in 15 minutes. It took approximately 45 minutes to complete the evacuation. The public was notified to evacuate by emergency response personnel going door to door. The evacuation took place all at once, and there were no special problems regarding warning and subsequent citizen action.

Traffic Movement and Control
It is unknown whether people were given specific instructions about where to go when they evacuated or whether they were told to use specific routes. No special institutions were evacuated. Road conditions before the evacuation were dry; there were no traffic accidents or traffic problems, and all major roadways were available to evacuees. Reverse-laning was not used. No one spontaneously evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers
The American Red Cross set up congregate care centers. It is unknown how many evacuees used the congregate care centers. There were no shadow evacuations.

Law Enforcement
Police secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
A joint decision between the mayor and fire chief authorized re-entry at 12 p.m. on March 25, 1994. No special controls were used during the re-entry process and no major problems occurred during re-entry. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

According to the Prichard fire chief, the good response and cooperation of residents and the public's prior knowledge of hazards and evacuations contributed to the success of the evacuation. However, one lesson learned is that the setup and mobility of the ICP needs to be improved. No unusual circumstances occurred during this incident other than the hazard itself.

CONTACT INFORMATION AND REFERENCES

Contact

Prichard Fire Chief
(251) 452-7823
(Telephone Conversation, 8/19/03)

References

Prichard, Alabama. From Wikipedia, the Free Encyclopedia.
<http://www.wikipedia.org/w/wiki.phtml?title=Prichard%2C_Alabama&printable=yes

Burlington Northern Railroad Derailment, Superior, Wisconsin, June 30, 1992, ID #16

Summary

Rank Value: 49
Number Evacuated: 40,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

On June 30, 1992, a Burlington Northern Railroad freight train derailed as it approached a bridge over the Nemadji River in Douglas County near the Town of Superior, Wisconsin. The railcar was on its way from Novacor Chemical Ltd. in Alberta, Canada to Chicago, where its contents was going to be used to manufacture rubber. Fourteen freight cars derailed, including three tank cars that contained hazardous materials. About 99,332 L (21,850 gal) of aromatic concentrates spilled into the river. The more volatile constituents of the aromatic concentrates evaporated from the surface of the river and formed a vapor cloud about 32 km (20 mi) long and 8 km (5 mi) wide that resulted in the evacuation of more than 40,000 people from the City of Superior, Wisconsin, from Duluth, Minnesota, and from surrounding areas. A large-scale, staged evacuation was initiated and generally progressed smoothly. There were some injuries as a direct result of the evacuation; however, none of these were life threatening and governors from both states praised the public for their orderly departure.

COMMUNITY CONTEXT

General

On June 30, 1992, at 2:50 a.m. a Burlington Northern freight train derailed in Douglas County, Wisconsin near the City of Superior. The hazardous plume resulted in the evacuation of approximately 40,000 people from the following communities: Douglas County, the Town of Superior, and the City of Superior, Wisconsin; and Duluth, Cloquet, Carlton, Wrenshall, and Esko, Minnesota. According to written reports there was substantial compliance with the evacuation. The Town of Superior is a rural community located immediately south of the City of Superior across Superior Bay from Duluth. Duluth is a more urban and a more heavily populated area.

The size of Douglas County is 3,833 km^2 (1,480 mi^2); it has a population of approximately 43,000. The population density during the evacuation, primarily in Duluth, was high. The City of Superior has a mayoral form of government. Its main economic base is commercial, retail, and service industries with some industrial facilities. Ethnicity, nationality, and age were not important factors in the evacuation. The nearest commercial nuclear plant, Monticello, is located near Minneapolis, Minnesota, more than 80 km (50 mi) from the incident. The evacuation did not impact operations and did not enter the emergency planning zone (EPZ) of the reactor.

History of Emergencies
The Douglas County region is more prone to hazards than the average community. There is a refinery and tank farm in the City of Superior, along with the railroad activities. Approximately one year before this event, one of the same railcars that derailed had a leak at the rail yard, requiring an emergency response but not an evacuation. The Douglas County emergency management coordinator and the City of Superior chief of police said there had been no previous evacuations before this event, and the alerting mechanism had not been utilized in the past.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Douglas County, Wisconsin, and Duluth, Minnesota, both have emergency management plans. The Douglas County disaster plan was activated for this event and had been reviewed by the Wisconsin Department of Military Affairs, Division of Emergency Response and had been approved as meeting all federal and state emergency planning requirements. The latest certification of the county disaster plan before the accident occurred March 1, 1992.

The Duluth disaster planning was included within the St. Louis County, Minnesota, disaster plan. This plan was reviewed by a Regional Review Committee for the Minnesota Department of Public Safety, and was approved as meeting all federal and state emergency planning requirements. The St. Louis County disaster plan was not activated during this emergency response.

The Douglas County plan did not address evacuation organization, communication, or routing. According to the City of Superior chief of police, there was confusion over who made decisions during the early development of the EOC. However, the decision issues were quickly resolved. There was no ETE in the plan, and it is difficult to estimate the total time for the evacuation because it covered multiple communities and was being conducted by separate police departments throughout the day. The emergency plans likely did not meet the requirements of NUREG-0654/FEMA-REP-1, Rev. 1.

There was no hesitation in establishing an ICP at approximately 3:30 a.m. 3.2 km (2 mi) north of the accident site. Based on the Douglas County disaster plan, the fire chief became the incident commander (IC) and the patrol commander became the law enforcement on-scene coordinator. Later in the morning when the plume was headed for Duluth (about 8:00 a.m.), Duluth and St. Louis County safety officials established a joint EOC. A Duluth police department lieutenant became the incident commander for the Minnesota response.

Training

The Burlington Northern Railroad had an active training program. When the train conductor radioed the 28th Street yard, a Burlington Northern trainmaster was dispatched immediately to the site, and the yardmaster called the Douglas County Communication Center (911), CHEMTREC, Wisconsin Department of Emergency Management, the City of Superior police and fire departments, and appropriate Burlington Northern officials. CHEMTREC is the Chemical Transportation Emergency Center operated by the Chemical Manufacturer's Association; it was established to provide initial and immediate information on handling hazardous materials and chemicals.

According to the Douglas County Emergency Coordinator and the City of Superior Chief of Police, response teams had training in emergency response. This training included frequent, but not necessarily annual training and exercises in the handling of hazardous materials and railcar leaks. The training level of the county responders was described as being at the awareness level while the training for the city responders was described as being at the technician level.

Drills and Exercises

Douglas County and the City of Superior conducted exercises with hazardous materials and railcar leaks before this event. In January 1991, Wisconsin and Minnesota emergency organizations conducted a tabletop exercise simulating a train derailment and materials spill into the Mississippi River on the border between the two states. The emergency notification coordination was tested in June 1991 during a joint, full-scale exercise involving a simulated train derailment and hazardous materials spill into the Mississippi River. The county had last conducted a hazardous materials disaster drill on September 28, 1991.

Community Awareness

The community was very aware of technical hazards and is even more aware today. There is a refinery and tank farm in the City of Superior along with the railroad activities. However, there had not been evacuations in the past, so the community was not aware of the alerting methods that were used in the evacuations.

THREAT CONDITIONS

On a calm morning, June 30, 1992, at approximately 2:50 a.m. a Burlington Northern Railroad freight train derailed as it approached a bridge over the Nemadji River in Douglas County Wisconsin. Three tank cars contained hazardous materials including aromatic concentrates, liquid petroleum gas (LPG), and crude butadiene. The three tank cars fell about 71 feet, with one landing in the river and two landing in a flood plain adjacent to the river. About 99,332 L (21,850 gal) of aromatic concentrates spilled into the river.

Based on discussions with the manufacturer (Novacor) and information available from emergency guides, the Town of Superior fire chief, in coordination with the Douglas County patrol commander, decided that the damaged and leaking crude butadiene represented the worst threat. At that time, about 3:40 a.m., a 2.6-km (1-mi) area around the accident site was evacuated. At around 5:30 a.m., Douglas County personnel reported to the EOC observation of an oil-like sheen downriver from the accident. The sheen extended several miles downriver and was traveling toward the City of Superior and Lake Superior. Following this observation and further telephone consultation with Novacor, the IC decided to expand the evacuation area from 2.6 km (1 mi) around the accident to 2.6 km (1 mi) on each side of the river in a downriver direction. This evacuation extended into the town of South Superior and into the southeastern part of the city of Superior.

The Civil Air Patrol was called in and spotted a massive vapor cloud that had formed over the Nemadji River downriver from the site. At approximately 6:20 a.m., the Douglas County EOC notified the Duluth police department about the accident and the vapor cloud moving toward Duluth. The City of Superior police notified Minnesota Point of the accident and recommendations to evacuate. Local officials in Minnesota Point were aware of the event and had already initiated evacuation orders.

The morning was calm, and the chemical haze did not dissipate as it drifted across the cold water of Superior Bay. As the day warmed, the volume of the gas increased, moving up the Duluth hillside like a Lake Superior fog. In mid-afternoon, a wind off the lake blew the toxic haze away from Duluth's East End and Park Point and into Superior, causing substantial evacuations there.

The more volatile constituents of the aromatic concentrates evaporated from the surface of the river and formed a vapor cloud about 32 km (20 mi) long and 8 km (5 mi) wide. A total of more than 40,000 people were evacuated from Douglas County; the Town of Superior; the City of Superior, Wisconsin; from Duluth, Minnesota; and from surrounding areas. Most of the evacuations occurred during the early morning, with the last notices to evacuate occurring around 1:30 p.m. The weather was hot and dry and the roads were dry. By mid-afternoon, it started to rain, helping to dissipate the vapor cloud.

CONSEQUENCES

The derailment prompted one of the largest technical hazard evacuations in history. Winds first carried a strong smelling bluish haze into eastern Duluth and as far north as Hermantown and Two Harbors. Then the winds shifted, blowing the plume southwest into the St. Louis River Valley to communities such as Cloquet, Carlton, Wrenshall, and Esko, where some people were also evacuated.

More than 100 injuries were reported as a result of the release of the hazardous material and resulting evacuation. Most people complained of sore throats, headaches, and difficulty breathing. At least six people were admitted to the hospital; most were treated and released. Approximately 35 police and fire fighting personnel who were aiding in the evacuation activities at nursing homes, health care homes, and patrolling road blocks in the evacuated areas were treated for dizziness and eyes, nose, and throat irritations at area hospitals. Their injuries were a direct result of supporting the evacuation. According to the Chief of Police of the City of Superior, the patrolmen did not have respirators.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, county, state, and railroad agencies was very high, with decision-making authority changing hands in mid-morning. Some of the local, state and federal agencies involved in this emergency included the Douglas County Division of Emergency Response, Douglas County sheriff, Town and City of Superior police and fire departments, Wisconsin National Guard, Duluth police and fire departments, St. Louis County emergency management, Burlington Northern, CHEMTREC, the Civil Air Patrol, the U.S. Coast Guard, and the EPA. The evacuation crossed multiple political boundaries including city, county, and state borders. At approximately 10:00 a.m., at the direction of the EPA, the U.S. Coast Guard entered the Douglas County EOC and took over command as the federal on-scene coordinator until the EPA arrived. At this point, the Coast Guard restricted communication with the media.

The initial decision to evacuate Douglas County was made jointly by the police captain, the sheriff, and the Douglas County incident commander. Approximately 2,500 people were evacuated. As additional information arrived on the size of the spill in the river, the evacuation area was expanded. After reports from the Civil Air Patrol that a cloud was moving toward Duluth, police in Duluth began evacuating residents. As late as 1:30 p.m., several small towns in Carlton County, Minnesota, southwest of Duluth, were also evacuated. Ultimately, more than 40,000 people were evacuated.

Communications
The command, control and coordination processes could best be described as pre-planned. There were EOCs established in accordance with emergency plans. At approximately 3:30 a.m., the Douglas County emergency management director for the Division of Emergency Response established an EOC in the basement of the Douglas County Law Enforcement Center in the City of Superior, Wisconsin. At approximately 8:00 a.m., Duluth and St. Louis County Minnesota established a joint EOC in Duluth City Hall. Incident command was established by Douglas County approximately 3.2 km (2 mi) from the site and was later moved to a point 6.4 km (4 mi) from the site.

Radio was the primary means of communication between the train conductor and railroad officials. Notification to Douglas County and other emergency responders was by telephone. During the event, the City of Superior phone system locked up and shut down as a result of the massive volume of incoming calls.

When the Coast Guard took over operations at the direction of the EPA, they stopped all contact with the media until the arrival of the EPA. This created a communication issue with the evacuation. As winds changed the evacuation areas changed, while the media continued reporting the original information they had received. In some instances, they were reporting that residents needed to go to an evacuation center that had since been declared an evacuation area.

Notification and Warning

The train conductor radioed the Burlington Northern 28th Street yard in the City of Superior of the derailment. The yardmaster immediately dispatched a Burlington Northern trainmaster and called the Douglas County Communication Center (911) to report the incident. The yardmaster then called Novacor and CHEMTREC to obtain details on the potential hazards. The police attempted to notify the mayor of the City of Superior; however he was out of town. The police then telephoned the president of the City Council. There were no problems with notification of local officials or responders.

Once the decision to evacuate was made, the police and fire department started going door to door to wake individuals. Initially, the residents were told to leave and were given very little instruction. However, as the evacuations expanded, the police notified the public through radio and television and provided more information on where and how to leave.

The time to complete the evacuation cannot readily be determined. The continuing spread of the plume required that additional areas be evacuated throughout much of the day. The early evacuations in Douglas County used police and firemen going door to door and loudspeakers to wake residents. Later evacuations also used the media to notify residents to leave the area.

A minor problem with warning residents was that much of the Douglas County area is very rural, requiring significant manpower to notify a relatively small number of residents. The NTSB report states that nearly all affected residents complied with the evacuation requests. However, most of Duluth's news organizations are downtown in the area that was evacuated, and many news staff members ignored the requests and stayed to cover the event.

Traffic Movement and Control

Evacuation routes were designated by police barricades. Northbound Interstate Highway 35 outside of Duluth was blocked for several hours to prevent people from entering the city, while cars streamed out of the city in southbound lanes. There was a traffic jam getting off the Interstate 35 exit ramp to Hinckley. The Interstate was backed up coming from the north. The Wisconsin National Guard troops were called in to assist local authorities with traffic control, transportation of evacuees, and maintaining barricades. The troops assisted local law enforcement with patrolling the traffic control barricades for the next four days.

Special institutions were evacuated, including nursing and health care homes. A prison was planning to evacuate; however, there were not enough buses to transport the prisoners because the buses were being used to support other evacuation needs. Eventually, the prison officials determined that they did not require evacuation. Road conditions prior to the evacuation were clear and dry. It was noted that there were no serious traffic accidents reported during the evacuations.

Congregate Care Centers
Some people moved to evacuation centers set up by the American Red Cross on higher ground, above areas where the cloud seemed to settle. Others left for cabins or towns on the Iron Range to the north. In Duluth and Superior, two high schools, a National Guard Armory and student centers at the University of Wisconsin-Superior and at the University of Minnesota-Duluth were declared emergency centers operated by the Red Cross.

Employees of the Carlton County Courthouse loaded people present for jury duty into a bus and drove them 31 km (19 mi) south to Moose Lake, where authorities set up a makeshift courtroom in a boardroom of the high school. More than 150 people took refuge in a school auditorium, and others pitched camp in Moose Lake Park. The total number of people that went to congregate care centers has not been determined.

Law Enforcement
The evacuated areas were secured by barricades set up by the local police. The barricades were patrolled by the police and the Wisconsin National Guard. There were no reported instances of looting or vandalism or any problems identified with law enforcement.

Re-Entry
By 3:40 p.m. on June 30th, the vapor cloud over the Minnesota areas had dissipated, and the evacuation orders were lifted for these areas. The mayor of Duluth authorized the re-entry and notified the public through the media. However, the media message caused some confusion and residents in the City of Superior and Douglas County thought it was clear to return. However, these areas remained evacuation areas for a few more hours. By 6:30 p.m., the vapor cloud in Wisconsin had dissipated, and the evacuation order was lifted for the City of Superior and South Superior. A 9.7-km (6-mi) by 8-km (5-mi) evacuation zone remained around the accident site within the Town of Superior.

Information that it was safe to return home was conveyed to the public via the media. The re-entry process was not controlled. At 6:00 p.m. on July 3, 1992, the remaining evacuation order was lifted and at 6:15 p.m., the ICP was closed.

Many people received financial settlements from Burlington Northern and were not able to discuss the settlements. Burlington Northern settled and paid out claims to over 12,000 people. The City of Superior settled a claim against the railroad for $89,000 for city expenses involved in the cleanup. In addition, the U.S. government received $260,000 for costs incurred from the spill. There was no mention of how much of this amount was for evacuation-related expenses.

INVESTIGATOR COMMENTS

In discussions with the Douglas County Emergency Management Coordinator and the City of Superior Chief of Police, the following observations and lessons learned were noted:

1. The evacuation was noted as proceeding well because (1) the local population cooperated with authorities; (2) the use of media for notification was well received; (3) the command structure was understood, even when the Coast Guard took over operations; and (4) the emergency responders felt empowered and did not need to wait for local officials to make decisions.

2. Problems with the evacuation included the shutdown of the phone system that occurred because of the mass number of residents calling for information on the evacuation. The news media, although helpful in getting the information out to the public, became a problem when winds changed and evacuation directions needed to be updated. The media in some instances were providing old information, sending residents to evacuation centers that were now located in evacuation areas.

3. As a result of this event, the City of Superior, the state of Wisconsin, Duluth, and the state of Minnesota have developed increased capabilities for response to hazardous materials emergencies.

CONTACT INFORMATION AND REFERENCES

<u>Contacts</u>

Douglas County Emergency Management Coordinator
(Lead Canary Team during event)
(715) 395-1391

City of Superior Chief of Police
1407 Hammond Ave.
City of Superior, Wisconsin
(715) 395-7234

<u>References</u>

Kuchera, Steve. "Toxic Tuesday remains under a cloud of concern." *Duluth News – Tribune.* June 30, 1997. <http://www.marshallschool.org/school/cours/course/dvosen/chem/Notes/FireUnit/Toxic%20Tuesday%20(5yrs%20later).pdf> (June 2003).

Lush, David. "Toxic Tuesday' the studies, doubts, lawsuits, payments." *The Daily Telegram.* July 1, 2002. <http://www.ashlandwi.com/upnorth/placed/story/07-01-2002UNW.html> (June 2003).

Oaks, L. and P. Doyle. "Thousands flee toxic cloud // Derailment spills chemicals into river south of Duluth, Superior." *Star Tribune*. July 1, 1992. <http://www.marshallschool.org/school/cours/course/dvosen/chem/Notes/FireUnit/Duluth%20Benzene%20Spill92.pdf> (June 2003).

Park Point Community Club. "Minnesota Point Environmental Management Plan." <http://www.parkpoint.org/envplan/toxic.html> (June 2003).

Rasid, H. and J. Hufferd. "Hazards of living at the edge of the water: the case of Minnesota point, Duluth, Minnesota." Human Ecology 17(1), 85-100. 1989.

University of Wisconsin Disaster Management Center. "Aim and Scope of Disaster Management." <http://dmc.engr.wisc.edu/courses/aimscope/AA02-05.html> (June 2003).

Hanford Fire, Benton City, Washington, June 27, 2000, ID #103

<u>Summary</u>

Rank Value: 47
Number Evacuated: 2,500
Category: Natural Disaster
Specific Type: Wildfire
Community: Suburban

INTRODUCTION

On June 27, 2000, an automobile collided with a tractor trailer, igniting a huge wildfire that swept through portions of the DOE Hanford Nuclear Site near Richland, Washington. The fire was reported to have been the fastest-growing fire in the United States during the past ten years. It burned 777 km^2 (192,000 acres) of sagebrush/grass-covered land in the region and destroyed eleven homes in nearby Benton City and West Richland. The fire forced approximately 1,700 employees to evacuate the DOE Hanford Site and more than 10,500 residents to evacuate their homes, including 2,500 from Benton City. There was one fatality due to the automobile accident and at least three injuries from the fire, but no deaths or injuries related to the evacuation itself. The focus of this case study is the evacuation that took place in Benton City, Washington. Information for this case study was derived from news wire sources, reports, and interviews with personnel involved in the evacuations, including the Benton County Emergency Management Department.

COMMUNITY CONTEXT

<u>General</u>
All 2,500 residents of Benton City were ordered to evacuate on June 28, 2000, as wildfires neared their community. The entire population (100%) complied with the evacuation order. Some people voluntarily evacuated before the official order. Benton City is a residential (suburban) community surrounded by rural areas. The size of the community and of the evacuated area is 4.5 km^2 (1.8 mi^2). The population density during the evacuation was low. Benton City has a mayoral form of government and farming is its main economic base. There are no special characteristics that attract a large number of non-residents.

Several unique aspects to this community made it extremely well prepared for an evacuation, according to Lyle Ball of the Benton County Emergency Management Department. The community is close to the DOE Hanford Site Reservation, which is 24.1 km (15 mi) away, the Columbia (Energy Northwest) Nuclear Power Plant [10.3 km (6.4 mi) from the EPZ or 26.4 km (16.4 mi) from the facility itself], and a U.S. Army chemical stockpile detail. Approximately 50 to 60 chemical facilities are located in the area. Because of this, Benton County is subject to several emergency management plans, each conforming to the guidelines outlined in NUREG-

0654/FEMA-REP-1, Rev. 1. The city evacuated in accordance with the Benton County Comprehensive Emergency Plan, which contains an evacuation section. However, the plan does not contain evacuation time estimates for Benton City. Training, drills and exercises, including full-scale field exercises, are a part of the plan and occur on a routine basis. A minimum of four exercises are conducted each year and sometimes as many as six to eight exercises are conducted each year.

History of Emergencies

The Benton County area is probably more prone to both natural and technological hazards than the average U.S. city. The area was evacuated in the mid-1990s because of wildfires and in 1998 because of flooding on the Yakima River. The proximity to the DOE Hanford Site, the Columbia (Energy Northwest) Nuclear Power Plant, and the chemical facilities make it potentially more prone to technological hazards than the average community. Thus, community awareness of the hazard and of evacuation procedures is relatively high.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

The community was governed by several emergency plans, each of which addressed the hazard that occurred (the fire). These plans conform to the guidance contained in NUREG-0654/FEMA-REP-1, Rev. 1.

Training and Drills

Local law enforcement and fire departments are extremely well prepared for emergency response and evacuations because they undergo regular training and drills, including full-scale field exercises. This is related to their proximity to the DOE Hanford Site, the Columbia (Energy Northwest) Nuclear Power Plant, and several chemical facilities.

Community Awareness

Community awareness of local hazards is high. Many in the local population work at the above-referenced facilities and are cognizant of emergency procedures.

THREAT CONDITIONS

The hazard that led to this evacuation was the wildfire that began after an automobile collided with a tractor-trailer on June 27, 2000. Before the evacuation, residents were aware that this swiftly moving fire could reach their community and some people voluntarily evacuated before the official evacuation order.

Weather conditions at the time of the evacuation were dry with 48.4 km/h (30 mph) wind gusts and 37.8°C (100°F) temperatures. Thick smoke filled the air and may have had a slight impact on the efficiency of the evacuation, according to evacuees interviewed for news reports. As the fire progressed, the winds increased in strength and moved in the direction of the DOE Hanford site. The wildfires reportedly came within two to three miles of highly radioactive contamination at the DOE Hanford Site. Other than that, there were no unusual circumstances that occurred during this incident, other than the hazard itself. Roads in the vicinity were clear and dry and did not impact the effectiveness of the evacuation of Benton City.

CONSEQUENCES

Approximately 2,500 people evacuated from Benton City (100% of that community). Another 8,000 people were evacuated from the communities of West Richland and Horn Rapids and 1,700 employees evacuated the DOE Hanford Site. There were no deaths or injuries associated with the evacuations. There was, however, one fatality associated with the automobile accident that created the wildfire that led to the evacuation, and at least three people were hurt in the fire. The estimated cost of evacuated-related expenses incurred by the public is $200,000. This is primarily for hotel stay and meals. Although the government did not reimburse the public for its evacuation expenses, several funds were established to help the families; it is unknown how much money each family received.

The accident occurred at approximately 1:30 p.m. on June 27, 2000, and emergency responders arrived on the scene within minutes. The tractor-trailer involved in the accident was fully engulfed in flames at that time and the wildfires were rapidly growing. Benton County declared a state of emergency at 6:00 p.m. on June 27, and by 1:45 a.m. on June 28, the governor had declared a state of emergency in Benton County. The National Guard was activated to assist with the evacuations and the Red Cross set up congregate care centers in nearby Richland and Kennewick, Washington.

EMERGENCY RESPONSE

Decision Making

There was a high level of cooperation among local, state, and federal agencies. Political boundaries were not crossed. The command, control and coordination processes could best be described as ad hoc. The decision to evacuate was made by the County Emergency Manager. There were no problems with the decision-making process.

Communications

An EOC, including an ICP, was used in this emergency. Field emergency responders communicated with the EOC via radio and pager/cell phone. Communication was not identified as being a problem during this incident or during the evacuation.

Notification and Warning

There were no problems associated with notification and warning. The smoke resulting from the fire served to alert most in the community, including public officials, of the hazard. The police used sirens and police PA system to alert the public of the evacuation. Emergency information was also broadcast over the radio (KONA Radio on 610 AM and 105.3 FM). The evacuation of Benton City was staged all at once. Everyone was notified and evacuated at the same time. It took less than one hour to evacuate Benton City. No special problems were noted regarding warning and subsequent citizen action.

Traffic Movement and Control

There were no reported problems associated with traffic movement and control. People were given specific instructions about where to go when they were warned to evacuate. They were told to use specific routes, and they were directed out along those routes. The roads were reverse-laned to facilitate movement out of the city. Some people spontaneously evacuated before being told to do so and no one refused to evacuate. There were no traffic accidents or specific traffic problems during the evacuation. No special institutions, such as hospitals or prisons, were involved in the evacuation.

Congregate Care Centers

Congregate care centers managed by the American Red Cross were used. Approximately 20% of the evacuees went to the emergency congregate care centers, which included Richland High School and United Central Protestant Church in Richland. People did not evacuate from outside the designated evacuation area.

Law Enforcement

The area was secured by the National Guard and there was no problem with looting and vandalism. No problems were identified with law enforcement.

Re-Entry

The evacuation order was lifted by the Benton County Emergency Services on June 29, 2000, at 12:15 p.m. This decision was based on control of the fire. Residents were advised to stay tuned to local television and radio for further developments. There were no special controls and no special problems associated with re-entry.

INVESTIGATOR COMMENTS

Factors that contributed to the success of the evacuation included community awareness and emergency management preparedness and routine training and drills, including full-scale field exercises.

CONTACT INFORMATION AND REFERENCES

Contacts
DOE Planner
Benton County Emergency Management
(Part of Benton County Emergency Services)
561 Truman Avenue
Richland, WA 99352
(509) 628-2600

Director, Emergency Preparedness
Fluor Hanford
(509) 372-2823

References
Ashton, L. "Sky on fire." *Associated Press*. June 29, 2000.

CNN. "Energy secretary: Hanford fire contained: No radiation released, tests show; nuclear watchdogs urge more monitoring." June 30, 2000. <http://www.cnn.com/2000/US/06/30/hanford.fire.03/> (June 2003).

CNN. "Firefighters halt spread of blaze at Washington state nuclear site." June 29, 2000. <http://www.cnn.com/2000/US/06/29/hanford.fire.05/> (June 2003).

Department of Energy: Hanford Site (U.S.), "Hanford Site Fire Information." 2002. <http://www.hanford.gov/hanfordfire.html> (April 2003).

"Details On Hanford Fire." Hanford Joint Information Center, News Release.004, Richland, Washington, June 28, 2000, 8:15 p.m.

Disaster Relief. "Fierce Wildfire Burns Through Nuclear Reservation in Washington State." June 29, 2000. <http://www.disasterrelief.org/Disasters/000629washfire/> (June 2003).

Mulick, C. and J. Hagey. "Evacuate residents wait for word on fire." *Tri-City Herald*. June 29, 2000. <http://www.tri-cityherald.com/news/2000/0629/story2.html> (June 2003).

U.S. DOE. 2000. Type B Accident Investigation: U.S. DOE Report Response to the 24 Command Wildfire on the Hanford Site -- June 27-July 1, 2000, DOE/RL-2000-63. October 2000. http://www.hanford.gov/docs/rl-2000-63/

Wiley, J. K. "Wildfires at nuclear site raises fears." *Associated Press*. June 30, 2000.

Burlington Northern Santa Fe Derailment, Scottsbluff, Nebraska, November 4, 2000, ID #26

Summary

Rank Value: 47
Number Evacuated: 5,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

At 10:30 p.m. on Saturday, November 4, 2000, a Burlington Northern Santa Fe (BNSF) train derailed in northwestern Scottsbluff, Nebraska. Twenty-eight out of the 120 tank cars derailed; 10 of the tanker cars contained benzene and dicyclopentadiene and five ruptured, spilling chemicals. Approximately 5,000 people within a 2.6 km (1mi) radius were evacuated because of the noxious gas cloud early Sunday morning (November 5th).

COMMUNITY CONTEXT

General
Scottsbluff, Nebraska, is a city of approximately 14,732 people, based on the 2000 Census. Approximately 5,000 people, or slightly more than 30% of the population, were evacuated from a suburban area of northwestern Scottsbluff because of the train derailment and release of hazardous material. Population density was medium during the evacuation. The city covers 15.4 km^2 (5.9 mi^2) and the evacuated area was approximately 7.8 km^2 (3.14 mi^2). Ethnicity, nationality, and age were not important factors in the evacuation.

Scottsbluff is a rural farming community in western Nebraska. It has a mayoral form of government. Land uses in the evacuation area were residential, industrial and agricultural. The community's main economic base is farming. Tourism attracts a large number of non-residents. There are no commercial nuclear power plants within 80 km (50 mi) of Scottsbluff. However, there are two commercial power plants located in Nebraska.

History of Emergencies
Scottsbluff is likely no more prone to hazards than the average U.S. city. Although more than thirty trains pass through Scottsbluff daily, the community had no prior experience with derailments and chemical spills and had not experienced evacuations in the past ten years.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Scottsbluff has a written emergency plan with an evacuation section that was the plan used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and did not contain an ETE.

Training
Training is provided to emergency response personnel. However, joint training between industry and government is not regularly conducted.

Drills and Exercises
Scottsbluff's emergency response agencies regularly conduct emergency drills and exercises but the emergency plan used in this evacuation was not previously tested in a full-scale field exercise.

Community Awareness
The level of community awareness about local hazards, derailments/chemical spills, and evacuation procedures was relatively low. However, the community was highly aware of the alerting methods used, which included sirens, radio and television broadcasts, police/fire PA systems, and door-to-door notification.

THREAT CONDITIONS

At 10:30 p.m. on November 4, 2000, approximately 363,688 L (80,000 gal) of a chemical containing benzene was released following derailment of a Burlington Northern Santa Fe Train. Approximately 5,000 people within a one-mile radius were evacuated. The initial evacuation took place shortly after midnight. Most residents were allowed back into their homes by morning, but some families were evacuated again that day. The weather was cool, there was nothing unusual, such as storms, and the roads were dry. The only unusual circumstance was that the evacuation took place at night.

CONSEQUENCES

Approximately 5,000 people, or slightly more than 33% of the population, were evacuated. There were no reported deaths or injuries because of the evacuation, the derailment, or exposure to the benzene. The estimated cost to the public of the evacuation itself, and not from any of the damages associated with the train derailment, is unknown; BNSF reimbursed evacuees for their expenses.

EMERGENCY RESPONSE

Decision Making

There was a high level of cooperation among local, state, and federal agencies. Political boundaries were not crossed. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made jointly by Scottsbluff's police and fire chiefs. There were no problems with the decision-making process.

Communications

An EOC and an ICP were used in this emergency. Communication between field emergency responders and the EOC was by radio, telephone, cell phone, and fax. There were no problems with communication.

Notification and Warning

Senior local officials were notified of the incident after receiving a call from the command center. Emergency responders were notified of the incident by pager and telephone trees following report of the incident through the 911 emergency system. There were no problems with notification of emergency personnel or senior local officials. Response personnel mobilized to the scene in less than 15 minutes, and the decision to evacuate was made soon afterward. It took two hours to complete the evacuation. The public was notified of the evacuation by several methods, including sirens, radio and television broadcasts, police/fire PA systems, and door-to-door notification. The evacuation took place all at once. There were no special problems regarding warning or subsequent citizen action.

Traffic Movement and Control

People were given specific instructions when they evacuated, including which routes to use and what congregate care centers to go to. Police officers guided evacuees along the routes. No special institutions were evacuated. The road conditions were dry; no major roadways were unavailable, and there were no special traffic problems or traffic accidents. Reverse-laning was not used. No one evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers

Congregate care centers managed by the local chapter of the American Red Cross were used. Congregate care centers included Scottsbluff High School, Gering High School, and several area churches. According to the Red Cross, approximately 350 people (or 7% evacuees) sought congregate care centers immediately following the derailment. Evacuees were allowed to return to their homes just after 3:00 a.m. on November 5, 2000, or 4.5 hours following the derailment. There were some shadow evacuations, but this did not impact traffic or congregate care center capacity.

Law Enforcement

The evacuated area was secured by the police, and there were no instances of looting or vandalism or any other law enforcement problems.

Re-Entry
The Scottsbluff Fire Chief and Police Chief jointly authorized re-entry approximately 4.5 hours after the derailment occurred. There were no special controls on re-entry and BNSF compensated evacuees for their expenses. No major problems occurred during re-entry.

INVESTIGATOR COMMENTS

The alerting system (door-to-door) was very effective and contributed to the success of the evacuation, especially since it occurred at night.

Lessons learned in this evacuation include:

1. Communication needs to be improved.

2. The public needs to be educated on the use of sheltering in place as an option.

3. Personal protective clothing, including masks and suits are needed for response personnel.

CONTACT INFORMATION AND REFERENCES

Contacts

Special Operations Division
Police Department
(308) 630-6261

Scottsbluff Chapter of the American Red Cross
(308) 635-2114

References
Arizona Summer Wildcat Online. "Neb. town evacuated after derailment." November 6, 2000. <http://wildcat.arizona.edu/papers/94/55/01_93_m.html> (June 2003).

"Evacuation Ordered After Train Derailment Releases Fumes." *Associated Press.* November 5, 2000.

Nebraska Department of Environmental Quality. "DEQ Update: Scottsbluff Train Derailment." <http://www.deq.state.ne.us/Gen.nsf/Pages/Update1> (June 2003).

Nebraska Emergency Management Agency. "State of Nebraska Emergency Operations Plan." February 12, 2002.
<http://www.nebema.org/seop.html.pdf> (June 2003).

The Independent. "Scottsbluff Praised for Handling Derailment." November 16, 2000. <http://www.theindependent.com/stories/111600/new_scottsbluffderail16.html> (June 2003).

United Transportation Union. "NEBRASKA: Town evacuated after train derailment." <http://www.utu.org/DEPTS/PR-DEPT/NEWS/NDigest/2000/Nov2m/116/1160002.htm> (June 2003).

Fish Plant Ammonia Leak, Morro Bay, California, October 3, 2001, ID #66

Summary

Rank Value: 47
Number Evacuated: 3,500
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

On October 3, 2001, 500 kg (1,100 lb) of anhydrous ammonia leaked at a fish processing plant, causing the evacuation of approximately 3,500 people within a 910 m (1,000 yd) radius of the facility in Morro Bay, California. No deaths or injuries were associated with either the incident or the subsequent evacuation.

COMMUNITY CONTEXT

General

Morro Bay is a suburban community with a population of 10,350 people. Approximately 3,500 people, or 34% of the city's population, were evacuated on October 3, 2001. The city of Morro Bay covers an area of 26.3 km^2 (10.2 mi^2), although 50% of this area is covered in water. The evacuated area covered an area of 2.6 km^2 (1 mi^2). The population density was medium during the evacuation. Land use in the evacuated area was residential, commercial, and industrial. Age was an important factor in the evacuation since there were elderly patients in a handicapped facility that was evacuated. In addition, there was a significant Hispanic population that did not understand either verbal or written evacuation instructions, which were given in English.

The community has a mayoral form of government and its main economic base is tourism, which attracts a large number of non-residents. A portion of Morro Bay is located within the 16 km (10 mi) EPZ of the Diablo Canyon Nuclear Power Plant, with the remaining part of the city located just outside of the 16 km (10 m) EPZ and well within the 80 km (50 mi) EPZ.

History of Emergencies

The community is no more prone to hazards than average and had no prior experience with the hazard that led to this evacuation. Morro Bay has experienced evacuations in the past 10 years, but not of this magnitude. The community did not have previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan that was used in this emergency. It is unknown whether the plan contained an evacuation section. According to the Morro Bay Fire Chief, the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1. However, it did not contain an ETE.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises, and the emergency plan used in this evacuation was previously tested in a full-scale evacuation. Immediately before this evacuation, a tabletop exercise was performed.

Community Awareness
The community has an average level of awareness about local hazards and about evacuation procedures. However, awareness of the hazard that caused this evacuation (i.e., the anhydrous ammonia leak) was low. The community had an average level of awareness of the alerting methods used in this evacuation.

THREAT CONDITIONS

The threat condition leading to this evacuation was a leak of anhydrous ammonia at a fish processing plant, causing the evacuation of approximately 3,500 people during the day. The roads were dry; however, it was foggy outside with limited visibility. This did not have a major impact on the evacuation, and there were no unusual circumstances that occurred during the incident.

CONSEQUENCES

Approximately 3,500 residents were evacuated. No deaths or injuries were associated with either the incident or the subsequent evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high and included the U.S. Coast Guard. Political boundaries were not crossed. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made by the County Health Office and there were no problems with the decision-making process.

Communications

An EOC and an ICP were used and were co-located. Communication between field emergency responders and the EOC/ICP was by radio. There were no problems with this form of communication.

Notification and Warning

Senior local officials were notified of the incident by telephone and emergency responders were notified through a citizen's complaint of an ammonia odor. There were no problems with notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes. The evacuation was staged. The decision to evacuate Stage 1 was made approximately 30 minutes after discovery of the leak, and it took approximately 20 minutes to evacuate those people. The decision to evacuate Stage 2 was made three hours later and it took approximately 30 minutes to evacuate those people. The decision to evacuate the third and final stage was made six hours following discovery of the ammonia leak and it took approximately 90 minutes to evacuate those residents. The public was notified by emergency responders going door to door. There were problems with warning and subsequent citizen action because many in this community spoke predominantly Spanish and did not understand the evacuation instructions, which were given in English.

Traffic Movement and Control

Evacuees were given specific instructions, both verbal and written (i.e., a flyer), when they were told to evacuate. However, many in the community spoke predominantly Spanish and did not understand the instructions, which were in English. Evacuees were not told to use specific routes. No special institutions were evacuated; however, two schools were closed for the day. Road conditions before the evacuation were dry, although it was foggy outside, which hindered visibility. This did not impact the efficiency of the evacuation. There were no traffic accidents, no traffic problems, and major roadways were available to evacuees. Reverse-laning was not used. Some people evacuated before being told to do so and others refused to evacuate. The third, and largest, stage of the evacuation was timed to coincide with the morning commute to work and school. Thus, many evacuees simply went to work or went to school and had no need to go to a congregate care center.

Congregate Care Centers
Congregate care centers managed by the local American Red Cross were used. Congregate care centers consisted of schools and approximately 200 people, or 6% of evacuees, went to the congregate care centers. The third, and largest, stage of the evacuation was timed to coincide with the morning commute to work and school. Thus, many evacuees simply went to work or went to school rather than go to a congregate care center. There were no shadow evacuations.

Law Enforcement
Morro Bay police secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
The County Health Office authorized re-entry and there were no special controls during re-entry. Evacuees were not compensated for their expenses. There were no problems during re-entry.

INVESTIGATOR COMMENTS

According to the Morro Bay fire chief, the evacuation was successful because there was a good plan and time to put signs, personnel, etc. into place. In addition to the language issue, the only problem encountered was pressure from elected officials to authorize re-entry.

CONTACT INFORMATION AND REFERENCES

Contact

Morro Bay Fire Chief
(805) 772-6242
(Personal Communication, 7/14/03)

References

National Response Center. "2001 National Response Team Incident Summaries: Fish Plant." <http://www.nrc.uscg.mil/insum2001/fishplant1.html> (June 2003).

Louisville Cargo Transfer Accident, Louisville, Kentucky, November 19, 1998, ID #24

Summary

Rank Value: 47
Number Evacuated: 2,400
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Urban

INTRODUCTION

Approximately 2,400 people in and around a Ford Motor Company Plant in Louisville, Kentucky, were evacuated on the morning of November 19, 1998, after a chemical reaction produced a cloud of toxic gases. At approximately 8:25 a.m., a truck driver delivering chemicals noticed an orange cloud coming from the bulk storage building. Seven people were injured in the incident. No deaths or injuries were associated with the evacuation.

COMMUNITY CONTEXT

General
Louisville, Kentucky, is an urban area with a population of 256,231 people as of the 2000 Census; however, as a result of a merger with Jefferson County, it now has approximately 693,604 residents. Approximately 2,400 people, or less than 1% of the population, were evacuated because of this incident. The city of Louisville covers an area of 172.6 km^2 (66.7 mi^2) and the evacuated area covered a small area, probably less than 2.6 km^2 (1 mi^2). The population density was high during the evacuation. Land use in the evacuated area was residential, commercial, and industrial. Ethnicity, nationality, and age were not important factors in the evacuation.

The city has a mayoral form of government and its main economic base is commercial/retail/ services. The University of Louisville, University of Kentucky in nearby Lexington, and the Kentucky Derby all attract a large number of non-residents. The nearest nuclear power plant is over 80 km (50 mi) away and the state of Kentucky does not have any commercial nuclear power plants.

History of Emergencies
The community is no more prone to hazards than average and had no prior experience with the hazard that led to this evacuation. Louisville, Kentucky, has not experienced any major evacuations in the past 10 years. However, the city's residents did have previous experience with the alerting mechanism used in this evacuation (broadcasts on public television).

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Jefferson County had a written emergency plan that included an evacuation section that was used in this emergency. It is unknown whether the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or whether it contained an ETE.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies do not regularly conduct emergency drills and exercises.

Community Awareness
The community has a low level of awareness concerning local hazards and of the hazard that caused this evacuation. In addition, the community's level of awareness about evacuation procedures was low. The community's awareness about the alerting mechanisms used in the evacuation was also low, because although the emergency broadcasting system was tested on a periodic basis, it has rarely been used in an actual emergency.

THREAT CONDITIONS

The threat condition leading to this evacuation was an inadvertent mixing of chemicals, which produced toxic gases and forced the evacuation of 2,400 people in and around a Ford Motor Company Plant in Louisville, Kentucky, on the morning of November 19, 1998. After a pipe fitter at the plant inadvertently attached a hose to the wrong coupler, a nickel nitrate and phosphoric acid solution being unloaded from a cargo truck was inadvertently mixed with sodium nitrite solution in a storage tank. A chemical reaction ensued that produced toxic gases of nitric oxide and nitrogen dioxide, leading to the evacuation. The roads were dry and clear, and no unusual circumstances occurred during the incident.

CONSEQUENCES

Approximately 2,400 people were evacuated from the Ford Motor Company Plant and surrounding businesses, and another 600 local residents were told by authorities to remain inside their homes on the morning of November 19, 1998. The incident resulted in seven people being treated for minor inhalation injuries, including three police officers, three Ford Motor Company employees, and the truck driver. No deaths or injuries were associated with the evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. Political boundaries were not crossed. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made jointly by the Louisville Fire Chief and the Emergency Manager and there were no problems with the decision-making process.

Communications

An EOC was not used; however, an incident command post (ICP) was used and communication between field emergency responders and the ICP was by radio, telephone, and cell phone. There were no problems with communication.

Notification and Warning

Senior local officials were notified of the incident by telephone and emergency responders were notified by plant personnel through the 911 phone system. There were no problems with notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the decision to evacuate the Ford Plant was made within 15 minutes. The decision to evacuate nearby residents was made within one hour of the incident. It took approximately two hours to complete the evacuation. The public was notified by radio and television broadcasts, a police/fire PA system, and by door-to-door notification. The evacuation was staged; first, plant personnel were evacuated and then nearby residents were evacuated. There were no special problems regarding warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated and were told to use specific routes that were designated by roadblocks and manned police patrols. No special institutions were evacuated. Road conditions prior to the evacuation were dry and there were no traffic accidents, no traffic problems, and major roadways were available to evacuees. Reverse-laning was not used. No one evacuated before being told to do so and no one refused to evacuate.

Congregate Care Centers

Congregate care centers managed by Civil Defense were used. Fire stations were used as congregate care centers; however, none of the evacuees went to the congregate care centers. There were no shadow evacuations.

Law Enforcement
Police secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
The Louisville fire chief authorized re-entry and there were no special controls during re-entry. Evacuees were not compensated for their expenses. There were no problems during re-entry.

INVESTIGATOR COMMENTS

According to the assistant fire chief at the Worthington Fire Station in Louisville, the evacuation was successful due to coordinated effort between agencies.

CONTACT INFORMATION AND REFERENCES

Contact

Assistant Fire Chief
Worthington Fire Station
Louisville, Kentucky
(502) 241-9366
(Personal Communication, 7/15/03)

References

National Transportation Safety Board (U.S.) (NTSB). HZB-00-02, "Chemical Reactions During Cargo Transfer Louisville, Kentucky." NTSB: Washington, D.C. November 1998.

Pesticide Tanker Truck Explosion, Balch Springs, Texas, April 14, 1994, ID #243

Summary

Rank Value: 47
Number Evacuated: 5,000
Category: Technological Hazard
Specific Type: Transportation Accident
Community: Suburban

INTRODUCTION

On April 14, 1994, a truck carrying 10,500 kg (23,000 lb) of an acutely toxic pesticide, Temik 15-G, which contains aldicarb as its active ingredient, crashed. The truck hit a traffic sign and burst into flames on Interstate 20 in Balch Springs, Texas, southeast of Dallas, spilling the toxic pesticide, sending a smoke plume over the community, and causing the evacuation of approximately 5,000 people.

COMMUNITY CONTEXT

General
Balch Springs is a suburban community with a population of approximately 19,375 people and covers an area of 20.9 km^2 (8.1 mi^2). Approximately 5,000 people, or 26%, of the population were evacuated from a 12.8 km^2 (5 mi^2) area during this incident. The land use in the area is mainly residential, and the population density of the area was high at the time of the evacuation. Ethnicity and nationality were not important factors in the evacuation; however, age was a factor as several schools with young children were evacuated.

The city has a mayoral form of government, and the main economic base is industry. There are no special characteristics that attract large numbers of visitors to the area. The nearest nuclear power plant is Comanche Peak more than 80 km (50 mi) away.

History of Emergencies
The community is more prone to hazards than average but has not had experience with this type of emergency in the past. Balch Springs has had emergencies with storms and has a large flow of traffic, including transport of hazardous materials, through the area. The community has not experienced large-scale evacuations in the last 10 years and had no previous experience with the alerting mechanisms used in this emergency.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan.

Training
The community provides training to emergency response personnel. However, joint training between industry and government is not regularly conducted.

Drills and Exercises
The community's emergency response agencies do not conduct regular emergency drills and exercises. The emergency plan used in this evacuation was not previously tested in full-scale field exercises.

Community Awareness
The community has a medium level of awareness of the local hazards and a medium level of awareness of evacuations procedures. It had a low level of awareness of the hazards in this incident, including hazardous materials in general. The community does have a high level of awareness of the alerting methods used in this evacuation.

THREAT CONDITIONS

At about 8 a.m. on April 14, 1994, a truck carrying 10,500 kg (23,000 lb) of an acutely toxic pesticide, Temik 15-G, which contains aldicarb as its active ingredient, crashed. The truck hit the concrete post of a traffic sign and burst into flames on Interstate 20 in Balch Springs, Texas, southeast of Dallas. Temik is "the most toxic insecticide registered" with the EPA, according to the National Pesticide Telecommunications Network at Texas Tech University. Balch Spring firefighters initially sprayed water on the fire because they believed the driver might still be alive. But when they contacted the chemical manufacturer, Rhone-Poulenc Co., the company said the water would make the cloud more poisonous. The company advised firefighters to let the blaze burn. Authorities let the fire burn for more than 10 hours and the fire was out at about 6:15 p.m.

The evacuation area was initially limited to an area just north of I-20; however, the evacuation was expanded north during the afternoon as 10 to 20 mph winds pushed the smoke further. The weather was mild and the roads were dry.

CONSEQUENCES

A cloud of toxic smoke forced the evacuation of more than 5,000 people in a 12.8 km^2 (5 mi^2) area. Four Mesquite schools downwind were evacuated. The North Texas Poison Control Center at Parkland Memorial Hospital was swamped with calls from worried people, but no one who called or was treated showed any signs of pesticide poisoning.

At about 2 a.m. on April 15, police removed scores of roadblocks, allowing people to return to their homes. Tests by the EPA showed that the area suffered no contamination from the smoke emanating from the burning wreck.

The death of the truck driver was the only fatality from the incident. More than 100 individuals went to hospitals, mostly for eye and lung irritations, but no one was seriously injured. No injuries were reported during the evacuation. The estimated total cost of the evacuation-related expenses is unknown. The school district alone estimated costs of overtime pay, fuel, and food at approximately $30,000 to support the evacuation.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high, and political boundaries were crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made jointly by the mayor and the fire chief, and there were no problems with the decision-making process.

Communications

An EOC was used in this event and an ICP was established. Communication between field emergency responders and the ICP was primarily by radio and cell phone. There were no problems with communications during the event.

Notification and Warning

Senior local officials were notified of the incident by a telephone emergency tree. The emergency responders were notified through a 911 telephone call. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the initial decision to evacuate was made approximately 40 minutes after the notification of the incident. It took approximately two hours to complete the evacuation.

Evacuees were notified by radio and directly by the police using a PA system and going door to door. The evacuation was staged; as wind changed, the area increased. There were no problems with warning and subsequent citizen action. Some residents refused to evacuate.

Traffic Movement and Control

Evacuees were given instructions on where to go but were not told to use specific routes, as these were considered obvious. Police roadblocks were used to direct traffic. A number of special institutions were evacuated, including four Mesquite schools, a retirement home, and a day care center. Road conditions during the evacuation were dry, and no traffic accidents or traffic-related problems occurred during the event. Interstate 20 was closed because of the incident, but did not create problems. Reverse-laning was not used.

Congregate Care Centers
Congregate care centers were established at local schools and public buildings for this emergency and were managed by the Red Cross and city personnel. Approximately 450 evacuees, or 9%, went to the congregate care centers; remaining evacuees went to the homes of friends or relatives. There were shadow evacuations reported; however, these did not impact the traffic or capacity of the congregate care centers.

Law Enforcement
The Dallas police and sheriff secured the area following the evacuation and there were no instances of looting or vandalism. At least three arrests were made of individuals trying to enter the evacuation area prior to re-entry authorization.

Re-Entry
Re-entry was authorized by the state police and there were no special controls during the re-entry process. There were no problems reported during re-entry. Evacuees were compensated for their expenses. Agents for the trucking company set up evacuation claim centers and reimbursed people for lodging, food, medication, or other expenses from the evacuation. People with small claims received checks on the spot.

INVESTIGATOR COMMENTS

The fact that many people were at work and were easy to reach contributed to the success of this evacuation. Improvements could be made in public notification using television and radio.

CONTACT INFORMATION AND REFERENCES

Contacts

Balch Springs Battalion Chief
(972) 557-6042
(Personal Communication, 8/11/03)

References
Sustainable Agriculture Network. "PANUPS: Aldicarb Spill in Texas." April 21, 1994. <http://www.sare.org/htdocs/hypermail/html-home/4-html/0300.html> (June 2003).

United Press International: "Truckload of Pesticides Burn in Texas." April 14, 1994.

East Bay Hills Fire, Oakland, California, October 20, 1991, ID #234

Summary

Rank Value: 44
Number Evacuated: 20,000–30,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Suburban

INTRODUCTION

On October 20, 1991, the Oakland, California, fire became this nation's most costly fire and the worst fire involving loss of life and property since the Great San Francisco Earthquake and Fire of 1906. The unusual weather conditions, including high winds and record high temperatures, coupled with five years of drought, fueled an extremely fast-moving fire. Although estimates vary, up to 20,000–30,000 people were evacuated from portions of Oakland, Berkeley, and Piedmont, California, including part of the UC-Berkeley campus. A total of 25 people died in the fire and 150 were injured. Of the 25 people killed, 19 were in the process of evacuating when they died. Numerous problems were associated with the evacuation, including communication problems, traffic problems (including traffic accidents), and looting problems.

COMMUNITY CONTEXT

General
The fire and evacuation took place in the wildland-urban interface area between Oakland and Berkeley Hills. This is a suburban area that is heavily developed with expensive residential properties with spectacular views of Oakland and San Francisco. In these hills are a series of narrow canyons that hampered the fire-fighting efforts.

Oakland has a population of 399,484, and Berkeley has a population of 102,743. The evacuation involved up to 20,000 to 30,000, or approximately 6% of the total population. Population density during the evacuation was medium.

Oakland covers 2,024 km^2 (78.2 mi^2) and the evacuated area was approximately 26 km^2 (10 mi^2). The evacuated area was largely residential with some commercial/retail outlets, and also included the University of California at Berkeley campus. Oakland is a city with a mayoral form of government. Its main economic base is diverse, including business/financial, commercial/retail, and manufacturing/industry. The University of California at Berkeley attracts a large number of non-residents. Ethnicity, nationality, and age were not important factors in the evacuation.

The state of California contains commercial nuclear power plants. However, the evacuated area is about two hundred miles from the nearest plant, the Diablo Canyon Nuclear Power Plant near San Luis Obispo, California.

History of Emergencies

The wildland-urban interface area between Oakland and Berkeley Hills is more prone to fire than average. There have been 14 major fires since 1923. However, the community had not experienced a major evacuation in the previous ten years. The community had previous experience with the alerting mechanism used in this evacuation (police PA system).

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

The county had a written emergency plan that included an evacuation section. However, it is unknown if it was used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and did not contain an ETE.

Training

Training is provided to emergency response personnel. However, it is unknown whether joint training between industry and government was regularly conducted.

Drills and Exercises

The Oakland Fire Department regularly conducts emergency drills and exercises. However, it is unknown whether the emergency plan that was used in this evacuation had been previously tested in a full-scale field exercise.

Community Awareness

The community in the Oakland and Berkeley Hills area is highly aware of local hazards, mostly the potential for severe wildfires such as the one that prompted this evacuation. However, the community's familiarity with evacuation procedures is only average. The community was also highly aware of the alerting method used (police PA system).

THREAT CONDITIONS

On October 20, 1991, strong winds rekindled a grass fire that had started the previous day. The fire began on a steep hillside in a box canyon above State Highway 24 near the entrance to the Caldecott Tunnel. This is a wooded area with heavy underbrush, narrow streets and steep terrain. The unusual weather conditions, including high winds and record high temperatures and drought conditions, fueled a huge blaze. Road conditions before the evacuation were dry. However, smoke from the fire made it difficult, if not impossible, to see portions of the road and to ascertain the direction of the fire.

The evacuation included 20,000 to 30,000 people from significant portions of Oakland, Berkeley, and Piedmont, as well as part of the UC-Berkeley campus. Large areas were evacuated ahead of the fire. Fire officials identified the areas to be evacuated, while Oakland and Berkeley police officers conducted the actual evacuation. While some residents hurried to leave the area, others refused to leave. Police officers had to use their authority to evacuate some residents and to keep others from returning to endangered areas.

CONSEQUENCES

As many as 20,000 to 30,000 people were evacuated on October 20, 1991, because of the East Bay Hills Fire in the wildland-urban interface area between Oakland and Berkeley Hills. A total of 25 people died in the fire and 150 were injured. Of the 25 people killed, 19 were in the process of evacuating when they died. Eleven were killed when the fire caught up to them and eight died in the narrow smoke-filled streets during the evacuation. Many of the fatalities included individuals who were unable to evacuate because of age or disabilities. The body of an Oakland police officer was found, along with five civilian fatalities, at a narrow point on Charing Cross Road. It appeared that the cars were jammed at this point by a collision in the narrowest part of the road, and the occupants were unable to escape the advancing flames. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was extremely high. The response to this fire was one of the largest ever recorded: 440 engine companies and more than 1,500 firefighters responded to the fire. Initially, the Oakland Fire Department conducted operation and planning functions at the scene but later in the day, the California Department of Forestry and Fire Protection provided an overhead management team, and a joint command was established that consisted of the Oakland, Berkeley, and Piedmont fire departments, and Department of Forestry. Both Oakland and Berkeley are in Alameda County and participate in the Alameda County Fire Mutual Aid Plan. Oakland is the coordinating department for mutual aid within the North Zone of Alameda County, which includes 11 agencies. Engine units from Orinda, Moraga, and Contra Costa Counties were also dispatched to the fire. Command, control and coordination processes could best be described as ad hoc. The Incident Commander ordered the Oakland and Berkeley police to evacuate residents. There were no problems with the decision-making process.

Communications

The Incident Command System was used and there was both an EOC, which consisted of the Oakland Fire Department Dispatching Center, and an ICP or mobile command post. Communication between field emergency responders and the EOC was by radio, telephone, and cell phone. There were many communication problems that hampered both the fire-fighting efforts and the evacuation. The radio channels and Communications Center were overwhelmed by the situation. Radio communications were difficult or impossible because there were too many units on the same channel and too few mutual aid channels available; the steep, hilly terrain interfered with the radio signals. In the Oakland Fire Communications Center, the situation was also out of control. The incoming telephone lines rang continuously, with one caller after another reporting the fire. The news media were calling for information. The radio was so jammed with traffic that it was difficult to hear and respond to the messages that were directed to the Communications Center.

Notification and Warning

Senior local officials were notified of the incident by telephone, and emergency responders were notified through 911/dispatch. There were no problems with notification of emergency personnel or senior local officials. Emergency personnel were on the scene immediately because firefighters were onsite fighting the hotspots from the previous day. The elapsed time between the start of the fire and the decision to evacuate was a couple of hours. Most of the public was already aware of the fire but was officially notified to evacuate by police loudspeakers. A police helicopter PA system was used. Oakland chose not to use the Emergency Broadcast System, feeling it was inefficient.

The evacuation was partially staged. Large areas were evacuated ahead of the fire. The fire was fast moving and the winds were strong and variable in direction. It took several hours to complete the evacuation and not everyone made it out alive. The narrow streets were packed with people and the smoke made it impossible to know in which direction to evacuate. There were problems with warning and subsequent citizen action. Many people evacuated before the evacuation order and others refused to evacuate. Some of the residents refused to leave and tried in vain to protect their own homes. Police officers had to use their authority to evacuate some residents and to keep others from returning to endangered areas.

Traffic Movement and Control

Evacuees were not given specific instructions about where to go when they evacuated or which routes to use. The evacuation was conducted primarily by Oakland and Berkeley police officers. The scene was very chaotic because the smoke made it impossible to know in which direction to evacuate. In addition, the high winds produced a rapidly moving fire that actually caught up to and overwhelmed some of the evacuees. One known special institution (part of the University of California at Berkeley campus) was evacuated. However, it is unknown if any other special institutions were evacuated.

Special traffic problems existed during the evacuation. In addition to a heavy smoke that made it impossible to see, downed power lines and abandoned vehicles impeded the roadways. At least one traffic accident occurred during the evacuation and those involved in the accident, including a police officer, died in the fire. It is unknown whether reverse-laning was used. The steep and narrow roads, as well as the power lines and abandoned vehicles, forced evacuees to take any route possible to escape the fire.

There were some instances of people evacuating before being ordered to do so because the fire was moving so quickly. In addition, some people actually refused to evacuate and response personnel had to re-evacuate some people who returned to their homes.

Congregate Care Centers

Congregate care centers were opened in Oakland, Berkeley, and Piedmont. The congregate care centers were managed by the Red Cross, the Salvation Army, and by the Oakland, Berkeley, and Piedmont emergency planning and support agencies. It is unknown precisely what types of public buildings were used as congregate care centers or what percentage of evacuees went to the congregate care centers. There were no shadow evacuations.

Law Enforcement

The Oakland and Berkeley Police secured the evacuated area to prevent looting and vandalism. However, some civilians, posing as volunteers, entered the area and looted homes. There were problems with law enforcement because officers left the area to protect themselves from the fast-moving fire.

Re-Entry

It is unknown who authorized re-entry. However, it was a controlled phased re-entry because many homes had been destroyed in the fire. More than 3,000 structures and 1,500 acres were destroyed in the fire. Some evacuees received compensation for their evacuation-related expenses through their insurance companies. It is unknown whether there were major problems during re-entry. However, it could be assumed that there were problems since many homes were destroyed in the fire.

CONTACT INFORMATION AND REFERENCES

References

TR-060, The East Bay Hills Fire Oakland-Berkeley, California, October 1991, United States Fire Administration Technical Report Series, "The East Bay Hills Fire Oakland-Berkeley, California," Federal Emergency Management Agency, United States Fire Administration, National Fire Data Center. <http://www.usfa.fema.gov/downloads/txt/publications/tr-060.txt>

Parker, Captain Donald R. "The Oakland-Berkeley Hills Fire: An Overview," Oakland Office of Fire Services. January 1992. <http://www.sfmuseum.org/oakfire/overview.html>

"The Oakland Berkeley Hills Fire," National Fire Protection Association (NFPA) in cooperation with the Oakland and Berkeley, California Fire Departments and the California State Fire Marshal's Office. 1992. <http://www.firewise.org/pubs/theOaklandBerkeleyHillsFire/>

Railroad Accident, Appleton and Grand Chute, Wisconsin, November 3, 1997, ID #52

Summary

Rank Value: 44
Number Evacuated: 5,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Suburban

INTRODUCTION

On November 3, 1997, two railroad tankers carrying liquid petroleum gas derailed near the border of Appleton and Grand Chute, Wisconsin. Approximately 5,000 people within a 2.6 km^2 (1 mi^2) area were evacuated from their homes in Appleton and Grand Chute as a precaution because of the threat of an explosion.

COMMUNITY CONTEXT

General
Approximately 5,000 people were evacuated from a 2.6 km^2 (1 mi^2) area in a suburban (residential) community located on the border of the cities of Appleton and Grand Chute, Wisconsin. Appleton has a population of 70,087 people and covers an area of 55.3 km^2 (21.4 mi^2). Grand Chute has a population of 18,392 people and covers an area of 64.6 km^2 (25.0 mi^2). Grand Chute is about 121 km (75 mi) northwest of Milwaukee. Ethnicity, nationality, and age were not important factors in the evacuation.

The community has a mayoral form of government, and its main economic base is industry. There is a mall that attracts a large number of non-residents. The closest nuclear power plant is Point Beach, located near Manitowoc, Wisconsin, approximately 40 km (25 miles) away. Wisconsin has two commercial nuclear power plants.

History of Emergencies
The community is no more prone to hazards than the average U.S. city, although the city has had experience with derailments in the past. In 1996 there reportedly was a massive derailment and fire that resulted in a nearly three-week evacuation of Weyauwega, which is located 32 km (20 mi) west of Appleton. There were no large-scale evacuations in the previous 10 years. It is unknown whether the community had previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and there was no ETE in the plan.

Training
The community provides training to emergency response personnel but does not regularly conduct joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises, but it is unknown whether or not the emergency plan used in this evacuation was previously tested in a full-scale field exercise.

Community Awareness
The community has a low level of awareness of local hazards and of evacuation procedures. However, it has an average awareness of train derailment, in general, and a high level of awareness about the alerting methods used.

THREAT CONDITIONS

The threat condition leading to this evacuation was the derailment of two railroad tankers carrying liquid petroleum gas in the early evening (approximately 4 p.m.) on November 3, 1997. Weather conditions were overcast but there was no precipitation, and it was approximately 10°C (50°F). The roads were dry and clear, and there were no unusual circumstances that occurred during the derailment.

CONSEQUENCES

Approximately 5,000 people within a 2.6 km^2 (1 mi^2) area were evacuated from their homes after two railroad tankers carrying liquid petroleum gas derailed near the border of Appleton and Grand Chute, Wisconsin. There were no deaths or injuries associated with the derailment or the evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local, state, and federal agencies was high. Political boundaries were crossed, since the evacuation area included Appleton and Grand Chute,

Wisconsin. The command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Appleton fire chief, and there were no problems with the decision-making process.

Communications

An EOC was not used but there was an ICP used in this emergency. Communication between field emergency responders and the ICP was by face-to-face contact. There were no problems with this form of communication.

Notification and Warning

Senior local officials were notified of the incident by telephone and emergency responders were notified through the 911 phone system. There were no problems with notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes, and the decision to evacuate was made approximately one and one-half hours after the derailment. It is unknown how long it took to complete the evacuation. The public was notified by radio and television broadcasts and by door-to-door notification. The evacuation took place all at once, but some people refused to evacuate.

Traffic Movement and Control

Evacuees were given instructions about where to go to seek congregate care centers but were not told to use specific routes. One special institution, a manufacturing facility, was evacuated. Road conditions before the evacuation were dry and there were no traffic accidents and no traffic problems; all major roadways were available to evacuees. Reverse-laning was not used. It is unknown whether anyone evacuated before being told to do so. Some people refused to evacuate.

Congregate Care Centers

Two schools were opened as congregate care centers but it is unknown who managed those congregate care centers or what percentage of evacuees actually went to the congregate care centers. There were no shadow evacuations.

Law Enforcement

Police secured the area following the evacuation, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry

The Appleton fire chief authorized re-entry several hours after the derailment. There were no special controls during re-entry. It is unknown whether evacuees were compensated for their expenses. There were no problems during re-entry.

INVESTIGATOR COMMENTS

According to the Special Operations Chief in the Appleton Fire Department, the evacuation was successful because of cooperation among agencies, the responders' and the public's knowledge of the hazard, and the emergency plan that was in place.

CONTACT INFORMATION AND REFERENCES

Contact

Special Operations Chief
Appleton Fire Department
(920) 832-2281
(Personal Communication, 7/9/03)

References

"All Clear Given After Train Tankers Derail in Wisconsin." *Associated Press*. November 3, 1997.

"Wisconsin Neighborhood Evacuated Due to Derailment." *Associated Press*. November 3, 1997. <http://archive.ap.org> (May 22, 2003).

Keystone Cement, Bath, Pennsylvania, December 9, 1997, ID #53

Summary

Rank Value: 44
Number Evacuated: >1,600
Category: Technological Hazard
Specific Type: Fixed Site Hazmat
Community: Rural

INTRODUCTION

On December 9, 1997, the temperature doubled in a tank of hazardous solvents at the Keystone Cement Company in Bath, Pennsylvania, posing the possibility of an explosion. At least 1,600 people were evacuated, including 950 children from two elementary schools and a senior citizens townhouse complex during a 10-hour emergency that virtually shut down the borough of Bath.

COMMUNITY CONTEXT

General

Bath is a rural borough located in Northampton County, Pennsylvania. Bath has a population of 2,678 people and a total land area of 2.4 km^2 (0.9 mi^2). The evacuated area extended beyond the borders of Bath to include approximately 8 km^2 (3.14 mi^2). The estimated population for this area is 6,400 people. At least 1,600 people, or 25% of the community, was evacuated. The population density of the area during the evacuation was medium. Ethnicity, nationality, and age were not important factors in the evacuation.

Bath has a mayoral form of government. The area of the evacuation was primarily residential. The community's main economic base is manufacturing/industry. There are no special characteristics that attract a large number of non-residents. The Limerick Nuclear Power Plant, is located about 34 km (21 mi) northwest of Philadelphia, or about 60 km (37 mi) from this evacuation. The state of Pennsylvania has five commercial nuclear power plants, including Three Mile Island, located 16 km (10 mi) southeast of Harrisburg.

History of Emergencies

The Bath area is no more prone to hazards than average, and the community had no previous experience with the hazard that led to this evacuation or experience with any evacuations in the previous 10 years. It is unknown whether the community had previous experience with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan that included an evacuation section used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and there was no ETE in the plan.

Training
Training is provided to emergency response personnel, and although joint training is conducted between industry and government, it is not done on a regular basis.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. However, the emergency plan used in this evacuation was not previously tested in a full-scale field exercise.

Community Awareness
The community had a low level of awareness of local hazards but a high level of awareness about the hazard that caused this evacuation. The community's awareness of evacuation procedures and the alerting mechanisms used was average (medium).

THREAT CONDITIONS

The threat condition leading to this evacuation was a tank of hazardous solvents at the Keystone Cement Company in Bath, Pennsylvania. The tank doubled in temperature, posing the possibility of an explosion. The tank capacity was about 133,000 L (35,000 gal), but only 21,000 L (5,500 gal) were being stored. An explosion is more powerful when the tank contains more vapor than fuel. At least 1,600 people were evacuated. The road conditions were dry and the outside temperature was low, around 4.4° C (40° F), which helped keep vapors in the hazardous materials tank down. The evacuation began at 8:30 a.m., and people were allowed to return to their homes about 6:30 p.m.

CONSEQUENCES

On December 9, 1997, the hazmat incident at Keystone Cement led to the evacuation of at least 1,600 people, including 950 children from two elementary schools and a senior citizens townhouse complex. The evacuation lasted 10 hours and shut down Bath. There were no deaths or injuries associated with either the hazard or the evacuation. The estimated total cost of evacuation-related expenses incurred by the pubic was minimal.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. Approximately 60 firefighters with companies from East Allen, Allen, Hanover (Northampton County), Hanover (Lehigh County), Bath, Walnutport and Klecknersville were at the plant. Political boundaries were not crossed. Command, control and coordination processes could best be described as ad hoc. The decision to evacuate was made by the East Allen fire chief, who opted to evacuate a 2.6 km (1 mi) radius around the plant. There were no problems with the decision-making process.

Communications

An EOC and an ICP were used. Communication between field emergency responders and EOC was by radio, cell phone, and messenger. There were no problems with communications.

Notification and Warning

Senior local officials were notified of the incident by telephone, and emergency responders were notified through the county commission center. There were no problems with notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes. The elapsed time between start of the hazard and the decision to evacuate was one hour (the evacuation began at 8:30 a.m. and lasted for 10 hours). It is unknown how long it took to complete the evacuation. The public was notified by a police/fire PA system. The evacuation took place all at once, and there were no special problems regarding warning and subsequent citizen action. A few residents refused to evacuate but this was not a problem since residents were under a voluntary evacuation notice.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated and were told to use specific routes, which were designated by police roadblocks. Bath was cordoned off to normal traffic throughout the day. Route 329, where the Keystone plant is located, was blocked from Airport Road to the borough. Route 512 was closed from Main Street to Hanoverville Road. Roads were dry and there were no traffic accidents, but there were traffic jams. Traffic was detoured around the plant, and Routes 512 and 329 were closed for about 10 hours, causing major delays and tie-ups. Reverse-laning was not used.

Three special institutions were evacuated, including the Howard Jones townhouse apartments, a senior citizens complex, and two elementary schools. No one spontaneously evacuated before being told to do so. However, some people refused to evacuate, including an elderly couple who stayed in their home and a woman who openly strolled through the business district. The evacuation was mandatory for students and senior citizens but voluntary for the rest of the populace.

Congregate Care Centers
Congregate care centers managed by the American Red Cross were used. Children were taken to Moore Elementary School, located several miles northeast of Bath, and senior citizens were bused to the Klecknersville Fire Hall, also in Moore. Northampton High School students who live in Bath were kept at the high school until their parents picked them up. About 118 people, or 7% of those evacuated, mostly elderly, registered with the Red Cross. However, 1,000 school children were bused to an elementary school. Therefore, the total number of people going to congregate care centers was approximately 1,118 people, or 70% of those evacuated. There were no shadow evacuations.

Law Enforcement
The evacuated area was secured by police, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
The evacuation began at 8:30 a.m., and people were allowed to return to their homes about 6:30 p.m., according to the American Red Cross. Re-entry was authorized by the East Allen Fire Chief and no special controls during re-entry were used. Evacuees were not compensated for their expenses. There were no major problems during re-entry.

INVESTIGATOR COMMENTS

None

CONTACT INFORMATION AND REFERENCES

Contacts
East Allen Fire Marshall
(610) 262-6700
(Personal Communication, 7/15/03)

References
Csencsits, S. and K. Parrish. "Blast Hazard Shuts Down Bath: The Temperature in Tank of Solvents at Keystone Cement Doubles, Forcing Evacuations." *Lehigh County Emergency Response News.* December 9, 1997.
<http://www.dep.state.pa.us/dep/counties/Lehigh/Emergency_Response_NewsClips.htm> (May 9, 2003).

Devlin, Ron. "Borough Became Town Under Siege Residents Were Hostage to a Tank of Chemicals Until All-Clear at 6:30 P.M." *Lehigh County Emergency Response News.* December 9, 1997.
<http://www.dep.state.pa.us/dep/counties/Lehigh/Emergency_Response_NewsClips.htm> (May 9, 2003).

Propane Storage Facility Fire, Pascagoula, Mississippi, October 1998, ID #3

Summary

Rank Value: 44
Number Evacuated: >1,500
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

More than 1,500 residents of Pascagoula, Mississippi, were evacuated in October 1998 after a fire broke out at a propane storage facility. There were no deaths but three injuries were associated with the fire; no deaths or injuries were associated with the subsequent evacuation. There were no unusual circumstances that occurred during this incident.

COMMUNITY CONTEXT

General
The evacuated area was a suburban community in the city of Pascagoula, Mississippi, which has a total population of 26,200. Approximately 1,500 people, or 5.7% of the population was evacuated because of the incident. The evacuated area was approximately 1.3 km^2 (0.5 mi^2) and the city has a total area of 47.2 km^2 (18.2 mi^2). The evacuated area consisted of residential and commercial property. Population density of the evacuation area was average. Ethnicity, nationality, and age were not important factors in the evacuation.

Pascagoula has a mayoral form of government and its main economic base is manufacturing and industry. Tourism and shipbuilding attract a large number of non-residents. Ingalls Shipbuilding constructs many U.S. Navy ships here. Mississippi has one commercial nuclear power plant, the Grand Gulf 1, which is located over 80 km (50 mi) away from Pascagoula, or about 40 km (25 mi) south of Vicksburg.

History of Emergencies
Pascagoula is more prone to both natural disasters (e.g., hurricanes and storms) and technological hazards than the average U.S. city. However, the community had no prior experience with the hazard that led to this evacuation. There have been hurricane evacuations in the previous 10 years. However, the residents had no previous experience with the alerting mechanism used in this evacuation, which was door-to-door notification.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
Pascagoula has a written emergency plan with an evacuation section that was used in this emergency. It is unknown whether or not this plan conforms to NUREG-0654/FEMA-REP-1, Rev. 1, requirements.

Training
Pascagoula provides training to its emergency response personnel, including joint training between industry and government.

Drills and Exercises
Pascagoula's emergency response agencies regularly conduct emergency drills and exercises. It is unknown whether the emergency plan used in this evacuation was previously tested in a full-scale field exercise.

Community Awareness
The community level of awareness of local hazards is average and awareness of the hazard that caused this evacuation was low. However, community awareness of evacuation procedures and alerting methods used is high.

THREAT CONDITIONS

The hazard that led to this evacuation was a fire at the propane storage facility in Pascagoula, Mississippi. The incident occurred at approximately 1 p.m. on a sunny and fair day. The road conditions were dry, and there were no unusual circumstances that occurred during this incident.

CONSEQUENCES

At least 1,500 residents of Pascagoula, Mississippi, were evacuated after a fire broke out at a propane storage facility. There were no deaths and three injuries associated with the fire and no deaths or injuries associated with the subsequent evacuation. The estimated total cost of evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high. Political boundaries were not crossed. Command, control and coordination processes could best be described as pre-planned. The decision to evacuate was made jointly by the Pascagoula fire and police chiefs. There were no problems with the decision-making process.

Communications
An EOC and an ICP were used. Communication between field emergency responders and EOC was by radio and cell phone. There were no problems with communications.

Notification and Warning
Senior local officials were notified of the incident by telephone and emergency responders were notified of the incident through the 911 emergency system. There were no problems with notification of emergency personnel or senior local officials. Response personnel mobilized to the scene in less than 15 minutes, and the decision to evacuate was made in about ten minutes. It took one to two hours to complete the evacuation. The public was notified of the evacuation door to door. The evacuation took place all at once. There were no special problems regarding warning and subsequent citizen action.

Traffic Movement and Control
Evacuees were given specific instructions about where to go when they evacuated and were told to use specific routes around the hazard. Police officers directed evacuees along the routes that were designated. No special institutions were evacuated; however, two special institutions sheltered in place. Road conditions before the evacuation were dry. No major roadways were unavailable for use because of construction or damage caused by the hazard, and no special traffic problems, including traffic accidents, occurred during the evacuation. It is unknown whether anyone evacuated before being told to do so or if anyone refused to evacuate.

Congregate Care Centers
A congregate care center was managed by the Red Cross at the fairgrounds. The number of evacuees that went to the fairgrounds is unknown. There were no shadow evacuations.

Law Enforcement
Police secured the area following the evacuation, and there were no instances of looting or vandalism or any other problems with law enforcement.

Re-Entry
Re-entry was authorized by the incident commander and the EOC. No special controls were used during the re-entry process. Evacuees were not compensated for their expenses. There were no major problems during re-entry.

INVESTIGATOR COMMENTS

According to the Pascagoula fire chief, the evacuation went smoothly because of the availability of response personnel and the closeness of the neighborhood. In addition, the public was familiar with evacuation procedures because of storm-related evacuations.

CONTACT INFORMATION AND REFERENCES

Contacts
Pascagoula Fire Chief
(228) 762-0751
(Personal Communication, 7/9/03)

References
Fireworld. "Pascagoula, Mississippi." October 1998.
<www.fireworld.com/incidents/Oct1998.html> (May 27, 2003).

Transportation Accident, Bossier City, Louisiana, September 18, 1998, ID #239

Summary

Rank Value: 44
Number Evacuated: ~2,000
Category: Technological Hazard
Specific Type: Transportation Accident
Community: Suburban

INTRODUCTION

On September 18, 1998, workers loading a bomb from a B-52 accidentally dropped the 500-pound explosive on a runway in Bossier City, Louisiana. The bomb did not explode; however, as a precaution, approximately 2,000 people were evacuated before the bomb was picked up and moved to a safe location.

COMMUNITY CONTEXT

General

The city of Bossier, Louisiana is a suburban community with a population of approximately 56,400 people and covers an area of 107.8 km^2 (41.6 mi^2). Approximately 2,000 people, or 3.5%, of the population were evacuated from a 2.6 km^2 (1 mi^2) area during this incident. The land use in the area is mainly residential, and the population density of the area was medium. Ethnicity, nationality, and age were not important factors in the evacuation.

The city has a mayoral form of government, and the main economic base is tourism. Tourism attracts a large number of non-residents to casinos in the area. Additionally, Barksdale Air Force Base is located in the city and attracts a large number of visitors. The nearest nuclear power plant is River Bend located more than 80 km (50 mi) away. Louisiana has a commercial nuclear power plant northwest of Baton Rouge.

History of Emergencies

The community is more prone to hazards than average. However, the city had not had experience with unexploded ordnance in the past. The community had experienced evacuations for tornados, train accidents, and transportation accidents, and had experienced large-scale evacuations in the last 10 years. The community had had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning

The community has a written emergency plan with an evacuation section that was used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan.

Training

The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises

The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was previously tested in full-scale field exercises and in tabletop exercises.

Community Awareness

The community has a medium level of awareness of the local hazards and a low level of awareness of evacuations procedures. It has a medium level of awareness of these types of weapons in general, and a low level of awareness of the alerting methods used in this evacuation.

THREAT CONDITIONS

On September 18, 1999, a bomb was accidentally dropped while being loaded on a B-52 at Barksdale Air Force Base in Bossier City, Louisiana. The bomb did not explode; however, possible damage to the bomb and uncertainty about moving the bomb was cause to evacuate the area. Weather conditions were dry and clear and the roads were clear.

CONSEQUENCES

Approximately 2,000 people within a 2.6 km^2 (1 mi^2) area were evacuated from their homes after a bomb was dropped during a loading operation at Barksdale Air Force Base. There were no fatalities or injuries from the incident or the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high, and political boundaries were crossed in this event because the accident occurred on federal property near the city. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Bossier City fire chief, and there were no problems with the decision-making process.

Communications
An EOC was not used in this event; however, an ICP was established. Communication between field emergency responders and the ICP was primarily by radio. There were no problems with communications during the event.

Notification and Warning
Senior local officials were notified of the incident by telephone. The emergency responders were notified when the Air Force Base contacted the Fire Department Communication Division. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the initial decision to evacuate was made approximately three hours after the notification of the incident. It took approximately one hour to complete the evacuation.

The public was notified by telephone, radio and television broadcasts, and by police going door to door. The evacuation took place all at once and there were no problems with warning and subsequent citizen action. No one refused to evacuate.

Traffic Movement and Control
Evacuees were given instructions on where to go and were told which routes to use. These routes were designated by police roadblocks. There were no special institutions evacuated. Road conditions during the evacuation were dry, and no traffic accidents or traffic-related problems occurred during the event. Reverse-laning was not used.

Congregate Care Centers
Congregate care centers were established at local schools and churches for this emergency and were managed by the facility owners. It is unknown what percent of the evacuees went to the congregate care centers. There were no shadow evacuations.

Law Enforcement
Police secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
Re-entry was authorized as a joint decision between the Bossier City fire chief and Barksdale Air Force Base officials. Re-entry was not controlled, and evacuees were not compensated for their expenses. There were no problems reported during re-entry.

INVESTIGATOR COMMENTS

The coordinated efforts of the Air Force and the city contributed to the success of this evacuation. It was learned that improvements could be made in notifying the public and that it is important to work with different agencies in training.

CONTACT INFORMATION AND REFERENCES

Contacts

Bossier City Fire Chief
(318) 741-8700
(Personal Communication, 8/7/03)

Bossier City HazMat Officer
(318) 741-8700
(Personal Communication, 8/7/03)

References

"Air Traffic Suspended, Neighborhoods Evacuated After Bomb Accident." *Associated Press*. September 18, 1998.

Paint Plant Hazardous Materials Release, Chicago, Illinois, August 5, 1997, ID #51

Summary

Rank Value: 44
Number Evacuated: 2,500
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

On August 5, 1997, a leaky valve or hose at the Chicago Specialty Corporation released 6,600 kg (3,000 lbs) of sulfur trioxide into the atmosphere, causing an evacuation of approximately 2,500 people on the south side of Chicago, Illinois.

COMMUNITY CONTEXT

General

The city of Chicago, Illinois, is an urban community with a population of approximately 2,900,000 people and covers an area of 606 km^2 (234 mi^2). Approximately 2, 500 people, or less than 1%, of the population was evacuated from the south side suburbs of Chicago during this incident. Ethnicity, nationality and age were not important factors in the evacuation.

The city has a mayoral form of government, and the main economic base is industry and tourism. Tourism attracts a large number of non-residents. Additionally, there is a large military contingent and many workers who travel into the city. The nearest nuclear power plant is Dresden, located approximately 15 km (9 mi) east of Morris, Illinois.

History of Emergencies

Chicago is more prone to hazards than average, and the city has had experience with chemical leaks from manufacturing plants in the past. The community has experienced large-scale evacuations in the past 10 years, and the community has had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness

The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises, and the emergency plan used in this evacuation was previously tested in tabletop and full-scale exercises.

Community Awareness
The community has a medium level of awareness about the local hazards and a low level of awareness about evacuation procedures. It has a low level of awareness about hazardous materials in general, but a high level of awareness about the alerting methods used in this evacuation.

THREAT CONDITIONS

On August 5, 1997, a leaky valve or hose at the Chicago Specialty Corporation released 6,600 kg (3,000 lb) of sulfur trioxide. The chemical escaped from a tanker truck in liquid form, then vaporized and formed a toxic cloud that dispersed and caused an evacuation of approximately 2,500 people on the south side of Chicago, Illinois. Weather conditions were hot and the roads were dry.

CONSEQUENCES

Approximately 2,500 people were evacuated from their businesses and homes after a release of sulfur trioxide into the atmosphere. There were no fatalities from the incident; however hospitals reported treating 40 people for burning eyes and related ailments. There were no injuries from the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation between local, state, and federal agencies was high, and political boundaries were not crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Chicago Fire Chief, and there were no problems with the decision-making process.

Communications

It is unknown if an EOC was used; however, an ICP was used in this emergency. Communication between field emergency responders and the ICP was by radio. There were no problems with communications during the event.

Notification and Warning

Senior local officials were notified of the incident by a telephone tree, and emergency responders were notified through the 911 phone system. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes. It is not known how long it took to make the initial decision to evacuate or how long it took to complete the evacuation.

It is not known how the public was notified, but it was likely door-to-door notification. The evacuation was completed all at once. It is unknown if people evacuated before being told to do so or if some people refused to evacuate.

Traffic Movement and Control

Evacuees were given instructions on where to go and were told which routes to use. These routes were designated by police barricades. There were no special institutions evacuated. Road conditions during the evacuation were dry and no traffic accidents or traffic-related problems occurred during the event. Reverse laning was not used.

Congregate Care Centers

It is unknown if congregate care centers were established for this emergency. There were no shadow evacuations.

Law Enforcement

The police secured the area following the evacuation, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry

The fire chief authorized re-entry, and there were no special controls in place during re-entry. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

Interagency cooperation and a clear understanding of the threat were factors that made the evacuation work well. One problem with the evacuation was the need for clearer communication and more information.

CONTACT INFORMATION AND REFERENCES

Contacts

Chicago Fire Department
Chief of Hazmat
(312) 745-1044
(Personal Communication, 7/30/03)

References

"Toxic Spill Forces Evacuations." *Associated Press*. August 5, 1997.

Plastics Plant Fire, Mason City, Iowa, May 1998, ID #79

Summary

Rank Value: 44
Number Evacuated: 3,600
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

In May 1998, a fire started in a plastics plant, causing the potential for a chlorine gas leak. Approximately 3,600 people were evacuated from their businesses and homes.

COMMUNITY CONTEXT

General
Mason City, Iowa, is a suburban, community with a population of approximately 29,172 people and covers an area of 68 km^2 (26 mi^2). Approximately 3,600 people, or 12%, of the population were evacuated from a 2.6 km^2 (1 mi^2) area during this incident. Ethnicity, nationality, and age were not important factors in the evacuation.

The city has a mayoral form of government and the main economic base is manufacturing. Tourism attracts large numbers of non-residents to the area. The nearest nuclear power plant is more than 80 km (50 mi) away.

History of Emergencies
The area is more prone to hazards than the average city, and the city has had experience with chlorine leaks in the past. It is unknown if the community has experienced large-scale evacuations in the last 10 years; however, they have had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan that was used in this emergency, and the plan included an evacuation section. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan. The plan did comply with state requirements.

Training
The community regularly provides training to emergency response personnel; however, joint training between industry and government is not regularly conducted.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan had not been previously tested in full-scale exercises.

Community Awareness
The community has a medium level of awareness about the local hazards and about evacuation procedures. It has a low level of awareness about hazardous materials. The community does have a high level of awareness about the alerting methods used in this evacuation.

THREAT CONDITIONS

On Mother's Day in May 1998, there was a fire in the mid-afternoon at a plant that makes and stores plastics, creating a concern about the potential release of chlorine gas. As a result of this concern, approximately 3,600 people were evacuated. Weather conditions were dry and the roads were dry and clear. There were no unusual circumstances that occurred during the event.

CONSEQUENCES

Approximately 3,600 people within a 2.6 km^2 (1 mi^2) area were evacuated from their businesses and homes after a fire started at a plant that makes plastics. There was a significant potential for release of chlorine gas, hence the need for the evacuation. There were no fatalities or injuries from the incident or the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high, and political boundaries were not crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the Mason City Fire Chief, and there were no problems with the decision-making process.

Communications
An EOC was not used, but there was an ICP used in this emergency. Communication between field emergency responders and the ICP was by radio. There were no problems with communications during the event.

Notification and Warning
Emergency responders were notified through the 911 phone system, and there were no problems with the notification of emergency personnel. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes and the initial decision to evacuate was made approximately one hour later. The entire evacuation was completed within one hour.

Police going door to door notified the public, and the evacuation occurred all at once. There were no problems with warnings or subsequent citizen action. It is unlikely that anyone evacuated before being told to do so, and no one refused to evacuate.

Traffic Movement and Control
Evacuees were given instructions on where to go and were told which routes to use. These routes were designated by police road blocks. There were no special institutions evacuated. Road conditions during the evacuation were dry and no traffic accidents or traffic-related problems occurred during the event. Reverse-laning was not used.

Congregate Care Centers
Congregate care centers were established in churches and schools for this emergency; however, it is unknown how many people went to the congregate care centers. The Emergency Management director managed the congregate care centers. There were no shadow evacuations.

Law Enforcement
Police secured the area following the evacuation, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
The Mason City fire chief authorized re-entry, and there were no special controls during re-entry. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

The evacuation worked well due to good training, a good command system and the cooperation of the police and fire departments. A lesson learned was that there needs to be a better way to notify residents of the need to evacuate.

CONTACT INFORMATION

Contacts
Mason City Fire Chief
(641) 421-3640
(Personal Communication, 7/22/03)

Champion Technologies Inc., Odessa, Texas, August 20, 1992, ID #245

Summary

Rank Value: 44
Number Evacuated: 27,000
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

On August 20, 1992, a fire at the Champion Technologies Inc. Plant, located just outside the Odessa City limits, prompted the evacuation of approximately 27,000 area residents. The facility stores about 702 oilfield chemicals that could pose a health hazard if inhaled. To further complicate matters, weather conditions, including high humidity, caused the cloud of smoke to remain low and to blow directly over the city. There were no deaths, but 54 people were injured because of the hazard. There were no deaths or injuries associated with the evacuation.

COMMUNITY CONTEXT

General
Odessa is a city in Texas with a total population of 90,943 people. Approximately 27,000 residents (29.6% of the population) were evacuated from a suburban area of Odessa. An estimated 550 businesses, in addition to both Permian and Winwood Malls, were evacuated. Land use in the area was primarily residential, commercial, and industrial. The total land area of Odessa is 95.5 km^2 (36.9 mi^2) and the evacuated area was 72.5 km^2 (28 mi^2). The population density of the area during the evacuation was medium. Age was an important factor in the evacuation because a nursing home with numerous senior citizens had to be evacuated. Odessa is located over 50 miles away from the nearest commercial nuclear power plant.

History of Emergencies
Odessa is more prone to both technological hazards and natural disasters than the average U.S. city because it is located in a tornado-prone area and it is intersected by railroads and major interstates. The community did have previous experience with the hazard that led to this evacuation, but it is unknown whether the community had experienced evacuations in the previous 10 years.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. However, it is unknown whether the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1.

Training
Training is provided to emergency response personnel, and joint training between industry and government is regularly conducted.

Drills and Exercises
Odessa's emergency response agencies regularly conduct emergency drills and exercises. It is unknown whether the emergency plan used in this evacuation was previously tested in a full-scale field exercise.

Community Awareness
The level of community awareness about local hazards and about the hazard that caused this emergency was medium. The level of community awareness about evacuation procedures and about the alerting methods used was low.

THREAT CONDITIONS

The threat condition leading to this evacuation was a chemical spill that resulted in a fire at the Champion Technologies Inc. Plant near Odessa, Texas, at approximately 4:35 a.m. on August 20, 1992. According to Champion Technologies Inc., lightning had struck a chemical storage facility where approximately 702 oilfield chemicals were being stored. The chemicals involved in the fire posed a possible health hazard, specifically respiratory distress and irritation if inhaled for long periods of time. To further complicate matters, weather conditions, including high humidity, caused the cloud of smoke to remain low and blow directly over the city. The wind was blowing to the west at 13 to 16 km/hour (8 to 10 mph), humidity was 100%, and the temperature was 17.2°C (63°F). Changing wind direction forced the ICP to be moved and hindered the assessment of the evacuation boundary. There was a thunderstorm earlier that day but roads were clear and dry during the evacuation.

CONSEQUENCES

As a result of the fire at the Champion Technologies Inc. Plant in Odessa, Texas, 27,000 people were evacuated from their homes and businesses. Approximately 54 people were treated at Medical Center Hospital for symptoms, including watering and burning eyes, itching skin, and difficulty in breathing. Among those treated were several law enforcement officers. All 54 individuals were treated and released and there were no deaths. There were no deaths or injuries associated with the evacuation. The estimated total costs of evacuation-related expenses incurred by the public are unknown.

EMERGENCY RESPONSE

Decision Making

There was an integrated emergency response effort of the local, state, and federal agencies involved in response to the spill, explosion, and fire at Champion Technologies Inc., and the level of cooperation was moderate. No political boundaries were crossed. The command, control, and coordination process could best be described as pre-planned. The decision to evacuate was made by the Odessa fire chief; there were some problems with the decision-making process, and it was determined that a unified command structure was needed. Other agencies that worked with the jurisdiction during this emergency were the Texas Railroad commission, Texas Water Commission, Texas Air Control Board, Texas Department of Public Safety, Southwestern Bell Telephone, and Post-Newsweek Cable. A reported 40 officers from the Odessa Police Department, 25 officers from the Ector County Sheriff Department and Reserve Unit, 18 Texas Department of Public Safety Officers, three Ector County Independent School District personnel, four Adult Probation Officers, seven Midland County Sheriff Department Officers, and 12 Texas Department of Transportation personnel participated in the evacuation process.

Communications

An EOC was used as well as an ICP. Communication between field emergency responders and the ICP was by radio. There were no problems with the communication and equipment worked okay; however, the agency coordination could have been better. At the onset of the emergency, the assistant fire chief had been notified of the severity of the situation and in coordination with the battalion chief, the EOC was activated.

Notification and Warning

Senior local officials were notified of the incident by telephone, and emergency responders were notified of the incident through a 911 call from an employee of Champion Technologies. The elapsed time between the discovery of the incident and the mobilization of response personnel was less than 15 minutes. The elapsed time between the discovery of the incident and hazard and the decision to evacuate was one hour and 20 minutes. It took approximately three and a half hours to complete the evacuation. The public was notified by sirens, radio and television broadcasts, and by emergency responders going door to door. There were no problems with notification of emergency personnel or senior local officials. The evacuation took place all at once and there were no problems regarding warning and subsequent citizen action. Dispatchers notified fire department personnel, and fire units were dispatched to the scene of what was then considered a two-alarm fire. The battalion chief responded to the scene of the fire. After assessing the scene, other fire department personnel were requested to assist firefighters at the location. The Odessa Fire Department Hazmat Unit was also dispatched. Law enforcement officers, aided by volunteers from the public and private sector, notified residents of the need to leave their homes and businesses based upon information provided by the spotters. After sounding sirens to awaken the residents, door-to-door contact was made to warn and evacuate citizens. The broadcast news media and local cable company, in conjunction with reports from the public information officer, provided regular updates on the fire situation, areas to be evacuated and the location of congregate care centers. The excellent news coverage of the emergency was beneficial to the overall operations and was closely followed by key officials in the EOC, enabling them to grasp the magnitude of the situation even though they were removed from the scene.

Traffic Movement and Control
Evacuees were given instructions about where to go to seek congregate care centers and were given specific routes. Several special institutions were evacuated, including two nursing homes, two malls, one elementary school, and 550 small businesses. Road conditions before the evacuation were dry and all major roadways were available to evacuees. There were no special traffic problems encountered and reverse-laning was not used. Some people spontaneously evacuated; however, no one refused to evacuate.

Congregate Care Centers
By 7 a.m. the American Red Cross had established congregate care centers at the Odessa High School Field House and the Odessa College Sports Complex. Approximately 1,000 individuals (3.7% of evacuees) registered at the congregate care centers. EMS units dispatched to the Avalon Place Nursing Home assessed the need to send patients directly to Medical Center Hospital for more specialized care. Transportation buses provided by Ector County included those equipped for persons with disabilities.

Law Enforcement
Law enforcement personnel from the Odessa Police Department, Ector County Sheriff Department, and Texas Department of Public Safety were called in for assistance and secured the area following the evacuation. Aid from law enforcement personnel included securing the area, traffic control and evacuation of citizens in the threatened area. There were no instances of looting or vandalism and no problems with law enforcement.

Re-Entry
The evacuation order was lifted at 10:42 a.m.; citizens were allowed to return home and businesses were allowed to open. The Odessa Fire Chief authorized re-entry. There were no special controls during the re-entry process. Evacuees were not compensated for their expenses and there were no problems during re-entry.

INVESTIGATOR COMMENTS

The success of this emergency response operation with such a massive evacuation was a result of the tremendous cooperation and expertise of all individuals involved, coupled with pre-planning and training. Areas of improvement identified by city and county personnel included communications (phone and radio), notification, public education, equipment, and EOC arrangement.

1. Communications – add additional phone lines in the EOC, use cellular phones, use RACES more, and divert incoming calls to a phone bank to keep from tying up the EOC's lines.

2. Notification – keep a list in the EOC for first call up and assign non-key personnel to make contacts, as necessary.

3. Public Education – work with media to teach the public to stay off phones during disaster except for emergencies and not to contact 911 for informational purposes; have more programs to educate the public about various types of emergencies and how to react.

4. Equipment – arrange for fax machine in the EOC to send group information to media, etc.; use governmental access channel for training and to display emergency information updated from EOC/PIO, arrange for additional phones and radios for EOC.

5. EOC Arrangement – work to decrease noise level in the EOC; rearrange room to maximize use of space by moving phone bank into the hallway; move key officials into another area.

CONTACT INFORMATION AND REFERENCES

Contacts

Odessa Fire Chief
(915) 335-4650
(Personal Communication, 8/5/03)

Liquified Chlorine Gas Leak, Henderson, Nevada, May 6, 1991, ID #36

Summary

Rank Value: 44
Number Evacuated: ~7,000
Category: Technological Hazard
Specific Type: Fixed Site Hazmat Incident
Community: Suburban

INTRODUCTION

A massive leak of liquefied chlorine gas created a dangerous cloud over the city of Henderson, Nevada, May 6, 1991. The leak originated at the Pioneer Chlor Alkali facility located in an industrial area approximately 10 miles southeast of Las Vegas, Nevada. Pioneer is one of several chemical and materials processing facilities that are located in the Basic Management Inc. complex. More than 200 persons were examined at local hospitals, including some policemen who were exposed to chemicals while managing evacuation activities.

COMMUNITY CONTEXT

General

The city of Henderson, Nevada, is a suburban community with a population of approximately 207,640 people and covers an area of approximately 154 km^2 (96 mi^2). Approximately 7,000 people, or 3%, of the population were evacuated from an area of several square kilometers during this incident. Ethnicity, nationality, and age were not important factors in the evacuation.

The city has a mayoral form of government, and the main economic base is tourism. Tourism attracts a large number of non-residents to the area. The nearest nuclear power plant is more than 80 km (50 mi) away, and there are no commercial nuclear power plants in Nevada.

History of Emergencies

The community is more prone to hazards than average, and the city has had experience with chemical leaks from manufacturing plants in the past. Several hazardous material incidents have occurred in the immediate area, including an explosion of ammonium perchlorate at an adjacent facility in 1988, which resulted in two deaths and 372 injuries. The community has experienced large-scale evacuations in the last 10 years; however, it is unknown if the community had previous experience with the alerting mechanism used during this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community did not have a written emergency plan for use in this emergency.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government. Joint training exercises had been conducted with the Clark County Fire Department HazMat Team and other area fire departments.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises.

Community Awareness
The community has a medium level of awareness of the local hazards and a low level of awareness of evacuations procedures. It has a low level of awareness of hazardous materials in general, and with the alerting methods used in this evacuation.

THREAT CONDITIONS

Liquid chlorine is stored in pressure tanks at the facility. A leak was first detected by automatic monitoring equipment located near the storage tanks at approximately 1:10 a.m. on May 6, 1991. Employees responding to the alarm found a pinhole size leak in a pipe. Attempts were made by plant personnel to stop the flow and patch the leak. Management personnel were notified and members of the company's emergency team were called to respond to the plant. Plant employees were considered to be proficient in handling situations of this type.

At approximately 1:50 a.m. a citizen notified the Henderson Police Department of a strong offensive odor near the complex. The call was relayed to the Las Vegas City Fire Department Communications Center, which provides communications for the Clark County Fire Department. Since reports of odors in the area are a frequent occurrence, the Clark County battalion chief was notified and he made the decision to wait for a more positive report before responding. The communications personnel began to call the industries in the area to ask if any of them had a problem.

At approximately 2 a.m., a second call was received and the fire department was dispatched. Arriving at the gate of the facility, the Clark County battalion chief found several employees who had been exposed to chlorine gas and were in need of medical attention. Within a few minutes, the atmosphere around the plant entrance became enveloped by the chlorine cloud and most of the plant employees donned their emergency escape respirators. All fire department and plant personnel evacuated to a location approximately one half mile from the plant where a command post was established.

It was very difficult to accurately predict the size or travel of the gas cloud resulting from the vaporization of the liquid pool on the ground. The flow rate of the leak could not be determined, and the size of the resulting liquid pool could not be observed. The developing cloud could not be visually monitored because of the darkness and the location of the problem within the facility.

Weather conditions were clear and dry and the roads were dry.

CONSEQUENCES

The chlorine gas created a dangerous cloud of poison over the city of Henderson, Nevada, May 6, 1991. The leak originated at the Pioneer Chlor Alkali facility in an industrial area where several chemical and materials processing facilities are located. All of the adjacent industrial facilities were shut down and evacuated except one critical facility where employees donned self-contained breathing apparatus and continued working.

At approximately 3:30 a.m. conditions began to deteriorate rapidly. The command post and staging area were suddenly enveloped by the gas and had to be evacuated. The command post was relocated first to a convenience market parking lot, which also became unacceptable, and then to a race track parking lot several miles from the facility. Reports of strong odors in the residential areas and downtown portions of Henderson caused the IC to begin evacuations of residents. At approximately 3:45 a.m. a state of emergency was declared by the County Manager and the Clark County Emergency Operations Center was activated.

Approximately 7,000 people were evacuated from their businesses and residences. More than 200 persons were examined at local hospitals, including some policemen who were exposed to chemicals while managing evacuation activities. There were no fatalities from the incident or the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation between local, state, and federal agencies was high, and political boundaries of the city and county were crossed in this event. The command, control, and coordination processes could best be described as ad hoc. The decision to evacuate was made by the Battalion Chief for Clark County, and there were no problems with the decision-making process.

Communications

An EOC and an ICP were used in this emergency. The EOC was activated at 3:45 a.m. when the County Manager declared a state of emergency. The field ICP was relocated three times during the emergency. Communication between field emergency responders and the ICP was by radio and cell phone. There were problems with communications during the event: the agencies and jurisdictions involved used a variety of radio systems and frequencies. This problem was somewhat resolved through the use of cell phones to supplement the radio communications.

Notification and Warning

It is unknown how senior local officials were notified of the incident. Emergency responders were notified through the 911 phone system. There was a delay in the notification of emergency personnel while the battalion chief waited for a more positive report. There were no problems notifying senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was approximately 50 minutes and the initial decision to evacuate was made approximately four hours after the start of the incident. It took approximately four hours to complete the evacuation, which started with the surrounding industrial facilities and expanded to approximately 7,000 people.

The public was notified by use of a PA system and by police going door to door. The evacuation was completed all at once. It is unknown if some people evacuated prior to being told to do so, and no one refused to evacuate.

Traffic Movement and Control

Evacuees were given instructions on where to go and were told which routes to use. These routes were designated by police road blocks. There was one special institution evacuated and this was a retirement home in the direct path of the gas cloud. Additionally, the St. Rose Dominican Hospital in downtown Henderson was located within the affected area. A decision was made to leave the patients in the building with the air handling system set to recirculate the interior air. This was determined to be preferable to risking moving the patients outside into the contaminated atmosphere. Road conditions during the evacuation were dry, and no traffic accidents or traffic-related problems occurred during the event. Reverse-laning was not used.

Congregate Care Centers

Congregate care centers were established at local schools and hotels in Las Vegas for this emergency and were managed by the Red Cross. The Clark County School District made school buses available to the Fire Department and 50 off-duty firefighters were called in to drive them. Each bus driver was provided with an SCBA, in case a contaminated area was encountered, and two teams were made up of full crews of SCBA-equipped firefighters standing by to take buses into the contaminated areas to rescue residents in immediate danger. Police officers were assigned to notify residents in the predicted path of the cloud, while firefighters were assigned to areas where the presence of chlorine could be detected. Approximately 700 people, or 10% of those evacuated, went to the congregate care centers. There were shadow evacuations; however, this did not have an impact on congregate care center capacity or the evacuation.

Law Enforcement
Police secured the area following the evacuation, and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
Re-entry was authorized as a joint decision between the Las Vegas, County, and Henderson Unified Command. The re-entry was controlled and no problems were encountered. Evacuees were not compensated for their expenses.

INVESTIGATOR COMMENTS

The unified command working together contributed to the success of this evacuation. One problem was there were no qualified personnel to drive the evacuation buses.

Additional lessons learned include:

- The problems associated with a high-risk occupancy in one jurisdiction creating a problem in a different jurisdiction present obvious challenges for emergency planning response agencies. In this case the responding agencies worked well together, but the deficiencies of the regulatory and planning processes were a major focus of attention after the incident.

- The Incident Command System proved to be extremely effective in this incident, particularly in coordinating the efforts of several different agencies at the scene. The ability to assign major responsibilities to command officers from different fire departments, without any problems, is evidence that the personnel are trained and prepared to operate effectively.

- The lack of effective radio communications among agencies was a problem in this incident. Cell phones were used effectively to supplement public safety radio capabilities and proved reliable. Had the system become overloaded with calls during the incident, Centel Cellular would have blocked off communications, allowing only emergency personnel phones to work.

- Making the decision of whether to evacuate residents or warn them to remain indoors with windows and outside air inlets closed is critical. The risk of exposure during evacuation may be greater than the risk of staying indoors.

- The use of buses operated by fire department personnel is a practical means to evacuate. It is easier to train fire fighters to drive buses than to train bus drivers to use SCBA.

- Police officers who were not provided with or trained to use SCBA were effective in evacuating areas ahead of the contamination, but could not function in contaminated areas. Several police officers who were assigned traffic control or to assist with the evacuation were exposed to chlorine and transported themselves to medical facilities for evaluation.

- It proved to be extremely difficult to determine the size, shape, and movement of the chlorine cloud. Helicopter observation was a valuable asset, particularly with increasing daylight. An attempt was made to predict dispersion of the chlorine using CAMEO (a computer code) but complicated factors of terrain, slope, temperature, wind velocity, humidity and unknown rate of release made predictions extremely difficult.

CONTACT INFORMATION AND REFERENCES

Contacts

Henderson Fire Chief
(702) 565-2436
(Personal Communication, 7/21/03)

Clark County Deputy Chief
(702) 455-7311
(Personal Communication, 7/21/03)

References

Routley, J. G. "Massive Leak of Liquefied Chlorine Gas, Henderson, Nevada," May 6, 1991; Federal Emergency Management Agency Report.

Railroad Accident, Shepherdsville, Kentucky, November 19, 1991, ID #92

Summary

Rank Value: 42
Number Evacuated: 1,000
Category: Technological Hazard
Specific Type: Railroad Accident
Community: Urban

INTRODUCTION

A freight train derailment sent 14 cars, including one carrying explosive chemicals and one carrying cluster bombs, plunging off a railroad bridge just after noon on November 19, 1991 on the main rail line between Louisville and Nashville. Approximately 1,000 people in downtown Shepherdsville, Kentucky, plus homes and businesses within 1.6 km (1 mi) of the wreck were evacuated. The evacuation included four schools and the Bullitt County Jail. The derailment was caused by a garbage truck that struck part of the bridge moments before the train passed. The governor declared the site a disaster area, which allowed use of National Guard personnel and equipment to handle the emergency.

COMMUNITY CONTEXT

General
Shepherdsville Kentucky, is an urban community with a population of approximately 8,334 people and covers an area of 27.9 km^2 (10.8 mi^2). Approximately 1,000 people, or 12%, of the population were evacuated from a 7.68 km^2 (3 mi^2) area during this incident. The land use in the area is mainly residential, commercial and industrial, and the population density of the area was high at the time of the evacuation. Ethnicity, nationality, and age were not important factors in the evacuation.

The city has a mayoral form of government, and the main economic base is commercial activity. There are no special characteristics that attract large numbers of visitors to the area. The nearest nuclear power plant is more than 80 km (50 mi) away. Kentucky has no nuclear power plants.

History of Emergencies
The community is more prone to hazards than average but has not had experience with this type of emergency in the past. The community has not experienced large-scale evacuations in the last 10 years and had no previous experience with the alerting mechanisms used in this emergency.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community has a written emergency plan with an evacuation section that was used in this emergency. It is unknown if the plan conformed to NUREG-0654/FEMA-REP-1, Rev. 1, or if there was an ETE in the plan.

Training
The community provides training to emergency response personnel and regularly conducts joint training between industry and government.

Drills and Exercises
The community's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was not previously tested in full-scale field exercises.

Community Awareness
The community has a low level of awareness of the local hazards and a low level of awareness of evacuations procedures. It also had a low level of awareness of the hazards in this incident, including hazardous materials and cluster bombs in general, and a medium awareness of the alerting methods used in this evacuation.

THREAT CONDITIONS

On November 19, 1991, a garbage truck struck a trestle leading to a bridge causing the tracks to move 30 cm (12 in) laterally and 10 cm (4 in) vertically. A freight train crossing the bridge derailed sending fourteen cars plunging off a railroad bridge just after noon. A total of 28 cars derailed. One of the cars that derailed, but did not go over the bridge carried 4,100 kg (9,000 lb) of explosives, including 90 cluster bombs. Of the 14 cars that fell over the bridge, one containing corn syrup and one containing construction materials caught fire.

The 89-car train was passing over the Salt River about 32 km (20 mi) from Louisville just after noon at about the same time the truck struck the bridge. The accident occurred on the main rail line between Louisville and Nashville. The weather was wet and the roads were wet.

CONSEQUENCES

Approximately 1,000 people in downtown Shepherdsville, Kentucky, plus homes and businesses within 1.6 km (1 mi) of the wreck were evacuated as a result of the accident. Some of the cars contained chemicals and explosives, prompting officials to evacuate the area. Additionally, some of the cars, not near the explosives, caught fire. The evacuation included four schools and the Bullitt County Jail. The governor declared the site a disaster area, which allowed use of National Guard personnel and equipment to handle the emergency.

There were no fatalities from the incident, but four firefighters became ill and had to be taken to the hospital. No injuries were reported during the evacuation. The estimated total cost of the evacuation-related expenses is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high, and political boundaries were crossed in this event. The command, control, and coordination processes could best be described as pre-planned. The decision to evacuate was made by the fire chief, and there were no problems with the decision-making process.

Communications

An EOC was used in this event and an ICP was established. Communication between field emergency responders and the ICP was primarily by radio. There were problems with communications during the event; different frequencies were being used by different agencies.

Notification and Warning

Senior local officials were notified of the incident by telephone. The emergency responders were notified through a fire lieutenant who saw the accident. There were no problems with the notification of emergency personnel or senior local officials. The elapsed time between discovery of the incident and mobilization of response personnel was less than 15 minutes, and the initial decision to evacuate was made approximately 10 minutes after notification of the incident. It took approximately 8 hours to complete the evacuation.

Evacuees were notified by radio and television broadcast and directly by the police using a PA system. The evacuation was staged; as information became available on the contents of the railcars, additional areas were evacuated. There were no problems with warning and subsequent citizen action. No one refused to evacuate.

Traffic Movement and Control

Evacuees were given instructions on where to go and were told to use specific routes. Police roadblocks and traffic control were used to direct traffic. A number of special institutions were evacuated, including the Bullitt County Jail, four schools, a day care facility, and City Hall. Road conditions during the evacuation were wet but no traffic accidents or traffic-related problems occurred during the event. State Highway 61 was closed because of the incident but this did not create problems. Reverse-laning was not used.

Congregate Care Centers

Congregate care centers were established at local schools and public buildings for this emergency and were managed by the Red Cross. Approximately 200 evacuees, or 20%, went to the congregate care centers while the remaining evacuees went to friends or relatives. There were no shadow evacuations.

Law Enforcement
State and county police secured the area following the evacuation and there were no instances of looting or vandalism or any problems with law enforcement.

Re-Entry
Re-entry was authorized by the Kentucky Division of Disaster and there were no special controls during the re-entry process. Evacuees were not compensated for their expenses. There were no problems reported during re-entry.

INVESTIGATOR COMMENTS

Cooperation of the residents in this event was likely enhanced because of the unknown potential consequences and this cooperation contributed to the success of this evacuation. Improvements could be made in communications with various agencies, and communication equipment such as additional and standard frequencies are needed. Lessons learned included the importance of agency cooperation.

CONTACT INFORMATION AND REFERENCES

Contacts

Shepherdsville Fire Chief
(502) 543-6833
(Personal Communication, 8/6/03)

References

Gibson, A. "Train Plunges off Bridge South of Louisville." *Associated Press*. November 20, 1991.

Schreiner, B. "Crews Remove Cluster Bombs from Site of Derailed Train." *Associated Press*. November 21, 1991.

"Train Carrying Chemicals, Bombs, Plunges off Bridge." *Associated Press*. November 20, 1991.

Rodeo-Chediski Fire, Show Low, Arizona, June 18, 2002, ID #116

Summary

Rank Value: 42
Number Evacuated: 20,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Rural

INTRODUCTION

The Rodeo-Chediski Fire in Show Low, Arizona, began as two separate fires. The Rodeo Fire, which was started on June 18, 2002, combined with the Chediski Fire on June 23, 2002, and was finally contained on July 7, 2002. The combined fire forced the evacuation of approximately 20,000 people.

COMMUNITY CONTEXT

General
Show Low is a rural town in east central Arizona. For the majority of the year, it has a total population of 7,695 people and the population increases to around 20,000 people during the summer season. Approximately 20,000 residents (100% of the population) were evacuated after a wildfire approached the town. Land use in the area was primarily residential and commercial. The total area of Show Low and the evacuated area is 72.3 km^2 (27.9 mi^2). The population density of the area during the evacuation was low. Ethnicity, nationality, and age were not important factors in this evacuation.

Show Low has a council/manager form of government and its main economic base is tourism, which attracts a large number of non-residents, and retail. The community is located more than 50 miles away from the nearest commercial nuclear power plant.

History of Emergencies
Show Low is more prone to natural disasters and technological hazards than the average U.S. community. The community has had previous experience with hazardous material spills, floods, earthquakes and the hazard that led to this evacuation. The community had not experienced evacuations in the previous ten years or had previous experiences with the alerting mechanism used in this evacuation.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
The community had a written emergency plan with an evacuation section that was used in this emergency. The plan did not conform to NUREG-0654/FEMA-REP-1, Rev. 1, and it is unknown if the plan contained an ETE.

Training
Training is provided to emergency response personnel, and joint training between industry and government is regularly conducted.

Drills and Exercises
Show Low's emergency response agencies regularly conduct emergency drills and exercises. The emergency plan used in this evacuation was not previously tested in a full-scale field exercise.

Community Awareness
The level of community awareness of local hazards was medium and the level of community awareness of evacuation processes was high. The level of community awareness about the hazard that caused the evacuation and the alerting methods used was high.

THREAT CONDITIONS

The Rodeo-Chediski fire burned in east-central Arizona from June 18, 2002, and was not controlled until July 7. It was the worst fire in Arizona to date, consuming 467,066 acres of woodland. Initially there were two separate fires. The first fire, the Rodeo Fire, was reported on the afternoon of June 18 near the Rodeo Fairground on the Fort Apache Reservation. An arsonist was arrested on June 29 and was later charged. By early evening, despite the efforts of fire crews, approximately 1,200 acres were ablaze. Increasing wind speeds fed the fire to more than 2,000 acres by the following morning and when wind speeds increased to around 25 mph, the fire grew rapidly, increasing fourfold over the next three hours. By June 21, the Rodeo fire had consumed approximately150,000 acres.

The Chediski fire, which was first reported on the morning of June 20 near Chediski Peak, had been started by a lost hiker who was later arrested and charged. Again fed by strong winds, it had spread to 2,000 acres by mid-afternoon, and by the following morning it covered more than 14,000 acres.

Show Low was evacuated in the early evening. Weather conditions were very warm and the skies were smoky. No unusual circumstances occurred other than the hazard itself.

CONSEQUENCES

On June 18, 2002, 20,000 residents were evacuated from their homes and businesses and were able to return home on July 7, 2002. No deaths or injuries were associated with the incident or the evacuation. The total cost of evacuation-related expenses and property damages incurred by the public is unknown.

EMERGENCY RESPONSE

Decision Making

The level of cooperation among local, state, and federal agencies was high. County and federal political boundaries were crossed. The command, control, and coordination process could best be described as ad hoc. The decision to evacuate was made by a unified command, and there were no problems with the decision making process.

Communication

An EOC was used along with an ICP. Communication between field emergency responders and EOC was by radio, telephone, and runners. There were no problems with communication.

Notification and Warning

Senior local officials were notified of the incident through paging and visual observations of the fire. Emergency responders were notified of the incident through government channels. The elapsed time between the discovery of the incident and the mobilization of response personnel was approximately 18 hours. The elapsed time between the start of the hazard and the decision to evacuate was three days. It took four hours to complete the evacuation, and there were no problems with notification of emergency personnel or senior local officials. The public was notified by radio and television broadcasts, PA systems, and emergency responders going door to door. The evacuation took place all at once, and there were no special problems regarding warning and subsequent citizen action.

Traffic Movement and Control

Evacuees were given specific instructions about where to go when they evacuated and specific routes to use. One hospital and two nursing homes had to be evacuated. Road conditions before the evacuation were dry, and all major roadways were available to evacuees. There were no traffic accidents during the evacuation and reverse laning was used. Some people spontaneously evacuated before being told to do so, and others refused to evacuate.

Congregate Care Centers

The American Red Cross set up congregate care centers at various schools; approximately 8,000 people (approximately 40%) of the evacuees showed up. There were shadow evacuations but they did not impact traffic or congregate care center capacity.

Law Enforcement

The National Guard secured the area following the evacuation and no instances of looting or vandalism, occurred, nor were there any problems with law enforcement. A small army of law enforcement officers and National Guard troops patrolled the evacuated area to prevent looting and vandalism. Roughly 100 Maricopa County Sheriff's Office posse members and 130 Arizona

Army National Guardsmen were among the 500 extras called in to help the Navajo County Sheriff's Department keep order in and around Show Low.

Re-Entry

On July 7, 2002, nineteen days since the start of the emergency, the unified command authorized re-entry and allowed evacuees to return to their homes. No special controls were used during the re-entry process. No major problems occurred during re-entry. Evacuees were compensated for their expenses.

INVESTIGATOR COMMENTS

According to the Show Low fire chief, the public's pre-education about evacuations and fire hazards contributed to the success of the evacuation. However, the evacuation was difficult because some people did not have local television stations and were not notified of the evacuation. What to do with evacuees' animals and livestock was also a problem.

CONTACT INFORMATION

Contacts

Show Low Fire Chief
(928) 537-5100
(Personal Communication, 8/22/03)

References

<http://www.wikipedia.org/w/wiki.phtml?title=Show_Low%2C_Arizona&printable=yes>

Biscuit Fire, Cave Junction, Oregon, July 13, 2002, ID #133

Summary

Rank Value: 33
Number Evacuated: 1,000
Category: Natural Disaster
Specific Type: Wildfire
Community: Rural

INTRODUCTION

The Biscuit Fire started July 13, 2002, from a lightning strike approximately 8 km (5 mi) west of Selma, Oregon, in the Siskiyou National Forest within the Kalmiopsis Wilderness. The fire continued burning through July and August of 2002, burning over 2,000 km^2 (500,000 acres). The fire had a 332 km (206 mi) perimeter and encompassed two regions, two national forests, five ranger districts, and many cooperating agencies. The vegetation, terrain, fire behavior, environmental factors, public concern and duration of this event made it an extremely complex operation. The Shelley Creek Fire, Sour Biscuit Fire and Florence Fire all combined in early August, and the fire was renamed the Biscuit Fire. During the fire, many towns and communities were placed on evacuation notice and ultimately more than 1,000 people were evacuated from their homes. The path of the fire provided opportunities for fire officials to provide early evacuation warning to residents, which contributed to the smooth evacuation process in the areas affected.

COMMUNITY CONTEXT

General
On July 13, 2002, a lightning strike caused a fire approximately 8 km (5 mi) west of Selma, Oregon, near the town of Cave Junction. The size of Cave Junction is 4.2 km^2 (1.6 mi^2) with a population of 1,363 residents in the town and an additional 15,000 rural residents in the area, for a total population in the area of almost 17,000 people. The area is frequented by vacationers in the summer, and the population density during the evacuation was medium.

As the fire grew, the entire town of Cave Junction was put on 24-hour evacuation notice. The Biscuit fire evacuations totaled more than 1,000 people spread over a number of communities. The Red Cross registered 950 people evacuating Cave Junction, which represents approximately 70% of the population. Cave Junction is a small town run by a mayor. It is the gateway to the Oregon Caves National Monument and is the commercial, service, and cultural center for a rural community of small farms, woodlots, and crafts people. The valley is in the basin of the Illinois River Valley and its tributaries and includes a number of small communities, all of which were impacted during the Biscuit Fire. The nearest commercial nuclear plant, the Columbia Generating Station, is located in Richland, Washington, more than 80 km (50 mi) from the fire.

The evacuations did not impact operations and did not enter the emergency planning zone (EPZ) of the reactor.

History of Emergencies
The Cave Junction area, including Gasquet, California, is more prone to natural disasters than the average community. The area has been identified as being at risk from previous wildfires, including the 1987 Silver Fire. Beginning in the spring of 1996 when the Gasquet Shaded Fuel break was burned, work began to reduce fuels to protect this community. The reduction in fuels proved to be critical when, in September 1996, the Panther Fire threatened Gasquet. The Panther Fire almost forced an evacuation of the community.

Additional hazards included flooding in 1997. After the floods, the Rogue Valley Interfaith Relief Network was established to support emergency responders in a variety of ways.

Emergency Preparedness
The community's emergency preparedness activities include planning, training, drills and exercises, and community awareness as described below.

Planning
An evacuation plan was available and was used in this event. The recommendation for evacuations is a joint responsibility of the fire-fighting organization and local officials. The incident commander manages the fire and gives recommendations to local law enforcement officials, the Josephine County sheriff. The sheriff then initiates the evacuation.

These evacuations covered multiple communities. To address the public concern and provide up-to-date information, many community meetings were held with the local, state, and federal officials. Residents were urged to listen to the radio and television for current updates on the evacuation status, and were requested to be ready to leave within 30 minutes upon notification of an evacuation. This is in effect an evacuation time estimate and there were no reports of individuals not evacuating within the allotted time. The evacuation plan was specific to the fire and likely did not meet the requirements of NUREG-0654/FEMA-REP-1, Rev. 1.

Training
The sheriff's office coordinates the evacuations and personnel receive emergency response training. The Rogue Valley Interfaith Relief Network was established to support emergency responders. The volunteers are members of regional churches; they go through extensive training to support the response and evacuation efforts.

Drills and Exercises
If drills or exercises were conducted, they were not reported.

Community Awareness
The Cave Junction area is a community that was known to be at risk of forest fire, and community awareness was high. Videos were distributed and public meetings had been held to persuade owners to thin trees and replace roofs with non-burning materials. Grants were available to help defer some of the costs.

THREAT CONDITIONS

What ultimately became known as the Biscuit fire started on July 13, 2002, with a lightning strike approximately 8 km (5 mi) west of Selma, Oregon, in the Siskiyou National Forest within the Kalmiopsis Wilderness. The Sour Biscuit fire spread and eventually combined with the Shelley Creek Fire and Florence Fire and was renamed the Biscuit Fire. The fire was one of the largest in Oregon history, burning over 2,000 km^2 (500,000 acres). Throughout most of the event, the weather was hot, dry, and windy. Roads were clear and dry, but many local roads, including Rowdy Creek Road, Low Divide Road and others were either closed or open only to residents. In addition, Highway 199 was closed because of the fire.

CONSEQUENCES

The Biscuit Fire, which started from a lightning strike on July 13, 2002, was one of the largest in Oregon history, burning more than 2,000 km^2 (500,000 acres), and having a 332 km (206 mi) perimeter and a 48 km (30 mi) front. The changing winds and hot weather made fighting the fire difficult and kept the surrounding communities on evacuation alert. Many communities were partially evacuated, including Cave Junction, Oak Flat, Gasquet, Low Divide, and Rowdy Creek. As a result of the fire, more than 1,000 people were evacuated. In addition, three homes were destroyed in California, two homes were destroyed in Oak Flat, Oregon, and eight buildings at the McCaleb Boy Scout Ranch were destroyed. At least four firefighters were injured in accidents.

EMERGENCY RESPONSE

Decision Making
The level of cooperation among local, state, and federal agencies was high. Some of the local, state and federal agencies involved in this emergency included the Jackson County sheriff, Josephine County sheriff, Oregon State fire marshal, Oregon National Guard, Illinois Valley Fire District, U.S. Forest Service, Bureau of Land Management, and firefighters from Canada, Australia, and New Zealand.

The fire crossed multiple political boundaries, including city, county, and state borders and was managed by the Southwest Oregon National Interagency Area Command Team from a center in Medford, Oregon. The fire was divided into four administrative zones that were managed by separate Incident Management Teams. The decisions to evacuate were made by the local sheriff after receipt of information from the incident commanders that the fires had crossed trigger lines.

Communications

The command, control and coordination processes could best be described as pre-planned. EOCs were established in accordance with emergency plans. The fire was divided into four administrative zones that were managed by separate Incident Management Teams. The teams closely coordinated their activities to construct fire lines, conduct burn-out operations and protect rural communities. Zone 1 had a command center in Lake Selmac, Oregon. Zone 2 managed the southern portion of the fire in northern California from a command center in Crescent City, California. Zone 3 managed the southwestern flank of the fire with a command center east of Brookings, Oregon. Zone 4 managed the northwestern portion of the fire from a command center in Gold Beach, Oregon. Radio was the primary means of communication.

Notification and Warning

There was considerable time between the start of the fire on July 13 and the initiation of evacuations, most of which occurred in August. As the fire grew and encroached upon the communities, the sheriff and fire officials maintained frequent communication with local officials. During this time, the sheriff and fire officials also notified the public of the current state of the fire through community meetings. The local television and radio stations were also used to keep the public posted on the evacuation notices. In some instances firefighters went door-to-door.

Most communities were provided 24-hour notice, followed by an eight-hour notice and sometimes as short as a one-hour notice. These evacuation notices notified residents that an evacuation order could come within the specified period. Residents should be prepared to leave within 30 minutes if an evacuation order was issued. There was some confusion during a public meeting in Gasquet at the American Legion Hall on August 5. The sheriff, federal and local fire officials notified the public that the fire had crossed a trigger point and that the residents should be on a one-hour evacuation notice alert. However, many residents understood this to mean they should evacuate. The following evening, the sheriff clarified the statement through the media that an evacuation order was not in place, only an evacuation notice. This likely resulted in shadow evacuations; however, the number of residents leaving was not identified.

The time to complete the evacuation was generally within the time allotted for the specified evacuation. There were no reports of evacuation notices not providing sufficient time to leave.

The Rogue Valley Interfaith Relief Network supported the communication link by answering telephones for residents calling and requesting the status of the fire and the current evacuation plans, including which roadways were open and directions to go in the event of an evacuation. There were no problems with notification of either local officials or responders. There were no special problems with warning the public, although many of the affected residents refused to leave. Many had built their homes and were not going to leave them unprotected.

Traffic Movement and Control

Throughout the incident, roads were clear and dry. Highway 199 was the largest road impacted; it was closed early on in the incident. Many local roads, including Rowdy Creek Road, Low Divide Road, and others were either closed or open only to residents. Evacuation routes were established by road closure barricades and reinforced by sheriff's deputies providing information to the residents as they were ordered to evacuate. The McCaleb Boy Scout Ranch was evacuated and there were no reports of problems with this evacuation. There were also no reports of traffic accidents occurring during the evacuations.

Congregate Care Centers

The American Red Cross established a number of evacuation congregate care centers throughout the event. Congregate care centers were set up at Crescent Elk School in Gasquet, Riley Creek School in Gold Beach, and Grants Pass South Middle School. In addition, the Seventh Day Adventist Churches in the Cave Junction area opened their facilities to evacuees who needed shelter.

The Red Cross reported 950 people registered as having left Cave Junction. They also reported 53 people staying at the Grants Pass South Middle School on August 2. In addition, the Red Cross reported that people were staying at motels, with friends, or at campsites until the evacuation notices were lifted. There were no reports on the number of people staying at the remaining congregate care centers or at the Seventh Day Adventist facilities. The Red Cross also made arrangement for pets and livestock, but there were no reports on numbers of animals sheltered.

Law Enforcement

The evacuated areas were secured by barricades set up by the Sheriff's departments. There were no reported instances of looting or vandalism or any problems identified with law enforcement.

Re-Entry

The sheriff generally authorized re-entry for each of the evacuated areas. Information was conveyed to the public through the media that it was safe to return home. Public meetings were held frequently to update the populace on evacuation conditions. Evacuees were not compensated for their expenses, and there were no reports on the total cost of the evacuations.

INVESTIGATOR COMMENTS

The considerable time between the start of the fire and the initiation of evacuations was important for the success of these evacuations. Communication between officials and residents through town meetings and use of the media kept the public very aware of the threat and provided the current status of potential evacuations at frequent intervals, which contributed to the success of this event.

REFERENCES

References

Biscuit Fire Chronology
<http://www.biscuitfire.com/pdf/chron-july-ext-attack.pdf> (June 2003).

CBS News. "Oregon's 30 mile wall of flames." August 4, 2002.
<http://www.cbsnews.com/stories/2002/08/01/national/main517254.shtml> (June 2003).

CBS News. "Oregon Valley gets reprieve from fire." August 2, 2002.
<http://www.cbsnews.com/stories/2002/08/05/national/main517525.shtml> (June 2003).

City of Ashland, Oregon. "Ashland City News: August 21 Biscuit Fire Update." August 21, 2002. <http://www.ashland.or.us/newsresults.asp?NewsID=859> (June 2003).

CNN. "Fireline last defense from Oregon wildfire." July 31, 2002.
<http://www.cnn.com/2002/US/07/31/oregon.fires/> (June 2003).

Disaster News Network. "Fire crews make progress." August 4, 2002.
<http://www.disasternews.net/news/news.php?articleid=1510> (June 2003).

Disaster Response. "17000 on edge in Oregon." August 1, 2002.
<http://www.ucc.org/disaster/d080102.htm> (June 2003).

Emergency Services Information Site. "Firefighters injured when engine rolls." August 16, 2002. <http://www.withthecommand.com/2002-Aug/OR-engineroll.html> (June 2003).

National Incident Team. "Florence Fire Information Update." August 3, 2002.
<http://www.pnw-team2.com/florence/fireupdates/PNWT2_fireupdate_080302am.pdf> (June 2003).

National Water Resources Association. "NWRA Weekly Report." July 3, 2002.
<http://www.nwra.org/article.cfm?nwranewsid=1080> (June 2003).

Rogue Basin Restoration. "Pool Reflections." Winter, 2003.
<http://216.239.41.104/search?q=cache:UKvOkuF4TloJ:www.restoretherogue.org/newsletter/pool_reflections7.pdf+McCaleb+ranch+evacuation+&hl=en&ie=UTF-8> (June 2003).

Seattle Post-Intelligencer. "Weather works in favor of crews." August 2, 2002.
<http://seattlepi.nwsource.com/local/81086_fire02.shtml> (June 2003).

The Olympian. "Fire fighters use backfires in effort." August 17, 2002. <http://www.theolympian.com/home/specialsections/Outdoors/20020817/33305.shtml> (June 2003).

USDA Forest Service. "Biscuit Fire Complex News Release." July 26, 2002. <http://www.fs.fed.us/r6/rogue/media020726.htm> (June 2003).

USDA Forest Service. "Incident Information." July 24, 2002. <http://www.fs.fed.us/r5/sixrivers/fire/2002/biscuit/> (June 2003).

USDA Forest Service. "Sour Biscuit News Release." July 30, 2002. <http://www.fs.fed.us/r5/sixrivers/fire/2002/shelly/news/7-30.html> (June 2003).

APPENDIX E

EVACUATION FREQUENCY ANALYSIS

CONTENTS

Introduction

Appendix E contains the distribution of questionnaire responses. Note that there were some missing values (i.e., unknowns) because interviewees either did not have all of the information or could not remember. Missing values were not included in the regression and correlation analyses (i.e., the method of pairwise deletion of missing values was used). For verification purposes, the regression analyses were performed on a select number of imputed datasets, and the results were similar to those obtained using the pairwise deletion method, confirming the appropriateness of pairwise deletion for this analysis.

Table E-1. Overall Efficiency Score

Overall Efficiency Score				
score	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	16	32.00	16	32.00
1	21	42.00	37	74.00
2	8	16.00	45	90.00
3	3	6.00	48	96.00
4	1	2.00	49	98.00
5	1	2.00	50	100.00

Table E-2. Evacuation Efficiency Score

Evacuation Efficiency Score				
scorec	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0 issues	16	32.00	16	32.00
1 issue	21	42.00	37	74.00
2 issues	8	16.00	45	90.00
3 or more issues	5	10.00	50	100.00

Table E-3. Community

Community				
comm	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Rural (R)	5	10.00	5	10.00
Suburban (S)	36	72.00	41	82.00
Urban (U)	9	18.00	50	100.00

Table E-4. Population

Population				
pnum	Frequency	Percent	Cumulative Frequency	Cumulative Percent
< 5,000	6	12.00	6	12.00
5,000-9,999	8	16.00	14	28.00
10,000-24,999	10	20.00	24	48.00
25,000-49,999	7	14.00	31	62.00
50,000-99,999	5	10.00	36	72.00
100,000-199,999	2	4.00	38	76.00
200,000-499,999	4	8.00	42	84.00
500,000-999,999	2	4.00	44	88.00
One Million or more	6	12.00	50	100.00

Table E-5. Number of Evacuees

Number of Evacuees				
nevac	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
1,000-1,999	6	12.00	7	14.00
2,000-2,999	13	26.00	20	40.00
3,000-3,999	6	12.00	26	52.00
4,000-9,999	9	18.00	35	70.00
10,000-24,999	5	10.00	40	80.00
25,000-49,999	4	8.00	44	88.00
50,000-99,999	1	2.00	45	90.00
100,000-499,999	3	6.00	48	96.00
500,000-999,999	2	4.00	50	100.00

Table E-6. Percent Evacuated

Percent Evacuated				
pevac	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
<10%	15	30.00	17	34.00
10-20%	8	16.00	25	50.00
21-50%	12	24.00	37	74.00
51-99%	3	6.00	40	80.00
100%	8	16.00	48	96.00
>100%	2	4.00	50	100.00

Table E-7. Population Density During Evacuation

Population Density During Evacuation				
pop_dens	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	4	8.00	4	8.00
Low	8	16.00	12	24.00
Medium	24	48.00	36	72.00
High	14	28.00	50	100.00

Table E-8. Community Area in km^2

Community Area in km^2				
c_area	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
1-4.9 km^2	3	6.00	4	8.00
5-9.9 km^2	2	4.00	6	12.00
10-49.9 km^2	16	32.00	22	44.00
50-99.9 km^2	13	26.00	35	70.00
100-499 km^2	6	12.00	41	82.00
500-999 km^2	2	4.00	43	86.00
1000 or more km^2	7	14.00	50	100.00

Table E-9. Evacuation Area in km^2

Evacuation Area in km^2				
e_area	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	8	16.00	8	16.00
1-4.9 km^2	13	26.00	21	42.00
5-9.9 km^2	12	24.00	33	66.00
10-49.9 km^2	9	18.00	42	84.00
50-99.9 km^2	2	4.00	44	88.00
100-499 km^2	1	2.00	45	90.00
500-999 km^2	1	2.00	46	92.00
1000 or more km^2	4	8.00	50	100.00

Table E-10. Was Ethnicity, Nationality, or Age Important?

Was Ethnicity, Nationality, or Age Important?				
ena_fctr	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	8	16.00	8	16.00
No	32	64.00	40	80.00
Yes	10	20.00	50	100.00

Table E-11. Land Uses in Evacuation Area

Land Uses in Evacuation Area				
land_use	Frequency	Percent	Cumulative Frequency	Cumulative Percent
All	3	6.00	3	6.00
Commercial	1	2.00	4	8.00
Commercial, Industrial	1	2.00	5	10.00
Commercial, Retail	3	6.00	8	16.00
Industrial	1	2.00	9	18.00
Other	2	4.00	11	22.00
Residential	15	30.00	26	52.00
Residential, Agricultural	1	2.00	27	54.00
Residential, Commercial	1	2.00	28	56.00
Residential, Commercial, Industrial	2	4.00	30	60.00
Residential, Commercial, Industrial, Agricultural	1	2.00	31	62.00
Residential, Commercial, Retail	9	18.00	40	80.00
Residential, Commercial, Retail, Agricultural	1	2.00	41	82.00
Residential, Commercial, Retail, Industrial	3	6.00	44	88.00
Residential, Commercial, Retail, Industrial, Agricultural	1	2.00	45	90.00
Residential, Industrial	2	4.00	47	94.00
Residential, Industrial, Agricultural	2	4.00	49	98.00
Unknown	1	2.00	50	100.00

Table E-12. Type of Community

Type of Community				
comm_type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
City	31	62.00	31	62.00
County	8	16.00	39	78.00
Other	2	4.00	41	82.00
Town	9	18.00	50	100.00

Table E-13. Form of Government

Form of Government				
govt_type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
City Manager	2	4.00	2	4.00
Commission/Board	8	16.00	10	20.00
Mayoral	32	64.00	42	84.00
Other	8	16.00	50	100.00

Table E-14. Community's Main Economic Base

Community's Main Economic Base				
econ_base	Frequency	Percent	Cumulative Frequency	Cumulative Percent
All	4	8.00	4	8.00
Commercial	2	4.00	6	12.00
Commercial/Industry/Retail/Services	1	2.00	7	14.00
Commercial/Retail/Services	4	8.00	11	22.00
Farming	5	10.00	16	32.00
Government	1	2.00	17	34.00
Industry	2	4.00	19	38.00
Industry/Retail	1	2.00	20	40.00
Manufacturing	2	4.00	22	44.00
Manufacturing/Commercial	1	2.00	23	46.00
Manufacturing/Industry	5	10.00	28	56.00
Manufacturing/Industry/Commercial/ Retail/Services	2	4.00	30	60.00
Manufacturing/Industry/Commercial/ Retail/Services/Other	1	2.00	31	62.00
Other	8	16.00	39	78.00
Tourism	5	10.00	44	88.00
Tourism/Commercial	1	2.00	45	90.00
Tourism/Commercial/Retail/Services	2	4.00	47	94.00
Tourism/Industry	1	2.00	48	96.00
Tourism/Manufacturing/Industry	1	2.00	49	98.00
Tourism/Retail	1	2.00	50	100.00

Table E-15. Any Special Characteristics?

Any Special Characteristics?				
spec_char	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
No	11	22.00	13	26.00
Yes	37	74.00	50	100.00

Table E-16. Proximity to a Commercial Nuclear Power Plant (km)

Proximity to a Commercial Nuclear Power Plant (km)				
prox_npp	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0-16	4	8.00	4	8.00
17-80	11	22.00	15	30.00
>80	35	70.00	50	100.00

Table E-17. Is the Community Located in a State that Contains a Nuclear Power Plant?

Is the Community Located in a State that Contains a Nuclear Power Plant?				
state_npp	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	11	22.00	11	22.00
Yes	39	78.00	50	100.00

Table E-18. Is the Area More Prone to Hazards than Average?

Is the Area More Prone to Hazards than Average?				
prone_haz	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	13	26.00	13	26.00
Yes	37	74.00	50	100.00

Table E-19. Has the Community had any Experience with the Hazard?

Has the Community had any Experience with the Hazard?				
haz_exp	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	1	2.00	1	2.00
No	24	48.00	25	50.00
Yes	25	50.00	50	100.00

Table E-20. Has the Community Experienced Evacuations in the Previous Ten Years?

Has the Community Experienced Evacuations in the Previous Ten Years?				
evac_exp	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	2	4.00	2	4.00
No	25	50.00	27	54.00
Yes	23	46.00	50	100.00

Table E-21. Has the Community had any Previous Experience with the Alerting Mechanism?

Has the Community had any Previous Experience with the Alerting Mechanism?				
alert_exp	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	5	10.00	5	10.00
No	17	34.00	22	44.00
Yes	23	46.00	45	90.00
Not Applicable	5	10.00	50	100.00

Table E-22. Did the Community have a Written Emergency Plan?

Did the Community have a Written Emergency Plan?				
em_plan	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	3	6.00	3	6.00
Yes	47	94.00	50	100.00

Table E-23. Did the Emergency Plan Contain an Evacuation Section?

Did the Emergency Plan Contain an Evacuation Section?				
evac_plan	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	4	8.00	4	8.00
No	3	6.00	7	14.00
Yes	40	80.00	47	94.00
Not Applicable	3	6.00	50	100.00

Table E-24. Was the Plan Used in This Emergency?

Was the Plan Used in This Emergency?				
plan_used	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
No	2	4.00	4	8.00
Yes	43	86.00	47	94.00
Not Applicable	3	6.00	50	100.00

Table E-25. Did the Plan Conform to NUREG-0654/FEMA-REP-1, Rev_ 1?

Did the Plan Conform to NUREG-0654/FEMA-REP-1, Rev_ 1?				
conform_nureg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	23	46.00	23	46.00
No	16	32.00	39	78.00
Yes	6	12.00	45	90.00
Not Applicable	5	10.00	50	100.00

Table E-26. Was there an Evacuation Time Estimate (ETE) in the Plan?

Was there an Evacuation Time Estimate (ETE) in the Plan?				
ete	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	2	4.00	2	4.00
No	13	26.00	15	30.00
Yes	1	2.00	16	32.00
Not Applicable	34	68.00	50	100.00

Table E-27. How Did the Actual Evacuation Time Compare to the ETE?

How Did the Actual Evacuation Time Compare to the ETE?				
ete_est	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	2	4.00	2	4.00
Not Applicable	48	96.00	50	100.00

Table E-28. Is Training Provided to Emergency Response Personnel?

Is Training Provided to Emergency Response Personnel?				
training	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Yes	50	100.00	50	100.00

Table E-29. Is Joint Training Between Industry and Government Regularly Conducted?

Is Joint Training Between Industry and Government Regularly Conducted?				
joint_training	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	8	16.00	9	18.00
Yes	40	80.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-30. Do the Community's Emergency Response Agencies Regularly Conduct Emergency Drills and Exercises?

Do the Community's Emergency Response Agencies Regularly conduct Emergency Drills and Exercises?				
drills	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	7	14.00	8	16.00
Yes	42	84.00	50	100.00

Table E-31. Was the Emergency Plan Used in this Evacuation Previously Tested in a Full-scale Field Exercise?

Was the Emergency Plan Used in this Evacuation Previously Tested in a Full-scale Field Exercise?				
plan_tested	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	8	16.00	8	16.00
No	20	40.00	28	56.00
Yes	20	40.00	48	96.00
Not Applicable	2	4.00	50	100.00

Table E-32. If So, What Type of Exercise was Performed Immediately Prior to this Evacuation?

If So, What Type of Exercise was Performed Immediately Prior to this Evacuation?				
exerc_type	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	2	4.00	2	4.00
Functional Drill (FD)	3	6.00	5	10.00
Full-Scale Field Exercise (FSFE)	5	10.00	10	20.00
FSFE and Table-Top Exercise (TT)	11	22.00	21	42.00
N/A	27	54.00	48	96.00
TT	2	4.00	50	100.00

Table E-33. Hazard that Led to Evacuation

Hazard that Led to Evacuation				
haz_type	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Natural Disaster (ND)	14	28.00	14	28.00
Malevolent Act (TE)	3	6.00	17	34.00
Technological Hazard (TH)	33	66.00	50	100.00

Table E-34. Time of Day

Time of Day				
time_day	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Day (D)	40	80.00	40	80.00
Night (N)	10	20.00	50	100.00

Table E-35. Road Conditions/Weather Conditions

Road Conditions/Weather Conditions				
cond_good	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	7	14.00	7	14.00
No	2	4.00	9	18.00
Yes	41	82.00	50	100.00

Table E-36. Other Unusual Circumstances

Other Unusual Circumstances				
unus_circ	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	22	44.00	22	44.00
No	20	40.00	42	84.00
Yes	8	16.00	50	100.00

Table E-37. Number of Deaths Caused by the Hazard

Number of Deaths Caused by the Hazard				
haz_death	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	44	88.00	44	88.00
1	2	4.00	46	92.00
3	1	2.00	47	94.00
15	1	2.00	48	96.00
25	1	2.00	49	98.00
2,823	1	2.00	50	100.00

Table E-38. Number of Injuries Caused by the Hazard

Number of Injuries Caused by the Hazard				
haz_inj	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No Injuries	24	48.00	25	50.00
1-10	12	24.00	37	74.00
11-100	7	14.00	44	88.00
101-200	4	8.00	48	96.00
>1000	1	2.00	49	98.00
4710	1	2.00	50	100.00

Table E-39. Number of Deaths Caused by the Evacuation

Number of Deaths Caused by the Evacuation				
evac_death	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
0	48	96.00	49	98.00
19	1	2.00	50	100.00

Table E-40. Number of Injuries Caused by the Evacuation

Number of Injuries Caused by the Evacuation				
evac_inj	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	3	6.00	3	6.00
0	45	90.00	48	96.00
1	1	2.00	49	98.00
35	1	2.00	50	100.00

Table E-41. Estimated Total Cost of Evacuation Related Expenses and Property Damages

Estimated Total Cost of Evacuation Related Expenses and Property Damages				
evac_cost	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	43	86.00	43	86.00
0	1	2.00	44	88.00
10,000-15,000	1	2.00	45	90.00
20,000	1	2.00	46	92.00
200,000	2	4.00	48	96.00
2,000,000	1	2.00	49	98.00
8,000,000	1	2.00	50	100.00

Table E-42. Were Political Boundaries Crossed (i.e., more than one county or state involved)?

Were Political Boundaries Crossed (i.e., more than one county or state involved)?				
bdry_crss	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	5	10.00	5	10.00
No	26	52.00	31	62.00
Yes	19	38.00	50	100.00

Table E-43. Command, Control and Coordination Processes

Command, Control and Coordination Processes				
ccc_proc	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Ad Hock	12	24.00	12	24.00
Preplanned	38	76.00	50	100.00

Table E-44. Did the Mayor Participate in the Decision to Evacuate?

Did the Mayor Participate in the Decision to Evacuate?				
mayor_ev	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	47	94.00	47	94.00
Yes	3	6.00	50	100.00

Table E-45. Did the Fire Chief Participate in the Decision to Evacuate?

Did the Fire Chief Participate in the Decision to Evacuate?				
fire_chief_ev	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	25	50.00	25	50.00
Yes	25	50.00	50	100.00

Table E-46. Did the Police Chief Participate in the Decision to Evacuate?

Did the Police Chief Participate in the Decision to Evacuate?				
police_chief_ev	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	39	78.00	39	78.00
Yes	11	22.00	50	100.00

Table E-47. Did Emergency Managers Participate in the Decision to Evacuate?

Did Emergency Managers Participate in the Decision to Evacuate?				
em_mgr_ev	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	45	90.00	45	90.00
Yes	5	10.00	50	100.00

Table E-48. Did the Governor Participate in the Decision to Evacuate?

Did the Governor Participate in the Decision to Evacuate?				
governor_ev	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	48	96.00	48	96.00
Yes	2	4.00	50	100.00

Table E-49. Did Others Participate in the Decision to Evacuate?

Did Others Participate in the Decision to Evacuate?				
other_ev	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	36	72.00	36	72.00
Yes	14	28.00	50	100.00

Table E-50. Did Multiple People Participate in the Decision to Evacuate?

Did Multiple People Participate in the Decision to Evacuate?				
multiple_ev	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	40	80.00	40	80.00
Yes	10	20.00	50	100.00

Table E-51. Were there Issues with the Decision Making Process?

Were there Issues with the Decision Making Process?				
decis_prob	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	44	88.00	44	88.00
Yes	6	12.00	50	100.00

Table E-52. Was an Emergency Operations Center (EOC) Used?

Was an Emergency Operations Center (EOC) Used?				
eoc_used	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	15	30.00	16	32.00
Yes	34	68.00	50	100.00

Table E-53. Was a Field (Incident) Command Post Used?

Was a Field (Incident) Command Post Used?				
icp_used	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	5	10.00	5	10.00
Yes	45	90.00	50	100.00

Table E-54. Was Communication Between Field Emergency Responders and EOC by Radio?

Was Communication Between Field Emergency Responders and EOC by Radio?				
radio	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	3	6.00	3	6.00
Yes	47	94.00	50	100.00

Table E-55. Was Communication Between Field Emergency Responders and EOC by Telephone?

Was Communication Between Field Emergency Responders and EOC by Telephone?				
telephone	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	43	86.00	43	86.00
Yes	7	14.00	50	100.00

Table E-56. Was Communication Between Field Emergency Responders and EOC by Cell Phone?

Was Communication Between Field Emergency Responders and EOC by Cell Phone?				
cell_phone	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	31	62.00	31	62.00
Yes	19	38.00	50	100.00

Table E-57. Was Communication Between Field Emergency Responders and EOC by Pager?

Was Communication Between Field Emergency Responders and EOC by Pager?				
pager	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	49	98.00	49	98.00
Yes	1	2.00	50	100.00

Table E-58. Was Communication Between Field Emergency Responders and EOC by Multiple Methods?

Was Communication Between Field Emergency Responders and EOC by Multiple Methods?				
multiple	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
No	30	60.00	30	60.00
Yes	20	40.00	50	100.00

Table E-59. Were there Issues with Communications?

Were there Issues with Communications?				
comm_prob	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	1	2.00	1	2.00
No	35	70.00	36	72.00
Yes	14	28.00	50	100.00

Table E-60. How Were Senior Local Officials Notified of the Incident?

How Were Senior Local Officials Notified of the Incident?				
off_notif	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	4	8.00	4	8.00
CANS	2	4.00	6	12.00
Cell phone	1	2.00	7	14.00
Dispatcher	1	2.00	8	16.00
Door to Door	1	2.00	9	18.00
N/A	1	2.00	10	20.00
Pager, Cell Phone	1	2.00	11	22.00
Pager, Visual	1	2.00	12	24.00
Radio	1	2.00	13	26.00
Radio and telephone	1	2.00	14	28.00
Radio and television	1	2.00	15	30.00
Telephone	34	68.00	49	98.00
Word of Mouth	1	2.00	50	100.00

Table E-61. How Were Emergency Responders Notified of the Incident?

How Were Emergency Responders Notified of the Incident?				
er_notif	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	3	6.00	3	6.00
911	41	82.00	44	88.00
AF base call	1	2.00	45	90.00
Fire Lt. Saw accident	1	2.00	46	92.00
N/A	3	6.00	49	98.00
Police saw fire	1	2.00	50	100.00

Table E-62. ET Between Discovery of the Incident and Mobilization (Minutes)

ET Between Discovery of the Incident and Mobilization (Minutes)				
resp_time	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	7	14.00	7	14.00
0-15	37	74.00	44	88.00
31-60	1	2.00	45	90.00
60+	4	8.00	49	98.00
N/A	1	2.00	50	100.00

Table E-63. Elapsed Time Between Start of Hazard and Decision to Evacuate (Hours)

Elapsed Time Between Start of Hazard and Decision to Evacuate (Hours)				
start_time	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	6	12.00	6	12.00
0.0	1	2.00	7	14.00
0.1	7	14.00	14	28.00
0.2	4	8.00	18	36.00
0.3	2	4.00	20	40.00
0.5	6	12.00	26	52.00
0.6	1	2.00	27	54.00
0.7	3	6.00	30	60.00
1	3	6.00	33	66.00
1.3	1	2.00	34	68.00
1.5	1	2.00	35	70.00
1.7	1	2.00	36	72.00
3	2	4.00	38	76.00
6	1	2.00	39	78.00
72	1	2.00	40	80.00
96	1	2.00	41	82.00
108	2	4.00	43	86.00
120	1	2.00	44	88.00
132	1	2.00	45	90.00
144	1	2.00	46	92.00
168	1	2.00	47	94.00
<24	1	2.00	48	96.00
>4 Days	1	2.00	49	98.00
N/A	1	2.00	50	100.00

Table E-64. Time to Complete the Evacuation (Hours)

Time to Complete the Evacuation (Hours)				
total_time	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Unknown	10	20.00	10	20.00
0.3	1	2.00	11	22.00
0.6	3	6.00	14	28.00
0.7	3	6.00	17	34.00
1	7	14.00	24	48.00
1.5	3	6.00	27	54.00
2	6	12.00	33	66.00
3	1	2.00	34	68.00
3.5	1	2.00	35	70.00
4	4	8.00	39	78.00
6	2	4.00	41	82.00
8	2	4.00	43	86.00
12	1	2.00	44	88.00
14	1	2.00	45	90.00
17	1	2.00	46	92.00
22	1	2.00	47	94.00
<1 Day	2	4.00	49	98.00
>4 Days	1	2.00	50	100.00

Table E-65. Were there Issues with Notification of Emergency Personnel or Senior Local Officials?

Were there Issues with Notification of Emergency Personnel or Senior Local Officials?				
notif_prob	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
No	46	92.00	48	96.00
Yes	2	4.00	50	100.00

Table E-66. Was the Public Notified by a Siren?

Was the Public Notified by a Siren?				
sirens_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	42	84.00	43	86.00
Yes	7	14.00	50	100.00

Table E-67. Was the Public Notified by Telephone?

Was the Public Notified by Telephone?				
telephone_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	37	74.00	38	76.00
Yes	12	24.00	50	100.00

Table E-68. Was the Public Notified by Radio/TV?

Was the Public Notified by Radio/TV?				
radio_tv_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	25	50.00	26	52.00
Yes	24	48.00	50	100.00

Table E-69. Was the Public Notified by an Emergency Broadcast System?

Was the Public Notified by an Emergency Broadcast System?				
ebs_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	48	96.00	49	98.00
Yes	1	2.00	50	100.00

Table E-70. Was the Public Notified by a PA System?

Was the Public Notified by a PA System?				
pa_system_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	22	44.00	23	46.00
Yes	27	54.00	50	100.00

Table E-71. Was the Public Notified by NOAA?

Was the Public Notified by NOAA?				
noaa_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	48	96.00	49	98.00
Yes	1	2.00	50	100.00

Table E-72. Was the Public Notified Door-to-Door?

Was the Public Notified Door-to-Door?				
door_door_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	15	30.00	16	32.00
Yes	34	68.00	50	100.00

Table E-73. Was the Public Notified by Multiple Methods?

Was the Public Notified by Multiple Methods?				
multiple_pn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	14	28.00	15	30.00
Yes	35	70.00	50	100.00

Table E-74. Was the Evacuation Staged?

Was the Evacuation Staged?				
staged	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	30	60.00	30	60.00
Yes	20	40.00	50	100.00

Table E-75. Were there Any Special Issues Regarding Warning and Subsequent Citizen Action?

Were there Any Special Issues Regarding Warning and Subsequent Citizen Action?				
warn_prob	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	38	76.00	38	76.00
Yes	12	24.00	50	100.00

Table E-76. Were People Given Specific Instructions About Where to go When They Evacuated?

Were People Given Specific Instructions About Where to go When They Evacuated?				
evac_instruct	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	3	6.00	3	6.00
No	7	14.00	10	20.00
Yes	39	78.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-77. Were People Told to Use Specific Routes?

Were People Told to Use Specific Routes?				
evac_route	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	3	6.00	3	6.00
No	15	30.00	18	36.00
Yes	31	62.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-78. How Were These Routes Designated?

How Were These Routes Designated?				
route_design	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	4	8.00	4	8.00
N/A	19	38.00	23	46.00
Roadblocks	20	40.00	43	86.00
Signs	1	2.00	44	88.00
Verbal Instructions	6	12.00	50	100.00

Table E-79. How Many Special Institutions (e.g., Hospitals, Prisons) Were Evacuated?

How Many Special Institutions (e.g., Hospitals, Prisons) Were Evacuated?				
inst_evac	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	6	12.00	6	12.00
0	26	52.00	32	64.00
1	8	16.00	40	80.00
2	2	4.00	42	84.00
3	4	8.00	46	92.00
5	3	6.00	49	98.00
>10	1	2.00	50	100.00

Table E-80. Road Conditions Prior to Evacuation

Road Conditions Prior to Evacuation				
road_dry	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	2	4.00	3	6.00
Yes	46	92.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-81. Were Any Major Roadways Unavailable for Use?

Were Any Major Roadways Unavailable for Use?				
road_haz	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
No	32	64.00	34	68.00
Yes	15	30.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-82. Were there Any Special Traffic Issues Encountered?

Were there Any Special Traffic Issues Encountered?				
traff_prob	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	36	72.00	36	72.00
Yes	14	28.00	50	100.00

Table E-83. Did Some People Spontaneously Evacuate Before Being Told to Do So?

Did Some People Spontaneously Evacuate Before Being Told to Do So?				
early_evac	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	6	12.00	6	12.00
No	21	42.00	27	54.00
Yes	22	44.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-84. Was Reverse-laning Used?

Was Reverse-laning Used?				
revlan_used	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	3	6.00	3	6.00
No	40	80.00	43	86.00
Yes	6	12.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-85. Were there Traffic Accidents During the Evacuations?

Were there Traffic Accidents During the Evacuations?				
traff_accid	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	6	12.00	6	12.00
No	40	80.00	46	92.00
Yes	4	8.00	50	100.00

Table E-86. Did Anyone Refuse to Evacuate?

Did Anyone Refuse to Evacuate?				
refus_evac	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	3	6.00	3	6.00
No	21	42.00	24	48.00
Yes	26	52.00	50	100.00

Table E-87. Were Congregate Care Centers Used?

Were Congregate Care Centers Used?				
shltr_used	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
No	8	16.00	10	20.00
Yes	40	80.00	50	100.00

Table E-88. Who Managed the Congregate Care Centers?

Who Managed the Congregate Care Centers?				
mgmt_shelter	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
City	1	2.00	2	4.00
Civil Defense	2	4.00	4	8.00
N/A	10	20.00	14	28.00
Other	6	12.00	20	40.00
Red Cross	24	48.00	44	88.00
Red Cross, Other	6	12.00	50	100.00

Table E-89. Were Schools Used as Congregate Care Centers?

Were Schools Used as Congregate Care Centers?				
schools	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	8	16.00	9	18.00
Yes	31	62.00	40	80.00
Not Applicable	10	20.00	50	100.00

Table E-90. Were Churches Used as Congregate Care Centers?

Were Churches Used as Congregate Care Centers?				
churches	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	29	58.00	30	60.00
Yes	10	20.00	40	80.00
Not Applicable	10	20.00	50	100.00

Table E-91. Were Public Buildings Used as Congregate Care Centers?

Were Public Buildings Used as Congregate Care Centers?				
public_bldg	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	31	62.00	32	64.00
Yes	8	16.00	40	80.00
Not Applicable	10	20.00	50	100.00

Table E-92. Were Other Buildings Used as Congregate Care Centers?

Were Other Buildings Used as Congregate Care Centers?				
other	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	36	72.00	37	74.00
Yes	4	8.00	41	82.00
Not Applicable	9	18.00	50	100.00

Table E-93. Were Multiple Buildings Used as Congregate Care Centers?

Were Multiple Buildings Used as Congregate Care Centers?				
multiple_sh	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	26	52.00	27	54.00
Yes	13	26.00	40	80.00
Not Applicable	10	20.00	50	100.00

Table E-94. What Percent of Evacuees Went to Congregate Care Centers?

What Percent of Evacuees Went to Congregate Care Centers?				
shltr_perc	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	15	30.00	15	30.00
1.3	1	2.00	16	32.00
1.5	1	2.00	17	34.00
3.7	1	2.00	18	36.00
4	1	2.00	19	38.00
5	2	4.00	21	42.00
6	2	4.00	23	46.00
6.7	1	2.00	24	48.00
7	2	4.00	26	52.00
9	2	4.00	28	56.00
10	3	6.00	31	62.00
10.6	1	2.00	32	64.00
17.5	1	2.00	33	66.00
20	4	8.00	37	74.00
40	1	2.00	38	76.00
70	1	2.00	39	78.00
0	1	2.00	40	80.00
100	1	2.00	41	82.00
N/A	9	18.00	50	100.00

Table E-95. Did People Evacuate From Areas Outside the Designated Evacuation Area?

Did People Evacuate From Areas Outside the Designated Evacuation Area?				
shad_evac	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	7	14.00	7	14.00
No	24	48.00	31	62.00
Yes	18	36.00	49	98.00
Not Applicable	1	2.00	50	100.00

Table E-96. Did This Cause an Impact on Traffic?

Did This Cause an Impact on Traffic?				
shad_traff	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	13	26.00	14	28.00
Yes	5	10.00	19	38.00
Not Applicable	31	62.00	50	100.00

Table E-97. Did This Cause an Impact on Congregate Care Center Capacity?

Did This Cause an Impact on Congregate Care Center Capacity?				
shad_shltr	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
No	16	32.00	18	36.00
Not Applicable	32	64.00	50	100.00

Table E-98. How Was the Area Secured Following the Evacuation to Prevent Looting and Vandalism?

How Was the Area Secured Following the Evacuation to Prevent Looting and Vandalism?				
law_enfrc	Frequency	Percent	Cumulative Frequency	Cumulative Percent
National Guard	4	8.00	4	8.00
Police	38	76.00	42	84.00
Police, National Guard	5	10.00	47	94.00
Police, Other	3	6.00	50	100.00

Table E-99. Were There Any Instances of Looting or Vandalism?

Were There Any Instances of Looting or Vandalism?				
loot_vand	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	45	90.00	45	90.00
Yes	5	10.00	50	100.00

Table E-100. Were there Any Issues with Law Enforcement?

Were there Any Issues with Law Enforcement?				
law_prob	Frequency	Percent	Cumulative Frequency	Cumulative Percent
No	47	94.00	47	94.00
Yes	3	6.00	50	100.00

Table E-101. Did the Mayor Participate in the Authorization for Re-entry?

Did the Mayor Participate in the Authorization for Re-entry?				
mayor_re	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	43	86.00	44	88.00
Yes	6	12.00	50	100.00

Table E-102. Did the Fire Chief Participate in the Authorization for Re-entry?

Did the Fire Chief Participate in the Authorization for Re-entry?				
fire_chief_re	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	27	54.00	28	56.00
Yes	22	44.00	50	100.00

Table E-103. Did the Police Chief Participate in the Authorization for Re-entry?

Did the Police Chief Participate in the Authorization for Re-entry?				
police_chief_re	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	43	86.00	44	88.00
Yes	6	12.00	50	100.00

Table E-104. Did the Emergency Manager Participate in the Authorization for Re-entry?

Did the Emergency Manager Participate in the Authorization for Re-entry?				
em_mgr_re	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	45	90.00	46	92.00
Yes	4	8.00	50	100.00

Table E-105. Did the Governor Participate in the Authorization for Re-entry?

Did the Governor Participate in the Authorization for Re-entry?				
governor_re	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	49	98.00	50	100.00

Table E-106. Did Other People Participate in the Authorization for Re-entry?

Did Other People Participate in the Authorization for Re-entry?				
other_re	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	25	50.00	26	52.00
Yes	24	48.00	50	100.00

Table E-107. Did Multiple People Participate in the Authorization for Re-entry?

Did Multiple People Participate in the Authorization for Re-entry?				
multiple_re	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	37	74.00	38	76.00
Yes	12	24.00	50	100.00

Table E-108. Describe the Re-entry Process

Describe the Re-entry Process				
rentr_proc	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
Controlled Phased	9	18.00	10	20.00
No special controls	40	80.00	50	100.00

Table E-109. Were Evacuees Compensated for Their Expenses?

Were Evacuees Compensated for Their Expenses?				
exp_comp	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	4	8.00	4	8.00
No	32	64.00	36	72.00
Yes	14	28.00	50	100.00

Table E-110. Were there Major Issues During Re-entry?

Were there Major Issues During Re-entry?				
rentry_prob	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	2	4.00	2	4.00
No	44	88.00	46	92.00
Yes	4	8.00	50	100.00

Table E-111. Residential Land Use

Residential Land Use				
lu_residential	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	8	16.00	9	18.00
Yes	41	82.00	50	100.00

Table E-112. Commercial Land Use

Commercial Land Use				
lu_Commercial	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	23	46.00	24	48.00
Yes	26	52.00	50	100.00

Table E-113. Retail Land Use

Retail Land Use				
lu_Retail	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	29	58.00	30	60.00
Yes	20	40.00	50	100.00

Table E-114. Industrial Land Use

Industrial Land Use				
lu_Industrial	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	33	66.00	34	68.00
Yes	16	32.00	50	100.00

Table E-115. Agricultural Land Use

Agricultural Land Use				
lu_Agricultural	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unknown	1	2.00	1	2.00
No	40	80.00	41	82.00
Yes	9	18.00	50	100.00

APPENDIX F

CHI-SQUARE VALUES FOR LIKELIHOOD RATIO TESTS OF ASSOCIATION BETWEEN EACH VARIABLE AND EVACUATION EFFICIENCY SCORE

CONTENTS

Introduction

The results of the regression analyses are contained in Appendices F through K. All data preparation and analyses were carried out using SAS 8.02 for Windows. Each variable in the questionnaire was compared to the efficiency score using an ordinal logit model, which is a generalized linear model. In generalized linear regression, the relationship is constrained to be a straight line and maximum likelihoods are used to determine the best fit. An ordinal logit model was chosen because the dependent variable (i.e., efficiency score) is neither normally, nor Gaussian, distributed, and it is an ordinal random variable. Since hazard type is often associated with other variables, the regression results were adjusted for hazard type.

The resulting chi-squared value (probability or p-value) from the likelihood ratio tests were performed to test if each variable was significantly associated with the efficiency score. A p-value is the probability of observing the difference in the data by random chance. Thus, if $p < 0.05$, there is less than a 5% chance that this association would have occurred if there were no association, and the hypothesis that there is no association is rejected in favor of the hypothesis that there is an association. A variable with a p-value of less than 0.05 is considered to have a statistically significant association to the efficiency score. If the p-value is between 0.05 and 0.10, the variable is considered to have a marginal (or weak) statistical association to the efficiency score. Often a $p < 0.01$ is considered to show a highly significant statistical association.

Table F-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
1	traff_accid	Were there Traffic accidents during the evacuations?	44	1	0.3703	16.53	<.0001
2	rentr_proc	Describe the Re-entry Process	49	1	1.2103	13.22	0.0003
3	h_death	Number of deaths from hazard	50	1	10.7082	11.38	0.0007
4	evac_inj	Number of injuries caused by the evacuation	47	1	0.0000	11.00	0.0009
5	nat_guard	Was the National Guard used for law enforcement?	50	1	0.4219	8.71	0.0032
6	loot_vand	Were there any instances of looting or vandalism?	50	1	0.5959	8.14	0.0043
7	early_evac	Did some people spontaneously evacuate before being told to do so?	43	1	0.0540	7.95	0.0048
8	fire_chief_re	Did the fire chief participate in the authorization for re-entry?	49	1	3.3908	6.68	0.0097
9	refus_evac	Did anyone refuse to evacuate?	47	1	2.0257	6.23	0.0126
10	haz_exp	Has the community had any experience with the hazard?	49	1	0.5241	5.72	0.0168
11	schools	Were schools used as congregate care centers?	39	1	7.3277	5.53	0.0187
12	evac_death	Number of deaths caused by the evacuation	49	1	0.0000	5.26	0.0218
13	public_bldg	Were public buildings used as congregate care centers?	39	1	0.4690	5.25	0.0220
14	mgmt_shelter	Who managed the congregate care centers?	39	4	10.7916	11.12	0.0253
15	mayor_re	Did the mayor participate in the authorization for re-entry?	49	1	1.0333	4.77	0.0289
16	noaa_pn	Was the public notified by NOAA?	49	1	0.0000	4.76	0.0291
17	haz_type	Hazard that led to evacuation	50	2	4.1425	6.95	0.0310
18	st_time	Elapsed time between start of hazard and decision to evacuate (hours)	41	1	51.0653	4.01	0.0452
19	road_haz	Were any major roadways unavailable for use?	47	1	0.7908	3.97	0.0463
20	eoc_used	Emergency Operations Center (EOC) used	49	1	1.8256	3.69	0.0549
21	tot_time	Time to complete the evacuation (hours)	37	1	39.3267	3.55	0.0596
22	door_door_pn	Was the public notified door-to-door?	49	1	3.0670	3.16	0.0756
23	instevac	Were one or more special institutions evacuated?	44	1	1.6318	3.09	0.0787
24	pop_dens	Population density during evacuation	46	2	2.2197	5.08	0.0787
25	drills	Do the community's emergency response agencies regularly conduct emergency drills and exercises?	49	1	8.2453	3.07	0.0796
26	e_area	Evacuation Area in km^2	42	1	70.4392	2.89	0.0889

Table F-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score (continued)

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
27	prone_haz	Is the area more prone to hazards than average?	50	1	3.1587	2.85	0.0916
28	aware_alert	Level of community awareness with alerting methods used	49	2	2.6020	4.70	0.0954
29	comm_type	Type of Community	50	3	7.9581	6.03	0.1102
30	shad_traff	Did this cause an impact on traffic?	42	1	2.9452	2.46	0.1165
31	pevac	Percent Evacuated	48	1	80.3729	2.39	0.1224
32	resp_time	ET between discovery of the incident and mobilization (minutes)	42	2	3.8023	4.16	0.1249
33	multiple_sh	Were multiple buildings used as congregate care centers?	39	1	4.9626	2.34	0.1259
34	aware_lhaz	Level of community awareness with local hazards	59	2	1.2782	4.10	0.1287
35	fire_chief_ev	Did the fire chief participate in the decision to evacuate?	50	1	3.6447	2.30	0.1297
36	staged	Was the evacuation staged?	50	1	5.4893	1.96	0.1615
37	multiple_ev	Did multiple people participate in the decision to evacuate?	50	1	2.3018	1.64	0.2001
38	h_inj	Number of injuries from hazard	48	1	53.2639	1.62	0.2025
39	nevac	Number of Evacuations	49	1	79.7763	1.61	0.2044
40	spec_char	Were there any special characteristics?	48	1	0.4807	1.56	0.2118
41	coop_level	Level of cooperation between local, state, and federal agencies	49	1	4.2447	1.46	0.2264
42	er_notif	How were emergency responders notified of the incident?	44	3	1.8322	4.23	0.2379
43	pa_system_pn	Was the public notified by a PA system?	49	1	2.6479	1.36	0.2439
44	exp_comp	Were evacuees compensated for their expenses?	46	1	0.0670	1.35	0.2445
45	multiple_re	Did multiple people participate in the authorization for re-entry?	49	1	5.2741	1.32	0.2501
46	unus_circ	Other unusual circumstances	28	1	1.7946	1.31	0.2517
47	churches	Were churches used as congregate care centers?	39	1	3.3299	1.27	0.2597
48	conform_nureg	Did the plan conform to NUREG-0654/FEMA-REP-1, Rev_1?	22	1	2.2819	1.24	0.2646
49	radio	Was communication between field emergency responders and EOC by radio?	50	1	3.2863	1.20	0.2738
50	lu_Retail	Retail Land Use	49	1	0.2387	1.18	0.2774
51	ebs_pn	Was the public notified by emergency broadcast system?	49	1	2.5989	1.14	0.2865
52	off_notif	How were senior local officials notified of the incident?	45	10	20.9546	11.75	0.3019
53	revlan_used	Was reverse-laning used?	46	1	1.9220	0.99	0.3190
54	shltr_used	Were congregate care centers used?	48	1	1.2542	0.97	0.3240
55	em_mgr_re	Did the emergency manager participate in the authorization for re-entry?	49	1	0.4781	0.96	0.3265

Table F-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score (continued)

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
56	police	Were the police used for law enforcement?	50	1	0.4416	0.88	0.3479
57	bdry_crss	Were political boundaries crossed (i.e., more than one county or state involved)?	45	1	1.1540	0.85	0.3567
58	icp_used	Was a field (incident) command post used?	50	1	6.2073	0.85	0.3575
59	multiple_pn	Was the public notified by multiple methods?	49	1	1.7831	0.85	0.3577
60	route_design	How were these routes designated?	27	2	1.7599	2.05	0.3591
61	time_day	Time of Day	50	1	5.5379	0.83	0.3611
62	other	Were other buildings used as congregate care centers?	40	1	1.4270	0.80	0.3709
63	em_plan	Did the community have a written emergency plan?	50	1	3.8346	0.78	0.3780
64	governor_ev	Did the governor participate in the decision to evacuate?	50	1	2.0218	0.70	0.4016
65	road_dry	Road conditions prior to evacuation	48	1	0.6485	0.69	0.4059
66	lu_Agricultural	Agricultural Land Use	49	1	0.2164	0.63	0.4256
67	cond_good	Road conditions/weather conditions	43	1	0.5639	0.57	0.4488
68	evac_exp	Had the community experienced evacuations in the previous ten years?	48	1	0.1241	0.57	0.4519
69	exerc_type	If so, what type of exercise was performed immediately prior to this evacuation?	21	4	9.4252	3.54	0.4711
70	aware_ehaz	Level of community awareness with hazard that caused evacuation	50	2	4.5303	1.46	0.4810
71	joint_training	Is joint training between industry and government regularly conducted?	48	1	1.2887	0.48	0.4892
72	c_area	Community Area in km^2	49	1	117.4909	0.44	0.5048
73	sirens_pn	Was the public notified by a siren?	49	1	0.7606	0.44	0.5069
74	alert_exp	Did the community have previous experience with the alerting mechanism?	40	1	0.7895	0.41	0.5201
75	plan_tested	Was the emergency plan used in this evacuation previously tested in a full-scale field exercise?	40	1	1.9414	0.34	0.5585
76	ccc_proc	Command, control and coordination processes	50	1	3.4652	0.33	0.5664
77	lu_Commercial	Commercial Land Use	49	1	1.6215	0.31	0.5758
78	police_chief_re	Did the police chief participate in the authorization for re-entry?	49	1	4.2933	0.28	0.5955
79	govt_type	Form of Government	50	3	9.9771	1.79	0.6168
80	ete	Was there an Evacuation Time Estimate (ETE) in the plan?	14	1	1.5570	0.24	0.6234
81	evac_instruct	Were people given specific instructions about where to go when they evacuated?	46	1	3.9407	0.17	0.6783
82	other_re	Did other people participate in the authorization for re-entry?	49	1	2.3693	0.17	0.6822
83	radio_tv_pn	Was the public notified by radio/TV?	49	1	0.1289	0.17	0.6834

Table F-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score (continued)

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
84	pnum	Population	50	1	122.3110	0.16	0.6887
85	multiple	Was communication between field emergency responders and EOC by multiple ways?	50	1	2.0225	0.15	0.6984
86	evac_route	Were people told to use specific routes?	46	1	0.7840	0.12	0.7286
87	mayor_ev	Did the mayor participate in the decision to evacuate?	50	1	2.0558	0.11	0.7346
88	ena_fctr	Was Ethnicity, nationality, or age important?	42	1	8.0793	0.11	0.7433
89	prox_npp	Proximity to a commercial nuclear power plant (km)	50	2	2.3497	0.56	0.7570
90	aware_evac	Level of community awareness with evacuation procedures	50	2	5.1875	0.48	0.7860
91	fsfe	Full Scale Field Exercise Immediately prior to Evacuation	48	1	0.7603	0.05	0.8166
92	evac_plan	Did the emergency plan contain an evacuation section?	43	1	5.5015	0.04	0.8426
93	lu_residential	Residential Land Use	49	1	0.1747	0.03	0.8703
94	telephone	Was communication between field emergency responders and EOC by telephone?	50	1	2.9855	0.03	0.8711
95	telephone_pn	Was the public notified by telephone?	49	1	1.7498	0.02	0.8747
96	lu_Industrial	Industrial Land Use	49	1	1.8313	0.02	0.8930
97	cell_phone	Was communication between field emergency responders and EOC by cell phone?	50	1	2.0194	0.01	0.9042
98	pager	Was communication between field emergency responders and EOC by pager?	50	1	1.7542	0.01	0.9243
99	comm	Community	50	2	4.6091	0.15	0.9294
100	state_npp	Is the community located in a state that contains a nuclear power plant?	50	1	1.0813	0.01	0.9316
101	shad_evac	Did people evacuate from areas outside the designated evacuation area?	42	1	1.1778	0.01	0.9350
102	police_chief_ev	Did the police chief participate in the decision to evacuate?	50	1	5.3852	0.01	0.9402
103	other_ev	Did other participate in the decision to evacuate?	50	1	0.5610	0.00	0.9456
104	plan_used	Was the plan used in this emergency?	45	1	3.4162	0.00	0.9739
105	em_mgr_ev	Did emergency managers participate in the decision to evacuate?	50	1	3.4133	0.00	0.9859
106	shl_per	What percent of evacuees went to congregate care centers?	26	1	43.0944	0.00	0.9893

APPENDIX G

CROSS TABULATIONS WITH EVACUATION EFFICIENCY SCORE FOR SIGNIFICANTLY ASSOCIATED VARIABLES

CONTENTS

Table G-1. Traffic Accidents

Table of traff_accid by scorec					
traff_accid (Were there traffic accidents during the evacuations?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	3 6.00 50.00 14.29	2 4.00 33.33 25.00	1 2.00 16.67 20.00	6 12.00
No	16 32.00 40.00 100.00	18 36.00 45.00 85.71	5 10.00 12.50 62.50	1 2.00 2.50 20.00	40 80.00
Yes	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 25.00 12.50	3 6.00 75.00 60.00	4 8.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-2. Reentry Process

Table of rentr_proc by scorec					
rentr_proc (Describe the Re-entry Process)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
Controlled Phased	0 0.00 0.00 0.00	3 6.00 33.33 14.29	3 6.00 33.33 37.50	3 6.00 33.33 60.00	9 18.00
No special controls	16 32.00 40.00 100.00	18 36.00 45.00 85.71	5 10.00 12.50 62.50	1 2.00 2.50 20.00	40 80.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-3. Deaths from Hazard

Table of h_death by scorec					
h_death (Number of deaths from hazard)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
0	14 28.00 31.82 87.50	21 42.00 47.73 100.00	6 12.00 13.64 75.00	3 6.00 6.82 60.00	44 88.00
1	2 4.00 100.00 12.50	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 4.00
3	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 12.50	0 0.00 0.00 0.00	1 2.00
15	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 12.50	0 0.00 0.00 0.00	1 2.00
25	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
2823	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-4. Evacuation Injuries by Score

Table of evac_inj by scorec					
evac_inj (Number of injuries caused by the evacuation)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	1 2.00 33.33 4.76	1 2.00 33.33 12.50	1 2.00 33.33 20.00	3 6.00
0	16 32.00 35.56 100.00	20 40.00 44.44 95.24	7 14.00 15.56 87.50	2 4.00 4.44 40.00	45 90.00
1	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
35	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-5. National Guard Use by Score

Table of nat_guard by scorec					
nat_guard (Was the National Guard used for law enforcement?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	15 30.00 36.59 93.75	19 38.00 46.34 90.48	5 10.00 12.20 62.50	2 4.00 4.88 40.00	41 82.00
Yes	1 2.00 11.11 6.25	2 4.00 22.22 9.52	3 6.00 33.33 37.50	3 6.00 33.33 60.00	9 18.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-6. Instances of Looting or Vandalism

Table of loot_vand by scorec					
loot_vand (Were there any instances of looting or vandalism?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	16 32.00 35.56 100.00	20 40.00 44.44 95.24	6 12.00 13.33 75.00	3 6.00 6.67 60.00	45 90.00
Yes	0 0.00 0.00 0.00	1 2.00 20.00 4.76	2 4.00 40.00 25.00	2 4.00 40.00 40.00	5 10.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-7. Early Evacuations

Table of early_evac by scorec					
early_evac (Did some people spontaneously evacuate before being told to do so?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	3 6.00 42.86 18.75	1 2.00 14.29 4.76	3 6.00 42.86 37.50	0 0.00 0.00 0.00	7 14.00
No	10 20.00 47.62 62.50	9 18.00 42.86 42.86	1 2.00 4.76 12.50	1 2.00 4.76 20.00	21 42.00
Yes	3 6.00 13.64 18.75	11 22.00 50.00 52.38	4 8.00 18.18 50.00	4 8.00 18.18 80.00	22 44.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-8. Fire Chief Participation in Reentry

Table of fire_chief_re by scorec					
fire_chief_re (Did the fire chief participate in the authorization for re-entry?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0	0	1	0	1
	0.00	0.00	2.00	0.00	2.00
	0.00	0.00	100.00	0.00	
	0.00	0.00	12.50	0.00	
No	5	13	4	5	27
	10.00	26.00	8.00	10.00	54.00
	18.52	48.15	14.81	18.52	
	31.25	61.90	50.00	100.00	
Yes	11	8	3	0	22
	22.00	16.00	6.00	0.00	44.00
	50.00	36.36	13.64	0.00	
	68.75	38.10	37.50	0.00	
Total	16	21	8	5	50
	32.00	42.00	16.00	10.00	100.00

Table G-9. Refusals to Evacuate

Table of refus_evac by scorec					
refus_evac (Did anyone refuse to evacuate?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	3	0	0	0	3
	6.00	0.00	0.00	0.00	6.00
	100.00	0.00	0.00	0.00	
	18.75	0.00	0.00	0.00	
No	10	7	3	1	21
	20.00	14.00	6.00	2.00	42.00
	47.62	33.33	14.29	4.76	
	62.50	33.33	37.50	20.00	
Yes	3	14	5	4	26
	6.00	28.00	10.00	8.00	52.00
	11.54	53.85	19.23	15.38	
	18.75	66.67	62.50	80.00	
Total	16	21	8	5	50
	32.00	42.00	16.00	10.00	100.00

Table G-10. Previous Hazard Experience

Table of haz_exp by scorec					
haz_exp (Has the community had any experience with the hazard?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	1 2.00 100.00 6.25	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
No	11 22.00 45.83 68.75	9 18.00 37.50 42.86	3 6.00 12.50 37.50	1 2.00 4.17 20.00	24 48.00
Yes	4 8.00 16.00 25.00	12 24.00 48.00 57.14	5 10.00 20.00 62.50	4 8.00 16.00 80.00	25 50.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-11. Use of Schools as Congregate Care Centers

Table of schools by scorec					
schools (Were schools used as congregate care centers?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	5 10.00 45.45 31.25	5 10.00 45.45 23.81	1 2.00 9.09 12.50	0 0.00 0.00 0.00	11 22.00
No	2 4.00 25.00 12.50	0 0.00 0.00 0.00	3 6.00 37.50 37.50	3 6.00 37.50 60.00	8 16.00
Yes	9 18.00 29.03 56.25	16 32.00 51.61 76.19	4 8.00 12.90 50.00	2 4.00 6.45 40.00	31 62.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-12. Evacuation Deaths

Table of evac_death by scorec					
evac_death (Number of deaths caused by the evacuation)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
0	16 32.00 33.33 100.00	21 42.00 43.75 100.00	8 16.00 16.67 100.00	3 6.00 6.25 60.00	48 96.00
19	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-13. Use of Public Schools as Congregate Care Centers

Table of public_bldg by scorec					
public_bldg (Were public buildings used as congregate care centers?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	5 10.00 45.45 31.25	5 10.00 45.45 23.81	1 2.00 9.09 12.50	0 0.00 0.00 0.00	11 22.00
No	10 20.00 32.26 62.50	14 28.00 45.16 66.67	5 10.00 16.13 62.50	2 4.00 6.45 40.00	31 62.00
Yes	1 2.00 12.50 6.25	2 4.00 25.00 9.52	2 4.00 25.00 25.00	3 6.00 37.50 60.00	8 16.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-14. Management of Congregate Care Center

Table of mgmt_shelter by scorec					
mgmt_shelter (Who managed the congregate care centers?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	5 10.00 45.45 31.25	5 10.00 45.45 23.81	1 2.00 9.09 12.50	0 0.00 0.00 0.00	11 22.00
City	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 12.50	0 0.00 0.00 0.00	1 2.00
Civil Defense	2 4.00 100.00 12.50	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 4.00
Other	4 8.00 66.67 25.00	1 2.00 16.67 4.76	1 2.00 16.67 12.50	0 0.00 0.00 0.00	6 12.00
Red Cross	5 10.00 20.83 31.25	10 20.00 41.67 47.62	5 10.00 20.83 62.50	4 8.00 16.67 80.00	24 48.00
Red Cross, Other	0 0.00 0.00 0.00	5 10.00 83.33 23.81	0 0.00 0.00 0.00	1 2.00 16.67 20.00	6 12.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-15. Participation of Mayor in Reentry Authorization

Table of mayor_re by scorec					
mayor_re (Did the mayor participate in the authorization for re-entry?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 12.50	0 0.00 0.00 0.00	1 2.00
No	15 30.00 34.88 93.75	20 40.00 46.51 95.24	5 10.00 11.63 62.50	3 6.00 6.98 60.00	43 86.00
Yes	1 2.00 16.67 6.25	1 2.00 16.67 4.76	2 4.00 33.33 25.00	2 4.00 33.33 40.00	6 12.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-16. Public Notification by NOAA

Table of noaa_pn by scorec					
noaa_pn (Was the public notified by NOAA?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	1 2.00 100.00 6.25	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
No	15 30.00 31.25 93.75	21 42.00 43.75 100.00	8 16.00 16.67 100.00	4 8.00 8.33 80.00	48 96.00
Yes	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 20.00	1 2.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-17. Type of Hazard that Led to Evacuation

Table of haz_type by scorec					
haz_type (Hazard that led to evacuation)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Natural Disaster	1 2.00 7.14 6.25	7 14.00 50.00 33.33	3 6.00 21.43 37.50	3 6.00 21.43 60.00	14 28.00
Malevolent Act	1 2.00 33.33 6.25	1 2.00 33.33 4.76	0 0.00 0.00 0.00	1 2.00 33.33 20.00	3 6.00
Technological Hazard	14 28.00 42.42 87.50	13 26.00 39.39 61.90	5 10.00 15.15 62.50	1 2.00 3.03 20.00	33 66.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-18. Elapsed Time Between Start of Hazard and Evacuation

Table of st_time by scorec					
st_time (Elapsed time between start of hazard and decision to evacuate (hours))	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	2 4.00 22.22 12.50	2 4.00 22.22 9.52	4 8.00 44.44 50.00	1 2.00 11.11 20.00	9 18.00
15 minutes or less	7 14.00 58.33 43.75	4 8.00 33.33 19.05	1 2.00 8.33 12.50	0 0.00 0.00 0.00	12 24.00
16 minutes to 1 hour	3 6.00 25.00 18.75	7 14.00 58.33 33.33	1 2.00 8.33 12.50	1 2.00 8.33 20.00	12 24.00
1-3 hours	3 6.00 37.50 18.75	3 6.00 37.50 14.29	1 2.00 12.50 12.50	1 2.00 12.50 20.00	8 16.00
4-10 hours	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
One - Two Days	1 2.00 20.00 6.25	2 4.00 40.00 9.52	0 0.00 0.00 0.00	2 4.00 40.00 40.00	5 10.00
Over Two Days	0 0.00 0.00 0.00	2 4.00 66.67 9.52	1 2.00 33.33 12.50	0 0.00 0.00 0.00	3 6.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-19. Unavailability of Roadways for Use

Table of road_haz by scorec					
road_haz (Were any major roadways unavailable for use?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	1 2.00 33.33 6.25	2 4.00 66.67 9.52	0 0.00 0.00 0.00	0 0.00 0.00 0.00	3 6.00
No	13 26.00 40.63 81.25	12 24.00 37.50 57.14	5 10.00 15.63 62.50	2 4.00 6.25 40.00	32 64.00
Yes	2 4.00 13.33 12.50	7 14.00 46.67 33.33	3 6.00 20.00 37.50	3 6.00 20.00 60.00	15 30.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-20. Use of Emergency Operations Center

Table of eoc_used by scorec					
eoc_used (Was an Emergency Operations Center (EOC) used?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	1 2.00 100.00 6.25	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
No	7 14.00 46.67 43.75	6 12.00 40.00 28.57	2 4.00 13.33 25.00	0 0.00 0.00 0.00	15 30.00
Yes	8 16.00 23.53 50.00	15 30.00 44.12 71.43	6 12.00 17.65 75.00	5 10.00 14.71 100.00	34 68.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-21. Total Time to Complete Evacuation

Table of tot_time by scorec					
tot_time (Time to complete the evacuation (hours))	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	2 4.00 15.38 12.50	6 12.00 46.15 28.57	3 6.00 23.08 37.50	2 4.00 15.38 40.00	13 26.00
0.33	1 2.00 100.00 6.25	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
0.6	1 2.00 50.00 6.25	1 2.00 50.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 4.00
0.66	1 2.00 100.00 6.25	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
0.75	1 2.00 33.33 6.25	2 4.00 66.67 9.52	0 0.00 0.00 0.00	0 0.00 0.00 0.00	3 6.00
1	3 6.00 42.86 18.75	3 6.00 42.86 14.29	1 2.00 14.29 12.50	0 0.00 0.00 0.00	7 14.00
1.5	1 2.00 33.33 6.25	1 2.00 33.33 4.76	1 2.00 33.33 12.50	0 0.00 0.00 0.00	3 6.00
2	5 10.00 83.33 31.25	1 2.00 16.67 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	6 12.00
3	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
3.5	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00

Table G-21. Total Time to Complete Evacuation (continued)

Table of tot_time by scorec					
tot_time (Time to complete the evacuation (hours))	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
4	1 2.00 25.00 6.25	1 2.00 25.00 4.76	1 2.00 25.00 12.50	1 2.00 25.00 20.00	4 8.00
6	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 4.00 100.00 40.00	24.00
8	0 0.00 0.00 0.00	1 2.00 50.00 4.76	1 2.00 50.00 12.50	0 0.00 0.00 0.00	24.00
12	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00 100.00 12.50	0 0.00 0.00 0.00	12.00
14	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	12.00
17	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
22	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-22. Notification by Door to Door

Table of door_door_pn by scorec					
door_door_pn (Was the public notified door-to-door?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	1 2.00 100.00 6.25	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
No	3 6.00 20.00 18.75	6 12.00 40.00 28.57	2 4.00 13.33 25.00	4 8.00 26.67 80.00	15 30.00
Yes	12 24.00 35.29 75.00	15 30.00 44.12 71.43	6 12.00 17.65 75.00	1 2.00 2.94 20.00	34 68.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-23. Evacuation of One or More Institutions

Table of instevac by scorec					
instevac (Was One or more special institutions evacuated?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	1 2.00 16.67 6.25	4 8.00 66.67 19.05	1 2.00 16.67 12.50	0 0.00 0.00 0.00	6 12.00
No	12 24.00 46.15 75.00	8 16.00 30.77 38.10	4 8.00 15.38 50.00	2 4.00 7.69 40.00	26 52.00
Yes	3 6.00 16.67 18.75	9 18.00 50.00 42.86	3 6.00 16.67 37.50	3 6.00 16.67 60.00	18 36.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-24. Population Density

Table of pop_dens by scorec					
pop_dens (Population density during evacuation)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	4 8.00 100.00 19.05	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 8.00
High	6 12.00 42.86 37.50	5 10.00 35.71 23.81	1 2.00 7.14 12.50	2 4.00 14.29 40.00	14 28.00
Low	1 2.00 12.50 6.25	2 4.00 25.00 9.52	3 6.00 37.50 37.50	2 4.00 25.00 40.00	8 16.00
Medium	9 18.00 37.50 56.25	10 20.00 41.67 47.62	4 8.00 16.67 50.00	1 2.00 4.17 20.00	24 48.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-25. Regular Conduct of Emergency Drills/Exercises

Table of drills by scorec					
drills (Do the community's emergency response agencies regularly conduct emergency drills and exercises?)	scorec				
Frequency Percent Row Pct Col Pct	0 Issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
No	5 10.00 71.43 31.25	0 0.00 0.00 0.00	2 4.00 28.57 25.00	0 0.00 0.00 0.00	7 14.00
Yes	11 22.00 26.19 68.75	20 40.00 47.62 95.24	6 12.00 14.29 75.00	5 10.00 11.90 100.00	42 84.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-26. Extent of Evacuation in km²

Table of e_area by scorec					
e_area (Evacuation Area in km^2)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	1 2.00 12.50 6.25	3 6.00 37.50 14.29	2 4.00 25.00 25.00	2 4.00 25.00 40.00	8 16.00
1-4.9 km^2	6 12.00 46.15 37.50	5 10.00 38.46 23.81	2 4.00 15.38 25.00	0 0.00 0.00 0.00	13 26.00
5-9.9 km^2	5 10.00 41.67 31.25	6 12.00 50.00 28.57	1 2.00 8.33 12.50	0 0.00 0.00 0.00	12 24.00
10-49.9 km^2	3 6.00 33.33 18.75	2 4.00 22.22 9.52	1 2.00 11.11 12.50	3 6.00 33.33 60.00	918.00
50-99.9 km^2	1 2.00 50.00 6.25	1 2.00 50.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 4.00
100-499 km^2	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
500-999 km^2	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
1000 or more km^2	0 0.00 0.00 0.00	2 4.00 50.00 9.52	2 4.00 50.00 25.00	0 0.00 0.00 0.00	4 8.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-27. Whether Area Is More Prone to Hazards than Average

Table of prone_haz by scorec					
prone_haz (Is the area more prone to hazards than average?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	6 12.00 46.15 37.50	6 12.00 46.15 28.57	0 0.00 0.00 0.00	1 2.00 7.69 20.00	13 26.00
Yes	10 20.00 27.03 62.50	15 30.00 40.54 71.43	8 16.00 21.62 100.00	4 8.00 10.81 80.00	37 74.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

Table G-28. Level of Community Awareness of Alerting Methods

Table of aware_alert by scorec					
aware_alert (Level of community awareness with alerting methods used)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
Unknown	0 0.00 0.00 0.00	1 2.00 100.00 4.76	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 2.00
High	7 14.00 41.18 43.75	7 14.00 41.18 33.33	2 4.00 11.76 25.00	1 2.00 5.88 20.00	17 34.00
Low	2 4.00 20.00 12.50	2 4.00 20.00 9.52	4 8.00 40.00 50.00	2 4.00 20.00 40.00	10 20.00
Medium	7 14.00 31.82 43.75	11 22.00 50.00 52.38	2 4.00 9.09 25.00	2 4.00 9.09 40.00	22 44.00
Total	16 32.00	21 42.00	8 16.00	5 10.00	50 100.00

APPENDIX H

P-VALUES FOR TESTS OF EACH VARIABLE'S ASSOCIATION WITH HAZARD-TYPE CATEGORICAL VARIABLES TESTED USING FISHER'S EXACT TEST AND CONTINUOUS VARIABLES TESTED USING THE EXACT MEDIAN TEST

CONTENTS

Table H-1. P-values for Tests of Each Variable's Association With Hazard-type Categorical Variables Tested Using Fisher's Exact Test and Continuous Variables Tested Using the Exact Median Test

Obs	Variable	Question	Test	n	p-value
1	haz_type	Hazard that led to evacuation	Fisher's Exact	50	0.00000
2	fire_chief_re	Did the fire chief participate in the authorization for re-entry?	Fisher's Exact	49	0.00000
3	haz_exp	Has the community had any experience with the hazard?	Fisher's Exact	49	0.00001
4	fire_chief_ev	Did the fire chief participate in the decision to evacuate?	Fisher's Exact	50	0.00002
5	aware_ehaz	Level of community awareness with hazard that caused evacuation	Fisher's Exact	50	0.00002
6	comm_type	Type of Community	Fisher's Exact	50	0.00008
7	nat_guard	Was the National Guard used for law enforcement?	Fisher's Exact	50	0.00033
8	eoc_used	Emergency Operations Center (EOC) used	Fisher's Exact	49	0.00093
9	nevac	Number of Evacuations	Exact Median	49	0.00140
10	govt_type	Form of Government	Fisher's Exact	50	0.00151
11	lu_residential	Residential Land Use	Fisher's Exact	49	0.00173
12	icp_used	Field (incident) command post used	Fisher's Exact	50	0.00197
13	tot_time	Time to complete the evacuation (hours)	Exact Median	37	0.00203
14	early_evac	Did some people spontaneously evacuate before being told to do so?	Fisher's Exact	43	0.00221
15	e_area	Evacuation Area in km^2	Exact Median	42	0.00242
16	refus_evac	Did anyone refuse to evacuate?	Fisher's Exact	47	0.00432
17	police	Were the Police used for law enforcement?	Fisher's Exact	50	0.00574
18	revlan_used	Was reverse-laning used?	Fisher's Exact	46	0.00716
19	shad_traff	Did this cause an impact on traffic?	Fisher's Exact	42	0.00837
20	evac_instruct	Were people given specific instructions about where to go when they evacuated?	Fisher's Exact	46	0.00916
21	other_re	Did other people participate in the authorization for re-entry?	Fisher's Exact	49	0.01100
22	other_ev	Did other people participate in the decision to evacuate?	Fisher's Exact	50	0.01487
23	bdry_crss	Were political boundaries crossed (i.e., more than one county or state involved)?	Fisher's Exact	45	0.01694
24	shltr_used	Were congregate care centers used?	Fisher's Exact	48	0.01807

Table H-1. P-values for Tests of Each Variable's Association With Hazard-type Categorical Variables Tested Using Fisher's Exact Test and Continuous Variables Tested Using the Exact Median Test (continued)

Obs	Variable	Question	Test	n	p-value
25	c_area	Community Area in km^2	Exact Median	49	0.01850
26	aware_evac	Level of community awareness with evacuation procedures	Fisher's Exact	50	0.02097
27	st_time	Elapsed time between start of hazard and decision to evacuate (hours)	Exact Median	41	0.02259
28	aware_lhaz	Level of community awareness with local hazards	Fisher's Exact	50	0.02343
29	h_death	Number of deaths from hazard	Exact Median	50	0.02500
30	telephone	Was communication between field emergency responders and EOC by telephone?	Fisher's Exact	50	0.02942
31	aware_alert	Level of community awareness with alerting methods used	Fisher's Exact	49	0.03261
32	comm	Community	Fisher's Exact	50	0.03584
33	off_notif	How were senior local officials notified of the incident?	Fisher's Exact	45	0.04035
34	resp_time	ET between discovery of the incident and mobilization (minutes)	Fisher's Exact	42	0.04353
35	pevac	Percent Evacuated	Exact Median	48	0.04602
36	loot_vand	Were there any instances of looting or vandalism?	Fisher's Exact	50	0.05843
37	coop_level	Level of cooperation between local, state, and federal agencies	Fisher's Exact	49	0.05874
38	pop_dens	Population density during evacuation	Fisher's Exact	46	0.06067
39	plan_tested	Was the emergency plan used in this evacuation previously tested in a full-scale field exercise?	Fisher's Exact	40	0.08698
40	governor_ev	Did the governor participate in the decision to evacuate?	Fisher's Exact	50	0.11102
41	prone_haz	Is the area more prone to hazards than average?	Fisher's Exact	50	0.11580
42	em_mgr_re	Did the emergency manager participate in the authorization for re-entry?	Fisher's Exact	49	0.12096
43	road_haz	Were any major roadways unavailable for use?	Fisher's Exact	47	0.12761
44	multiple_re	Did multiple people participate in the authorization for re-entry?	Fisher's Exact	49	0.13259
45	lu_agricultural	Agricultural land use	Fisher's Exact	49	0.13705
46	traff_accid	Were there traffic accidents during the evacuations?	Fisher's Exact	44	0.15938
47	mgmt_shelter	Who managed the congregate care centers?	Fisher's Exact	39	0.17763
48	mayor_ev	Did the mayor participate in the decision to evacuate?	Fisher's Exact	50	0.19128
49	shad_evac	Did people evacuate from areas outside the designated evacuation area?	Fisher's Exact	42	0.19939
50	public_bldg	Were public buildings used as congregate care centers?	Fisher's Exact	39	0.21255
51	evac_route	Were people told to use specific routes?	Fisher's Exact	46	0.22192

Table H-1. P-values for Tests of Each Variable's Association With Hazard-type Categorical Variables Tested Using Fisher's Exact Test and Continuous Variables Tested Using the Exact Median Test (continued)

Obs	Variable	Question	Test	n	p-value
52	rentr_proc	Describe the re-entry process	Fisher's Exact	49	0.22430
53	police_chief_re	Did the police chief participate in the authorization for re-entry?	Fisher's Exact	49	0.23043
54	prox_npp	Proximity to a commercial nuclear power plant (km)	Fisher's Exact	50	0.26288
55	em_mgr_ev	Did emergency managers participate in the decision to evacuate?	Fisher's Exact	50	0.27511
56	schools	Were schools used as congregate care centers?	Fisher's Exact	39	0.27991
57	route_design	How were these routes designated	Fisher's Exact	27	0.28917
58	pnum	Population	Exact Median	50	0.31943
59	evac_death	Number of deaths caused by the evacuation	Exact Median	49	0.32653
60	state_npp	Is the community located in a state that contains a nuclear power plant?	Fisher's Exact	50	0.34086
61	ebs_pn	Was the public notified by an emergency broadcast system?	Fisher's Exact	49	0.34694
62	noaa_pn	Was the public notified by NOAA?	Fisher's Exact	49	0.34694
63	h_inj	Number of injuries from hazard	Exact Median	48	0.35151
64	sirens_pn	Was the public notified by a siren?	Fisher's Exact	49	0.37232
65	instevac	Were one or more special institutions evacuated?	Fisher's Exact	44	0.40269
66	ete	Was there an Evacuation Time Estimate (ETE) in the plan?	Fisher's Exact	14	0.42857
67	alert_exp	Did the community have previous experience with the alerting mechanism?	Fisher's Exact	40	0.43042
68	mayor_re	Did the mayor participate in the authorization for re-entry?	Fisher's Exact	49	0.43527
69	radio_tv_pn	Was the public notified by radio/TV?	Fisher's Exact	49	0.44203
70	door_door_pn	Was the public notified door-to-door?	Fisher's Exact	49	0.45661
71	telephone_pn	Was the public notified by telephone?	Fisher's Exact	49	0.45819
72	exp_comp	Were evacuees compensated for their expenses?	Fisher's Exact	46	0.50881
73	em_plan	Did the community have a written emergency plan?	Fisher's Exact	50	0.62286
74	joint_training	Is joint training between industry and government regularly conducted?	Fisher's Exact	48	0.66791
75	lu_industrial	Industrial land use	Fisher's Exact	49	0.67834
76	unus_circ	Other unusual circumstances	Fisher's Exact	28	0.71146
77	time_day	Time of Day	Fisher's Exact	50	0.72562
78	conform_nureg	Did the plan conform to NUREG-0654/FEMA-REP-1, Rev 1?	Fisher's Exact	22	0.73463

Table H-1. P-values for Tests of Each Variable's Association With Hazard-type Categorical Variables Tested Using Fisher's Exact Test and Continuous Variables Tested Using the Exact Median Test (continued)

Obs	Variable	Question	Test	n	p-value
79	ena_fctr	Was ethnicity, nationality, or age important?	Fisher's Exact	42	0.73790
80	police_chief_ev	Did the police chief participate in the decision to evacuate?	Fisher's Exact	50	0.73981
81	churches	Were churches used as congregate care centers?	Fisher's Exact	39	0.78375
82	drills	Do the community's emergency response agencies regularly conduct emergency drills and exercises?	Fisher's Exact	49	0.78449
83	staged	Was the evacuation staged?	Fisher's Exact	50	0.78609
84	multiple_sh	Were multiple buildings used as congregate care centers?	Fisher's Exact	39	0.82016
85	exerc_type	If so, what type of exercise was performed immediately prior to this evacuation?	Fisher's Exact	21	0.89998
86	evac_exp	Has the community experienced evacuations in previous ten years?	Fisher's Exact	48	0.90005
87	lu_retail	Retail land use	Fisher's Exact	49	1.00000
88	lu_commercial	Commercial land use	Fisher's Exact	49	1.00000
89	pa_system_pn	Was the public notified by a PA system?	Fisher's Exact	49	1.00000
90	evac_plan	Did the emergency plan contain an evacuation section?	Fisher's Exact	43	1.00000
91	multiple_pn	Was the public notified by multiple methods?	Fisher's Exact	49	1.00000
92	evac_inj	Number of injuries caused by the evacuation	Exact Median	47	1.00000
93	multiple	Was communication between field emergency responders and EOC by multiple ways?	Fisher's Exact	50	1.00000
94	road_dry	Road conditions prior to evacuation	Fisher's Exact	48	1.00000
95	spec_char	Were there any special characteristics?	Fisher's Exact	48	1.00000
96	plan_used	Was the plan used in this emergency?	Fisher's Exact	45	1.00000
97	ccc_proc	Command, control and coordination processes	Fisher's Exact	50	1.00000
98	cond_good	Road conditions/weather conditions	Fisher's Exact	43	1.00000
99	cell_phone	Was communication between field emergency responders and EOC by cell phone?	Fisher's Exact	50	1.00000
100	er_notif	How were emergency responders notified of the incident?	Fisher's Exact	44	1.00000
101	multiple_ev	Did multiple people participate in the decision to evacuate?	Fisher's Exact	50	1.00000
102	other	Were other buildings used as congregate care centers?	Fisher's Exact	40	1.00000
103	pager	Was communication between field emergency responders and EOC by pager?	Fisher's Exact	50	1.00000
104	radio	Was communication between field emergency responders and EOC by radio?	Fisher's Exact	50	1.00000

APPENDIX I

CHI-SQUARE VALUES FOR LIKELIHOOD RATIO TESTS OF ASSOCIATION BETWEEN EACH VARIABLE AND EVACUATION EFFICIENCY SCORE AFTER ADJUSTING FOR HAZARD TYPE

Table I-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score After Adjusting for Hazard Type

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
1	rentr_proc	Describe the re-entry process	49	1	199.4046	12.40	0.0004
2	traff_accid	Were there traffic accidents during the evacuations?	44	1	169.3717	11.76	0.0006
3	aware_alert	Level of community awareness with alerting methods used	49	2	206.4430	13.33	0.0013
4	evac_inj	Number of injuries caused by the evacuation	47	1	195.8641	10.33	0.0013
5	h_death	Number of deaths from hazard	50	1	217.6996	9.44	0.0021
6	schools	Were schools used as congregate care centers?	39	1	170.3390	5.66	0.0174
7	mayor_re	Did the mayor participate in the authorization for re-entry?	49	1	216.1739	5.58	0.0181
8	loot_vand	Were there any instances of looting or vandalism?	50	1	226.1756	5.21	0.0225
9	early_evac	Did some people spontaneously evacuate before being told to do so?	43	1	184.3282	4.55	0.0330
10	refus_evac	Did anyone refuse to evacuate?	47	1	216.6778	4.27	0.0388
11	public_bldg	Were public buildings used as congregate care centers?	39	1	174.1760	3.74	0.0532
12	multiple_sh	Were multiple buildings used as congregate care centers?	39	1	174.1827	3.73	0.0533
13	door_door_pn	Was the public notified door-to-door?	49	1	225.6766	3.66	0.0559
14	evac_death	Number of deaths caused by the evacuation	49	1	217.9320	3.63	0.0566
15	noaa_pn	Was the public notified by NOAA?	49	1	226.2767	3.36	0.0670
16	nat_guard	Was the National Guard used for law enforcement?	50	1	230.2581	3.17	0.0752
17	mgmt_shelter	Who managed the congregate care centers?	39	4	165.7099	8.22	0.0839
18	h_inj	Number of injuries from hazard	48	1	214.7581	2.67	0.1024
19	spec_char	Were there any special characteristics?	48	1	215.4062	2.67	0.1024
20	instevac	Were one or more special institutions evacuated?	44	1	207.0517	2.59	0.1078
21	aware_evac	Level of community awareness with evacuation procedures	50	2	228.0223	4.28	0.1175
22	churches	Were churches used as congregate care centers?	39	1	177.0526	2.30	0.1295
23	road_haz	Were any major roadways unavailable for use?	47	1	221.7815	2.24	0.1347
24	drills	Do the community's emergency response agencies regularly conduct emergency drills and exercises?	49	1	228.3709	2.19	0.1389
25	multiple_ev	Did multiple people participate in the decision to evacuate?	50	1	232.7491	1.92	0.1659

Table I-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score After Adjusting for Hazard Type (continued)

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
26	radio	Was communication between field emergency responders and EOC by radio?	50	1	232.8356	1.88	0.1707
27	aware_lhaz	Level of community awareness with local hazards	50	2	230.0096	3.29	0.1930
28	haz_exp	Has the community had any experience with the hazard?	49	1	229.9653	1.51	0.2189
29	alert_exp	Did the community have previous experience with the alerting mechanism?	40	1	186.4828	1.43	0.2323
30	shad_evac	Did people evacuate from areas outside the designated evacuation area?	42	1	189.7794	1.41	0.2343
31	pop_dens	Population density during evacuation	46	2	214.7714	2.88	0.2366
32	unus_circ	Other unusual circumstances	28	1	131.0810	1.35	0.2454
33	lu_Retail	Retail Land Use	49	1	228.4968	1.29	0.2559
34	other_ev	Did other people participate in the decision to evacuate?	50	1	234.0418	1.27	0.2591
35	time_day	Time of Day	50	1	234.0529	1.27	0.2601
36	pa_system_pn	Was the public notified by a PA system?	49	1	230.5170	1.24	0.2663
37	staged	Was the evacuation staged?	50	1	234.1666	1.21	0.2711
38	fire_chief_re	Did the fire chief participate in the authorization for re-entry?	49	1	224.9717	1.18	0.2768
39	prone_haz	Is the area more prone to hazards than average?	50	1	234.2903	1.15	0.2837
40	off_notif	How were senior local officials notified of the incident?	45	10	189.9607	11.87	0.2942
41	evac_exp	Has the community experienced evacuations in the previous ten years?	48	1	227.4132	1.09	0.2956
42	resp_time	ET between discovery of the incident and mobilization (minutes)	42	2	192.1269	2.40	0.3014
43	er_notif	How were emergency responders notified of the incident?	44	3	202.2238	3.65	0.3019
44	route_design	How were these routes designated?	27	2	103.3675	2.25	0.3249
45	conform_nureg	Did the plan conform to NUREG-0654/FEMA-REP-1, Rev_1?	22	1	104.8101	0.95	0.3299
46	sirens_pn	Was the public notified by a siren?	49	1	231.2000	0.89	0.3443
47	ete	Was there an Evacuation Time Estimate (ETE) in the plan?	14	1	68.8740	0.87	0.3496
48	other	Were other buildings used as congregate care centers?	40	1	183.2163	0.83	0.3629
49	multiple_pn	Was the public notified by multiple methods?	49	1	231.4656	0.76	0.3829
50	c_area	Community Area in km^2	49	1	110.0815	0.75	0.3870
51	eoc_used	Was an Emergency Operations Center (EOC) used?	49	1	231.5358	0.73	0.3941

Table I-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score After Adjusting for Hazard Type (continued)

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
52	st_time	Elapsed time between start of hazard and decision to evacuate (hours)	41	1	183.8800	0.69	0.4050
53	comm_type	Type of Community	50	3	230.8689	2.86	0.4137
54	aware_ehaz	Level of community awareness with hazard that caused evacuation	50	2	233.0644	1.76	0.4143
55	telephone	Was communication between field emergency responders and EOC by telephone?	50	1	235.2622	0.66	0.4153
56	prox_npp	Proximity to a commercial nuclear power plant (km)	50	2	233.0792	1.75	0.4158
57	ccc_proc	Command, control and coordination processes	50	1	235.2679	0.66	0.4164
58	other_re	Did other people participate in the authorization for re-entry?	49	1	226.0867	0.63	0.4291
59	exp_comp	Were evacuees compensated for their expenses?	46	1	212.7030	0.62	0.4326
60	pnum	Population	50	1	114.9078	0.61	0.4332
61	em_mgr_ev	Did emergency managers participate in the decision to evacuate?	50	1	235.3817	0.60	0.4372
62	evac_instruct	Were people given specific instructions about where to go when they evacuated?	46	1	215.9498	0.54	0.4610
63	state_npp	Is community located in a state that contains a nuclear power plant?	50	1	235.6393	0.47	0.4907
64	mayor_ev	Did the mayor participate in the decision to evacuate?	50	1	235.7004	0.44	0.5050
65	coop_level	Level of cooperation between local, state, and federal agencies	49	1	231.9532	0.40	0.5279
66	lu_Commercial	Commercial Land Use	49	1	230.3341	0.37	0.5418
67	shltr_used	Were congregate care centers used?	48	1	228.4826	0.36	0.5478
68	icp_used	Was a field (incident) command post used?	50	1	235.8784	0.36	0.5511
69	exerc_type	If so, what type of exercise was performed immediately prior to this evacuation?	21	4	82.8150	3.02	0.5552
70	telephone_pn	Was the public notified by telephone?	49	1	232.2996	0.34	0.5573
71	pevac	Percent Evacuated	48	1	213.9769	0.34	0.5620
72	multiple_re	Did multiple people participate in the authorization for re-entry?	49	1	226.7607	0.29	0.5913
73	ebs_pn	Was the public notified by an emergency broadcast system?	49	1	232.4802	0.25	0.6142
74	em_plan	Did the community have a written emergency plan?	50	1	236.1064	0.24	0.6232
75	road_dry	Road conditions prior to evacuation	48	1	229.2839	0.24	0.6273
76	cond_good	Road conditions/weather conditions	43	1	201.0677	0.21	0.6487
77	multiple	Was communication between field emergency responders and EOC by multiple ways?	50	1	236.2370	0.18	0.6748

Table I-1. Chi-Square Values for Likelihood Ratio Tests of Association Between Each Variable and Evacuation Efficiency Score After Adjusting for Hazard Type (continued)

	Variable	Variable Label	n	DF	Deviance Statistic	χ^2	p-value
78	pager	Was communication between field emergency responders and EOC by pager?	50	1	236.2385	0.18	0.6754
79	joint_training	Is joint training between industry and government regularly conducted?	48	1	226.0342	0.14	0.7078
80	shl_per	What percent of evacuees went to congregate care centers?	26	1	114.4758	0.13	0.7160
81	lu_Industrial	Industrial Land Use	49	1	230.8281	0.13	0.7235
82	plan_used	Was the plan used in this emergency?	45	1	210.3203	0.10	0.7502
83	cell_phone	Was communication between field emergency responders and EOC by cell phone?	50	1	236.3896	0.10	0.7521
84	evac_route	Were people told to use specific routes?	46	1	222.3079	0.06	0.8017
85	tot_time	Time to complete the evacuation (hours)	37	1	167.2206	0.06	0.8024
86	fire_chief_ev	Did the fire chief participate in the decision to evacuate?	50	1	236.4868	0.05	0.8210
87	evac_plan	Did the emergency plan contain an evacuation section?	43	1	197.6525	0.05	0.8214
88	bdry_crss	Were political boundaries crossed (i_e_, more than one county or state involved)?	45	1	203.8249	0.05	0.8243
89	police_chief_ev	Did the police chief participate in the decision to evacuate?	50	1	236.5155	0.04	0.8478
90	police_chief_re	Did the police chief participate in the authorization for re-entry?	49	1	227.2689	0.03	0.8533
91	em_mgr_re	Did the emergency manager participate in the authorization for re-entry?	49	1	227.2704	0.03	0.8549
92	ena_fctr	Was ethnicity, nationality, or age important?	42	1	194.4006	0.03	0.8710
93	radio_tv_pn	Was the public notified by radio/TV?	49	1	232.9404	0.02	0.8770
94	police	Were the police used for law enforcement?	50	1	236.5552	0.02	0.8963
95	lu_residential	Residential Land Use	49	1	231.0523	0.01	0.9089
96	shad_traff	Did this cause an impact on traffic?	42	1	192.5901	0.01	0.9244
97	plan_tested	Was the emergency plan used in this evacuation previously tested in a full-scale field exercise?	40	1	190.7405	0.00	0.9588
98	revlan_used	Was reverse-laning used?	46	1	208.0585	0.00	0.9621
99	governor_ev	Did the governor participate in the decision to evacuate?	50	1	236.5852	0.00	0.9644
100	lu_Agricultural	Agricultural Land Use	49	1	231.0746	0.00	0.9647
101	e_area	Evacuation Area in km^2	42	1	184.4551	0.00	0.9773
102	govt_type	Form of Government	50	3	236.2856	0.15	0.9850
103	nevac	Number of Evacuations	49	1	233.0946	0.00	0.9946
104	comm	Community	50	2	250.1955	0.00	1.0000

APPENDIX J

P-VALUES FOR TESTS OF ASSOCIATION WITH EVACUATION EFFICIENCY SCORE FOR VARIABLES WITH SIGNIFICANT OR MARGINALLY SIGNIFICANT ASSOCIATIONS WITH EVACUATION EFFICIENCY SCORE

CONTENTS

Table J-1. P-Values for Tests of Association With Evacuation Efficiency Score for Variables with Significant or Marginally Significant Associations with Evacuation Efficiency Score

	Variable	Variable Label	n	p-value for test of interaction with hazard type	p-value for test of association after adjusting for hazard type	p-value for test of association
1	traff_accid	Were there traffic accidents during the evacuations?	44	0.1794	0.0006	<.0001
2	rentr_proc	Describe the Re-entry Process	49	0.2020	0.0004	0.0003
3	h_death	Number of deaths from hazard	50	.	0.0021	0.0007
4	evac_inj	Number of injuries caused by the evacuation	47	.	0.0013	0.0009
5	nat_guard	Was the National Guard used for law enforcement?	50	0.0096	0.0752	0.0032
6	loot_vand	Were there any instances of looting or vandalism?	50	0.1698	0.0225	0.0043
7	early_evac	Did some people spontaneously evacuate before being told to do so?	43	0.8356	0.0330	0.0048
8	fire_chief_re	Did the fire chief participate in the authorization for re-entry?	49	.	0.2768	0.0097
9	refus_evac	Did anyone refuse to evacuate?	47	0.2759	0.0388	0.0126
10	haz_exp	Has the community had any experience with the hazard?	49	0.0310	0.2189	0.0168
11	schools	Were schools used as congregate care centers?	39	0.0702	0.0174	0.0187
12	evac_death	Number of deaths caused by the evacuation	49	.	0.0566	0.0218
13	public_bldg	Were public buildings used as congregate care centers?	39	0.6073	0.0532	0.0220
14	mgmt_shelter	Who managed the congregate care centers?	39	.	0.0839	0.0253
15	mayor_re	Did the mayor participate in the authorization for re-entry?	49	0.1857	0.0181	0.0289
16	noaa_pn	Was the public notified by NOAA?	49	.	0.0670	0.0291
17	haz_type	Hazard that led to evacuation	50	.	.	0.0310
18	st_time	Elapsed time between start of hazard and decision to evacuate (hours)	41	.	0.4050	0.0452
19	road_haz	Were any major roadways unavailable for use?	47	0.0380	0.1347	0.0463
20	eoc_used	Was an Emergency Operations Center (EOC) used?	49	.	0.3941	0.0549
21	tot_time	Time to complete the evacuation (hours)	37	.	0.8024	0.0596

. = could not be calculated

Table J-1. P-Values for Tests of Association With Evacuation Efficiency Score for Variables with Significant or Marginally Significant Associations with Evacuation Efficiency Score (continued)

	Variable	Variable Label	n	p-value for test of interaction with hazard type	p-value for test of association after adjusting for hazard type	p-value for test of association
22	door_door_pn	Was the public notified door-to-door?	49	.	0.0559	0.0756
23	instevac	Were one or more special institutions evacuated?	44	.	0.1078	0.0787
24	pop_dens	Population density during evacuation	46	0.8533	0.2366	0.0787
25	drills	Do the community's emergency response agencies regularly conduct emergency drills and exercises?	49	0.0947	0.1389	0.0796
26	e_area	Evacuation Area in km^2	42	.	0.9773	0.0889
27	prone_haz	Is the area more prone to hazards than average?	50	0.0237	0.2837	0.0916
28	aware_alert	Level of community awareness with alerting methods used	49	0.6790	0.0013	0.0954

. = could not be calculated

APPENDIX K

CROSS TABULATIONS FOR VARIABLES WITH SIGNIFICANT INTERACTIONS WITH HAZARD TYPE BROKEN DOWN BY HAZARD TYPE

CONTENTS

Table K-1. National Guard Use/Natural Disaster

Table 1 of nat_guard by scorec					
Controlling for haz_type=Natural Disaster					
nat_guard (Was the National Guard used for law enforcement?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	0 0.00 0.00 0.00	5 35.71 71.43 71.43	0 0.00 0.00 0.00	2 14.29 28.57 66.67	7 50.00
Yes	1 7.14 14.29 100.00	2 14.29 28.57 28.57	3 21.43 42.86 100.00	1 7.14 14.29 33.33	7 50.00
Total	1 7.14	7 50.00	3 21.43	3 21.43	14 100.00

Table K-2. National Guard Use/Malevolent Act

Table 2 of nat_guard by scorec					
Controlling for haz_type=Malevolent Act					
nat_guard (Was the National Guard used for law enforcement?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	1 33.33 50.00 100.00	1 33.33 50.00 100.00	0 0.00 0.00 .	0 0.00 0.00 0.00	2 66.67
Yes	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 .	1 33.33 100.00 100.00	1 33.33
Total	1 33.33	1 33.33	0 0.00	1 33.33	3 100.00

. = could not be calculated

Table K-3. National Guard Use/Technological Hazard

Table 3 of nat_guard by scorec Controlling for haz_type=Technological Hazard					
nat_guard (Was the National Guard used for law enforcement?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	14 42.42 43.75 100.00	13 39.39 40.63 100.00	5 15.15 15.63 100.00	0 0.00 0.00 0.00	32 96.97
Yes	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 3.03 100.00 100.00	1 3.03
Total	14 42.42	13 39.39	5 15.15	1 3.03	33 100.00

Table K-4. Community Experience/Natural Disaster

Table 1 of haz_exp by scorec Controlling for haz_type=Natural Disaster					
haz_exp (Has the community had any experience with the hazard?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00
Yes	1 7.14 7.14 100.00	7 50.00 50.00 100.00	3 21.43 21.43 100.00	3 21.43 21.43 100.00	14 100.00
Total	1 7.14	7 50.00	3 21.43	3 21.43	14 100.00

. = could not be calculated

Table K-5. Community Experience/Malevolent Act

Table 2 of haz_exp by scorec Controlling for haz_type=Malevolent Act					
haz_exp (Has the community had any experience with the hazard?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	1 33.33 50.00 100.00	1 33.33 50.00 100.00	0 0.00 0.00 .	0 0.00 0.00 0.00	2 66.67
Yes	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 .	1 33.33 100.00 100.00	1 33.33
Total	1 33.33	1 33.33	0 0.00	1 33.33	3 100.00

. = could not be calculated

Table K-6. Community Experience/Technological Hazard

Table 3 of haz_exp by scorec Controlling for haz_type=Technological Hazard					
haz_exp (Has the community had any experience with the hazard?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	10 31.25 45.45 76.92	8 25.00 36.36 61.54	3 9.38 13.64 60.00	1 3.13 4.55 100.00	22 68.75
Yes	3 9.38 30.00 23.08	5 15.63 50.00 38.46	2 6.25 20.00 40.00	0 0.00 0.00 0.00	10 31.25
Total	13 40.63	13 40.63	5 15.63	1 3.13	32 100.00
Frequency Missing = 1					

Table K-7. Use of Schools as Congregate Care Centers/Natural Disaster

Table 1 of schools by scorec					
Controlling for haz_type=Natural Disaster					
schools (Were schools used as congregate care centers?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 15.38 100.00 66.67	2 15.38
Yes	1 7.69 9.09 100.00	6 46.15 54.55 100.00	3 23.08 27.27 100.00	1 7.69 9.09 33.33	11 84.62
Total	1 7.69	6 46.15	3 23.08	3 23.08	13 100.00
Frequency Missing = 1					

Table K-8. Use of Schools as Congregate Care Centers/Malevolent Act

Table 2 of schools by scorec					
Controlling for haz_type=Malevolent Act					
schools (Were schools used as congregate care centers?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	0 0.00 0.00 .	0 0.00 0.00 .	0 0.00 0.00 .	1 100.00 100.00 100.00	1 100.00
Yes	0 0.00 . .	0 0.00 . .	0 0.00 . .	0 0.00 . 0.00	0 0.00
Total	0 0.00	0 0.00	0 0.00	1 100.00	1 100.00
Frequency Missing = 2					

. = could not be calculated

Table K-9. Use of Schools as Congregate Care Centers/Technological Hazard

Table 3 of schools by scorec					
Controlling for haz_type=Technological Hazard					
schools (Were schools used as congregate care centers?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	2 8.00 40.00 20.00	0 0.00 0.00 0.00	3 12.00 60.00 75.00	0 0.00 0.00 0.00	5 20.00
Yes	8 32.00 40.00 80.00	10 40.00 50.00 100.00	1 4.00 5.00 25.00	1 4.00 5.00 100.00	20 80.00
Total	10 40.00	10 40.00	4 16.00	1 4.00	25 100.00
Frequency Missing = 8					

Table K-10. Unavailability of Major Roadways/Natural Disaster

Table 1 of road_haz by scorec					
Controlling for haz_type=Natural Disaster					
road_haz (Were any major roadways unavailable for use?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	1 7.14 14.29 100.00	4 28.57 57.14 57.14	1 7.14 14.29 33.33	1 7.14 14.29 33.33	7 50.00
Yes	0 0.00 0.00 0.00	3 21.43 42.86 42.86	2 14.29 28.57 66.67	2 14.29 28.57 66.67	7 50.00
Total	1 7.14	7 50.00	3 21.43	3 21.43	14 100.00

Table K-11. Unavailability of Major Roadways/Malevolent Act

Table 2 of road_haz by scorec					
Controlling for haz_type=Malevolent Act					
road_haz (Were any major roadways unavailable for use?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	1 50.00 100.00 100.00	0 0.00 0.00 .	0 0.00 0.00 .	0 0.00 0.00 0.00	1 50.00
Yes	0 0.00 0.00 0.00	0 0.00 0.00 .	0 0.00 0.00 .	1 50.00 100.00 100.00	1 50.00
Total	1 50.00	0 0.00	0 0.00	1 50.00	2 100.00
Frequency Missing = 1					

. = could not be calculated

Table K-12. Unavailability of Major Roadways/Technological Hazard

Table 3 of road_haz by scorec					
Controlling for haz_type=Technological Hazard					
road_haz (Were any major roadways unavailable for use?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	11 35.48 45.83 84.62	8 25.81 33.33 66.67	4 12.90 16.67 80.00	1 3.23 4.17 100.00	24 77.42
Yes	2 6.45 28.57 15.38	4 12.90 57.14 33.33	1 3.23 14.29 20.00	0 0.00 0.00 0.00	7 22.58
Total	13 41.94	12 38.71	5 16.13	1 3.23	31 100.00
Frequency Missing = 2					

Table K-13. Regular Conduct of Emergency Drills and Exercises/Natural Disaster

Table 1 of drills by scorec Controlling for haz_type=Natural Disaster					
drills (Do the community's emergency response agencies regularly conduct emergency drills and exercises?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	1 7.69 100.00 100.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 7.69
Yes	0 0.00 0.00 0.00	6 46.15 50.00 100.00	3 23.08 25.00 100.00	3 23.08 25.00 100.00	12 92.31
Total	1 7.69	6 46.15	3 23.08	3 23.08	13 100.00
Frequency Missing = 1					

Table K-14. Regular Conduct of Emergency Drills and Exercises/Malevolent Act

Table 2 of drills by scorec Controlling for haz_type=Malevolent Act					
drills (Do the community's emergency response agencies regularly conduct emergency drills and exercises?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	0 0.00 . 0.00	0 0.00 . 0.00	0 0.00 . .	0 0.00 . 0.00	0 0.00
Yes	1 33.33 33.33 100.00	1 33.33 33.33 100.00	0 0.00 0.00 .	1 33.33 33.33 100.00	3 100.00
Total	1 33.33	1 33.33	0 0.00	1 33.33	3 100.00

. = could not be calculated

Table K-15. Regular Conduct of Emergency Drills and Exercises/Technological Hazard

Table 3 of drills by scorec Controlling for haz_type=Technological Hazard					
drills (Do the community's emergency response agencies regularly conduct emergency drills and exercises?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	4 12.12 66.67 28.57	0 0.00 0.00 0.00	2 6.06 33.33 40.00	0 0.00 0.00 0.00	6 18.18
Yes	10 30.30 37.04 71.43	13 39.39 48.15 100.00	3 9.09 11.11 60.00	1 3.03 3.70 100.00	27 81.82
Total	14 42.42	13 39.39	5 15.15	1 3.03	33 100.00

Table K-16. Whether Area Is More Prone to Hazards than Average/Natural Disaster

Table 1 of prone_haz by scorec Controlling for haz_type=Natural Disaster					
prone_haz (Is the area more prone to hazards than average?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	0 0.00 0.00 0.00	1 7.14 100.00 14.29	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 7.14
Yes	1 7.14 7.69 100.00	6 42.86 46.15 85.71	3 21.43 23.08 100.00	3 21.43 23.08 100.00	13 92.86
Total	1 7.14	7 50.00	3 21.43	3 21.43	14 100.00

Table K-17. Whether Area Is More Prone to Hazards than Average/Malevolent Act

Table 2 of prone_haz by scorec					
Controlling for haz_type=Malevolent Act					
prone_haz (Is the area more prone to hazards than average?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 .	1 33.33 100.00 100.00	1 33.33
Yes	1 33.33 50.00 100.00	1 33.33 50.00 100.00	0 0.00 0.00 .	0 0.00 0.00 0.00	2 66.67
Total	1 33.33	1 33.33	0 0.00	1 33.33	3 100.00

. = could not be calculated

Table K-18. Whether Area Is More Prone to Hazards than Average/Technological Hazard

Table 3 of prone_haz by scorec					
Controlling for haz_type=Technological Hazard					
prone_haz (Is the area more prone to hazards than average?)	scorec				
Frequency Percent Row Pct Col Pct	0 issues	1 issue	2 issues	3 or more issues	Total
No	6 18.18 54.55 42.86	5 15.15 45.45 38.46	0 0.00 0.00 0.00	0 0.00 0.00 0.00	11 33.33
Yes	8 24.24 36.36 57.14	8 24.24 36.36 61.54	5 15.15 22.73 100.00	1 3.03 4.55 100.00	22 66.67
Total	14 42.42	13 39.39	5 15.15	1 3.03	33 100.00

APPENDIX L

CROSS TABULATIONS FOR VARIABLES IN THE CORRELATION ANALYSIS

CONTENTS

Introduction

The results of the correlation analysis are contained in Appendix L. Correlation coefficients were calculated for variables suspected of having a correlation to one of the variables used to define the evacuation efficiency score. Data preparation and analysis were carried out using SAS 8.02 for Windows.

Table L-1. Traffic Accidents/Issues

Table of traff_accid by traff_prob			
traff_accid (Traffic accidents during the evacuations?)	traff_prob (Were there any special traffic problems encountered?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	4 8.00 66.67 11.11	2 4.00 33.33 14.29	6 12.00
No	31 62.00 77.50 86.11	9 18.00 22.50 64.29	40 80.00
Yes	1 2.00 25.00 2.78	3 6.00 75.00 21.43	4 8.00
Total	36 72.00	14 28.00	50 100.00

Table L-2. Road Hazards/Issues

Table of road_haz by traff_prob			
road_haz (Were any major roadways unavailable for use?)	traff_prob (Were there any special traffic problems encountered?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	3 6.00 100.00 8.33	0 0.00 0.00 0.00	3 6.00
No	26 52.00 81.25 72.22	6 12.00 18.75 42.86	32 64.00
Yes	7 14.00 46.67 19.44	8 16.00 53.33 57.14	15 30.00
Total	36 72.00	14 28.00	50 100.00

Table L-3. Evacuations Instructions/Issues

Table of evac_instruct by traff_prob			
evac_instruct (Were people given specific instructions about where to go when they evacuated?)	traff_prob(Were there any special traffic problems encountered?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	2 4.00 50.00 5.56	2 4.00 50.00 14.29	4 8.00
No	2 4.00 28.57 5.56	5 10.00 71.43 35.71	7 14.00
Yes	32 64.00 82.05 88.89	7 14.00 17.95 50.00	39 78.00
Total	36 72.00	14 28.00	50 100.00

Table L-4. Instructions to Use Specific Routes/Issues

Table of evac_route by traff_prob			
evac_route (Were people told to use specific routes?)	traff_prob (Were there any special traffic problems encountered?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	3 6.00 75.00 8.33	1 2.00 25.00 7.14	4 8.00
No	8 16.00 53.33 22.22	7 14.00 46.67 50.00	15 30.00
Yes	25 50.00 80.65 69.44	6 12.00 19.35 42.86	31 62.00
Total	36 72.00	14 28.00	50 100.00

Table L-5. Ad Hoc Command, Control, and Coordination Processes/Traffic Issues

Table of adhoc by traff_prob			
adhoc (Ad hoc command, control and coordination processes)	traff_prob (Were there any special traffic problems encountered?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
No	28 56.00 73.68 77.78	10 20.00 26.32 71.43	38 76.00
Yes	8 16.00 66.67 22.22	4 8.00 33.33 28.57	12 24.00
Total	36 72.00	14 28.00	50 100.00

Table L-6. Evacuations from Outside Designated Areas/Special Traffic Issues

Table of shad_evac by traff_prob			
shad_evac (Did people evacuate from areas outside the designated evacuation area?)	traff_prob (Were there any special traffic problems encountered?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	7 14.00 87.50 19.44	1 2.00 12.50 7.14	8 16.00
No	18 36.00 75.00 50.00	6 12.00 25.00 42.86	24 48.00
Yes	11 22.00 61.11 30.56	7 14.00 38.89 50.00	18 36.00
Total	36 72.00	14 28.00	50 100.00

Table L-7. Crossing of Political (County, State) Boundaries/Decision-Making Issues

Table of bdry_crss by decis_prob			
bdry_crss (Were political boundaries crossed (i.e., more than one county or state involved)?)	decis_prob (Were there problems with decision making process?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	4 8.00 80.00 9.09	1 2.00 20.00 16.67	5 10.00
No	23 46.00 88.46 52.27	3 6.00 11.54 50.00	26 52.00
Yes	17 34.00 89.47 38.64	2 4.00 10.53 33.33	19 38.00
Total	44 88.00	6 12.00	50 100.00

Table L-8. Ad Hoc Command, Control, and Coordination Processes/Decision-Making Issues

Table of adhoc by decis_prob			
adhoc (Ad hoc command, control and coordination processes)	decis_prob (Were there problems with decision making process?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
No	33 66.00 86.84 75.00	5 10.00 13.16 83.33	38 76.00
Yes	11 22.00 91.67 25.00	1 2.00 8.33 16.67	12 24.00
Total	44 88.00	6 12.00	50 100.00

Table L-9. Communication Between Field Emergency Responders and EOC by Radio/Communications Issues

Table of radio by comm_prob				
radio (Was communication between field emergency responders and EOC by radio?)	comm_prob (Were there problems with communications?)			
Frequency Percent Row Pct Col Pct	Unknown	No	Yes	Total
No	0 0.00 0.00 0.00	2 4.00 66.67 5.71	1 2.00 33.33 7.14	3 6.00
Yes	1 2.00 2.13 100.00	33 66.00 70.21 94.29	13 26.00 27.66 92.86	47 94.00
Total	1 2.00	35 70.00	14 28.00	50 100.00

Table L-10. Communication Between Field Emergency Responders and EOC by Telephone/Communications Issues

Table of telephone by comm_prob				
telephone (Was communication between field emergency responders and EOC by telephone?)	comm_prob (Were there problems with communications?)			
Frequency Percent Row Pct Col Pct	Unknown	No	Yes	Total
No	1 2.00 2.33 100.00	31 62.00 72.09 88.57	11 22.00 25.58 78.57	43 86.00
Yes	0 0.00 0.00 0.00	4 8.00 57.14 11.43	3 6.00 42.86 21.43	7 14.00
Total	1 2.00	35 70.00	14 28.00	50 100.00

Table L-11. Communication Between Field Emergency Responders and EOC by Cell Phone/Communications Issues

Table of cell_phone by comm_prob				
cell_phone (Was communication between field emergency responders and EOC by cell phone?)	comm_prob (Were there problems with communications?)			
Frequency Percent Row Pct Col Pct	Unknown	No	Yes	Total
No	1 2.00 3.23 100.00	21 42.00 67.74 60.00	9 18.00 29.03 64.29	31 62.00
Yes	0 0.00 0.00 0.00	14 28.00 73.68 40.00	5 10.00 26.32 35.71	19 38.00
Total	1 2.00	35 70.00	14 28.00	50 100.00

Table L-12. Communication Between Field Emergency Responders and EOC by Pager/Communications Issues

Table of pager by comm_prob				
pager (Was communication between field emergency responders and EOC by pager?)	comm_prob (Were there problems with communications?)			
Frequency Percent Row Pct Col Pct	Unknown	No	Yes	Total
No	1 2.00 2.04 100.00	34 68.00 69.39 97.14	14 28.00 28.57 100.00	49 98.00
Yes	0 0.00 0.00 0.00	1 2.00 100.00 2.86	0 0.00 0.00 0.00	1 2.00
Total	1 2.00	35 70.00	14 28.00	50 100.00

Table L-13. Communication Between Field Emergency Responders and EOC/Communications Issues

Table of multiple by comm_prob				
multiple (Was communication between field emergency responders and EOC by multiple ways?)	comm_prob (Were there problems with communications?)			
Frequency Percent Row Pct Col Pct	Unknown	No	Yes	Total
No	1 2.00 3.33 100.00	20 40.00 66.67 57.14	9 18.00 30.00 64.29	30 60.00
Yes	0 0.00 0.00 0.00	15 30.00 75.00 42.86	5 10.00 25.00 35.71	20 40.00
Total	1 2.00	35 70.00	14 28.00	50 100.00

Table L-14. Ad Hoc Command, Control, and Coordination Processes/Communications Issues

Table of adhoc by comm_prob				
adhoc (Ad hoc command, control and coordination processes)	comm_prob (Were there problems with communications?)			
Frequency Percent Row Pct Col Pct	Unknown	No	Yes	Total
No	1 2.00 2.63 100.00	28 56.00 73.68 80.00	9 18.00 23.68 64.29	38 76.00
Yes	0 0.00 0.00 0.00	7 14.00 58.33 20.00	5 10.00 41.67 35.71	12 24.00
Total	1 2.00	35 70.00	14 28.00	50 100.00

Table L-15. Notification of Public by Siren/Warning and Subsequent Citizen Action Issues

Table of sirens_pn by warn_prob			
sirens_pn (Was the public notified by a siren?)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	31 62.00 73.81 81.58	11 22.00 26.19 91.67	42 84.00
Yes	6 12.00 85.71 15.79	1 2.00 14.29 8.33	7 14.00
Total	38 76.00	12 24.00	50 100.00

Table L-16. Notification of Public by Telephone/Special Issues Regarding Warning and Subsequent Citizen Action

Table of telephone_pn by warn_prob			
telephone_pn (Was the public notified by telephone)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	29 58.00 78.38 76.32	8 16.00 21.62 66.67	37 74.00
Yes	8 16.00 66.67 21.05	4 8.00 33.33 33.33	12 24.00
Total	38 76.00	12 24.00	50 100.00

Table L-17. Notification of Public by Radio/Special Issues Regarding Warning and Subsequent Citizen Action

Table of radio_tv_pn by warn_prob			
radio_tv_pn (Was the public notified by radio/TV?)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	17 34.00 68.00 44.74	8 16.00 32.00 66.67	25 50.00
Yes	20 40.00 83.33 52.63	4 8.00 16.67 33.33	24 48.00
Total	38 76.00	12 24.00	50 100.00

Table L-18. Notification of Public by Emergency Broadcast/Special Issues Regarding Warning and Subsequent Citizen Action

Table of ebs_pn by warn_prob			
ebs_pn (Was the public notified by emergency broadcast system?)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	36 72.00 75.00 94.74	12 24.00 25.00 100.00	48 96.00
Yes	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
Total	38 76.00	12 24.00	50 100.00

Table L-19. Notification of Public by PA System/Special Issues Regarding Warning and Subsequent Citizen Action

Table of pa_system_pn by warn_prob			
pa_system_pn (Was the public notified by a PA system?)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	15 30.00 68.18 39.47	7 14.00 31.82 58.33	22 44.00
Yes	22 44.00 81.48 57.89	5 10.00 18.52 41.67	27 54.00
Total	38 76.00	12 24.00	50 100.00

Table L-20. Notification of Public by NOAA/Special Issues Regarding Warning and Subsequent Citizen Action

Table of noaa_pn by warn_prob			
noaa_pn (Was the public notified by NOAA?)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	37 74.00 77.08 97.37	11 22.00 22.92 91.67	48 96.00
Yes	0 0.00 0.00 0.00	1 2.00 100.00 8.33	1 2.00
Total	38 76.00	12 24.00	50 100.00

Table L-21. Notification of Public by Door-to-Door/Special Issues Regarding Warning and Subsequent Citizen Action

Table of door_door_pn by warn_prob			
door_door_pn (Was the public notified door-to-door?)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	12 24.00 80.00 31.58	3 6.00 20.00 25.00	15 30.00
Yes	25 50.00 73.53 65.79	9 18.00 26.47 75.00	34 68.00
Total	38 76.00	12 24.00	50 100.00

Table L-22. Notification of Public by Multiple Methods/Special Issues Regarding Warning and Subsequent Citizen Action

Table of multiple_pn by warn_prob			
multiple_pn (Was the public notified by multiple methods?)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
Unknown	1 2.00 100.00 2.63	0 0.00 0.00 0.00	1 2.00
No	10 20.00 71.43 26.32	4 8.00 28.57 33.33	14 28.00
Yes	27 54.00 77.14 71.05	8 16.00 22.86 66.67	35 70.00
Total	38 76.00	12 24.00	50 100.00

Table L-23. Ad Hoc Command, Control, and Coordination Processes/ Special Issues Regarding Warning and Subsequent Citizen Action

Table of adhoc by warn_prob			
adhoc (Ad hoc command, control and coordination processes)	warn_prob (Were there any special problems regarding warning and subsequent citizen action?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
No	29 58.00 76.32 76.32	9 18.00 23.68 75.00	38 76.00
Yes	9 18.00 75.00 23.68	3 6.00 25.00 25.00	12 24.00
Total	38 76.00	12 24.00	50 100.00

Table L-24. Instances of Looting or Vandalism/Issues with Law Enforcement

Table of loot_vand by law_prob			
loot_vand (Were there any instances of looting or vandalism?)	law_prob (Were there any problems with law enforcement?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
No	44 88.00 97.78 93.62	1 2.00 2.22 33.33	45 90.00
Yes	3 6.00 60.00 6.38	2 4.00 40.00 66.67	5 10.00
Total	47 94.00	3 6.00	50 100.00

Table L-25. Use of National Guard for Law Enforcement/Issue with Law Enforcement

Table of nat_guard by law_prob			
nat_guard (Was the National Guard used for law enforcement?)	law_prob (Were there any problems with law enforcement?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
No	40 80.00 97.56 85.11	1 2.00 2.44 33.33	41 82.00
Yes	7 14.00 77.78 14.89	2 4.00 22.22 66.67	9 18.00
Total	47 94.00	3 6.00	50 100.00

Table L-26. Use of Police for Law Enforcement/Issues with Law Enforcement

Table of police by law_prob			
police (Were the police used for law enforcement?)	Law_prob (Were there any problems with law enforcement?)		
Frequency Percent Row Pct Col Pct	No	Yes	Total
0	48.00 100.00 8.51	0 0.00 0.00 0.00	48.00
1	43 86.00 93.48 91.49	3 6.00 6.52 100.00	46 9 2.00
Total	47 94.00	3 6.00	50 100.00

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D. Schneck, NRC Project Manager

11. ABSTRACT *(200 words or less)*

This study examines the efficiency and effectiveness of public evacuations of 1,000 or more people, in response to natural disasters, technological hazards, and malevolent acts, occurring in the United States between January 1, 1990 and June 30, 2003. A universe of 230 evacuation incidents was identified and a subset of 50 incidents was selected for case study analysis. Case study selection was based on a profiling and ranking scheme designed to identify evacuation incidents of sufficient complexity to challenge the local and regional emergency response capabilities. Case study analysis included completion of a detailed survey for each incident. Advanced statistical methods, including Fisher's exact test, multiple ordinal logistic regression analysis, and correlation analysis, were used to identify factors contributing to evacuation efficiency. The analysis identified that community familiarity with alerting methods and door-to-door notification were statistically significant for a more efficient evacuation. The following factors were statistically significant for a less efficient evacuation: traffic accidents, number of deaths from the hazard, number of injuries caused by the evacuation, people spontaneously evacuating before being told to do so, people refusing to evacuate, and looting or vandalism. All 50 evacuation cases studied safely evacuated people from the area, saved lives, and reduced the potential number of injuries from the hazard.

Volume I contains the Main Report. Volume II contains appendices supporting case studies.

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