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U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

November 1, 1982

SUBCOMMITTEE ON
OVERSIGHT & INVESTIGATIONS

CALCULATION OF REACTOR ACCIDENT CONSEQUENCES (CRAC2) FOR U.S. NUCLEAR POWER PLANTS (HEALTH EFFECTS AND COSTS) CONDITIONAL ON AN "SST1" RELEASE

	POWER[1] LEVEL (MWe)	PEAK[2] EARLY FATALITIES[4]	PEAK[2] EARLY INJURIES[5]	PEAK[2] CANCER DEATHS[6]	PEAK[2] FATAL RADIUS[7] (MILES)	PEAK[2] INJURY RADIUS[8] (MILES)	SCALED[3] COSTS (BILLIONS 1980 $)
ARKANSAS NUCLEAR ONE, Units 1 & 2, Russelville, AR							
NRC Result[9]	1120	2,550	6,010	3,380	17.5	35	-----
#1 Scaled[10]	836	1,900	3,400	2,900	----	--	68.1
#2 Scaled	912	2,100	4,000	3,000	----	--	84.9
BEAVER VALLEY, Units 1 & 2, Shippingport, PA							
NRC Result	1120	24,400	271,000	28,600	20	55	-----
#1 Scaled	833	19,000	156,000	24,000	----	--	122.0
#2 Scaled	833	19,000	156,000	24,000	----	--	*[11]
BELLEFONTE, Units 1 & 2, Scottsboro, AL							
NRC Result	1120	3,300	6,900	4,290	20	50	-----
#1 Scaled	1213	3,600	7,700	4,500	----	--	86.1
#2 Scaled	1213	3,600	7,700	4,500	----	--	82.7

BIG ROCK POINT, Charlevoix, MI

NRC Result	1120	3,450	6,030	10,900	12.5	40	-----
Scaled[12]	63	120	10	450	----	--	13.2

BRAIDWOOD, Units 1 & 2, Joliet, IL

NRC Result	1120	6,750	63,300	14,200	15	60	-----
#1 Scaled	1120	6,750	63,300	14,200	----	--	127.0
#2 Scaled	1120	6,750	63,300	14,200	----	--	122.0

BROWNS FERRY, Units 1, 2, & 3, Decatur, AL

NRC Result	1120	19,400	47,700	4,020	20	30	-----
#1 Scaled	1067	18,000	42,000	3,800	----	--	67.3
#2 Scaled	1067	18,000	42,000	3,800	----	--	69.1
#3 Scaled	1067	18,000	42,000	3,800	----	--	73.0

BRUNSWICK, Units 1 & 2, Brunswick, NC

NRC Result	1120	10,100	33,700	5,480	20	45	-----
#1 Scaled	790	7,500	18,000	4,600	----	--	56.5
#2 Scaled	790	7,500	18,000	4,600	----	--	53.9

BYRON, Units 1 & 2, Rockford, IL

NRC Result	1120	9,050	79,300	15,300	15	60	-----
#1 Scaled	1120	9,050	79,300	15,300	----	--	114.0
#2 Scaled	1120	9,050	79,300	15,300	----	--	114.0

CALLAWAY, Unit 1, Callaway, MO

NRC Result	1120	11,300	31,000	9,430	17.5	35	-----
#1 Scaled	1150	11,500	32,000	9,600	----	--	110.0

	70	-----	CALVERT CLIFFS, Units 1 & 2, Lusby, MD			
-	--	84.0	NRC Result	1120	7,090	25,900	27.3
			#1 Scaled	850	5,600	15,000	23.0
			#2 Scaled	850	5,600	15,000	23.0
5	35	-----	CATAWBA, Units 1 & 2, Rock Hill, SC			
--	--	155.0	NRC Result	1120	41,900	87,400	5,8[illegible]
--	--	158:0	#1 Scaled	1145	42,000	88,000	5,80
			#2 Scaled	1145	42,000	88,000	5,80
	60	-----	CLINTON, Clinton, IL			
--	--	23.5	NRC Result	1120	1,940	44,700	14,70
--	--	87.4	Scaled	950	1,600	32,000	13,000
--	--	89.6	COMMANCHE PEAK, Unit 1, Glen Rose, TX			
			NRC Result	1120	1,210	13,800	4,710
	35	-----	#1 Scaled	1150	1,200	14,000	4,800
--	--	53.8	COOK, Units 1 & 2, Bridgman, IL			
			NRC Result	1120	2,060	92,700	13,400
	40	-----	#1 Scaled	1054	1,900	80,000	13,000
-	--	52.2	#2 Scaled	1094	2,000	88,000	13,000
-	--	58.1	COOPER, Brownsville, NB			
			NRC Result	1120	2,220	5,420	3,790
	70	-----	Scaled	778	1,600	2,800	3,100
-	--	135.0	CRYSTAL RIVER, Unit 3, Red Level, FL			
			NRC Result	1120	1,160	6,630	3,310
			#3 Scaled	825	900	3,800	2,800

DAVIS-BESSE, Ottawa, OH

NRC Result	1120	1,790	110,000	11,600	15	70	-----
Scaled	906	1,400	73,000	10,000	----	--	84.0

DIABLO CANYON, Units 1 & 2, San Luis Obispo, CA

NRC Result	1120	10,600	12,400	13,000	17.5	35	-----
#1 Scaled	1084	10,000	11,000	12,000	----	--	155.0
#2 Scaled	1106	10,000	12,000	12,000	----	--	158.0

DRESDEN, Units 1, 2, & 3, Morris, IL

NRC Result	1120	56,600	71,400	15,900	15	60	-----
#1 Scaled[13]	200	6,000	4,000	5,000	----	--	23.5
#2 Scaled	800	42,000	39,000	13,000	----	--	87.4
#3 Scaled	800	42,000	39,000	13,000	----	--	89.6

DUANE ARNOLD, Palo, IA

NRC Result	1120	6,790	37,800	11,400	25	35	-----
Scaled	545	2,900	12,000	7,000	----	--	53.8

FARLEY, Units 1 & 2, Dothan, AL

NRC Result	1120	15,100	19,600	3,370	20	40	-----
#1 Scaled	860	12,000	12,000	2,900	----	--	52.0
#2 Scaled	860	12,000	12,000	2,900	----	--	[illegible]

FERMI, Unit 2, Laguna Beach, MI

NRC Result	1120	8,150	349,000	13,700	15	70	-----
#2 Scaled	1100	8,000	340,000	13,000	----	--	136.0

FITZPATRICK, Scriba, NY

NRC Result	1120	1,520	28,800	20,600	12.5	40	-----
Scaled	821	1,000	16,000	17,000	----	--	103.0

FORT CALHOUN, Washington, NB

NRC Result	1120	8,080	129,000	5,930	25	35	-----
Scaled	457	3,000	32,000	3,000	----	--	43.5

FORT ST. VRAIN, Fort St. Vrain, CO

NRC Result	1120	17,200	22,800	3,180	17.5	65	-----
Scaled[14]	330	3,000	3,000	1,000	----	--	38.8

GINNA, Ontario, NY

NRC Result	1120	5,480	98,900	23,400	12.5	40	-----
Scaled	490	2,000	28,000	14,000	----	--	63.0

GRAND GULF, Units 1 & 2, Vicksburg, MS

NRC Result	1120	3,890	8,220	3,500	20	40	-----
#1 Scaled	1250	4,500	10,000	3,800	----	--	83.0
#2 Scaled	1250	4,500	10,000	3,800	----	--	70.7

HADDAM NECK, Haddam Neck, CT

NRC Result	1120	60,600	144,000	34,500	17.5	50	-----
Scaled	575	29,000	50,000	23,000	----	--	74.[illegible]

HATCH, Units 1 & 2, Baxley, GA

NRC Result	1120	972	8,280	4,470	20	70	-----
#1 Scaled	786	700	4,000	3,000	----	--	51.0
#2 Scaled	786	700	4,000	3,000	----	--	56.0

INDIAN POINT, Units 2 & 3, Buchanan, NY

NRC Result	1120	56,600	227,000	15,600	17.5	50	-----
#2 Scaled	873	46,000	141,000	13,000	----	--	274.0
#3 Scaled	965	50,000	167,000	14,000	----	--	314.0

KEWAUNEE, Carlton, WI

NRC Result	1120	2,190	53,200	12,400	12.5	40	-----
Scaled	535	900	17,000	8,000	----	--	46.9

LASALLE, Units 1 & 2, Ottawa, IL

NRC Result	1120	14,900	13,900	15,300	15	60	-----
#1 Scaled	1078	14,000	12,000	15,000	----	--	118.0
#2 Scaled	1078	14,000	12,000	15,000	----	--	120.0

LACROSSE, La Crosse, WI

NRC Result	1120	3,090	14,600	6,610	15	35	-----
Scaled[15]	50	70	400	200	----	--	16.0

LIMERICK, Units 1 & 2, Montgomery, PA

NRC Result	1120	77,700	710,000	35,500	20	55	-----
#1 Scaled	1055	74,000	610,000	34,000	----	--	213.0
#2 Scaled	1055	74,000	610,000	34,000	----	--	197.0

MAINE YANKEE, Wiscasset, ME

NRC Result	1120	11,600	19,400	25,600	15	35	-----
Scaled	790	8,000	10,000	21,000	----	--	78.5

MARBLE HILL, Units 1 & 2, Jefferson, IN

NRC Result	1120	12,300	158,000	8,510	15	60	-----
#1 Result	1130	12,000	150,000	8,000	----	--	87.2
#2 Result	1130	12,000	150,000	8,000	----	--	83.8

MCGUIRE, Units 1 & 2, Cornelius, NC

NRC Result	1120	11,600	19,400	25,600	15	35	-----
#1 Scaled	1180	12,000	21,000	26,000	----	--	106.0
#2 Scaled	1180	12,000	21,000	26,000	----	--	110.0

MIDLAND, Units 1 & 2, Midland, MI

NRC Result	1120	10,300	36,200	12,400	12.5	40	-----
#1 Scaled	530	4,000	11,000	8,000	----	--	56.1
#2 Scaled	805	7,000	20,000	10,000	----	--	80.4

MILLSTONE, Units 1, 2, & 3, Waterford, CT

NRC Result	1120	23,000	28,800	37,300	20	65	-----
#1 Scaled	660	13,000	12,000	28,000	----	--	91.5
#2 Scaled	870	18,000	18,000	33,000	----	--	135.0
#3 Scaled	1150	23,000	30,000	38,000	----	--	174.0

MONTICELLO, Monticello, MN

NRC Result	1120	1,310	30,900	6,470	15	35	-----
Scaled	536	500	10,000	4,000	----	--	44.6

NINE MILE POINT, Units 1 & 2, Scriba, NY

NRC Result	1120	1,520	28,800	20,600	12.5	40	-----
#1 Scaled	610	800	11,000	14,000	----	--	65.2
#2 Scaled	1080	1,400	26,000	20,000	----	--	134.0

NORTH ANNA, Units 1 & 2, Mineral, VA

NRC Result	1120	2,290	9,320	33,900	20	55	-----
#1 Scaled	850	1,800	5,000	29,000	----	--	66.0
#2 Scaled	850	1,800	5,000	29,000	----	--	60.3

OCONEE, Units 1, 2, & 3, Seneca, SC

NRC Result	1120	5,630	76,400	4,940	20	30	-----
#1 Scaled	860	4,000	47,000	4,000	----	--	56.8
#2 Scaled	860	4,000	47,000	4,000	----	--	58.3
#3 Scaled	860	4,000	47,000	4,000	----	--	58.3

OYSTER CREEK, Toms River, NJ

NRC Result	1120	24,300	26,700	32,200	17.5	50	-----
Scaled	620	13,000	10,000	23,000	----	--	79.8

PALISADES, South Haven, MI

NRC Result	1120	1,700	15,000	13,000	----	--	-----
Scaled	740	1,000	7,000	10,000	----	--	52.6

PALO VERDE, Units 1, 2, & 3, Maricopa, AZ

NRC Result	1120	3,590	29,500	14,000	20	50	-----
#1 Scaled	1270	4,000	36,000	15,000	----	--	89.7
#2 Scaled	1270	4,000	36,000	15,000	----	--	85.1
#3 Scaled	1270	4,000	36,000	15,000	----	--	79.5

PEACH BOTTOM, Units 2 & 3, Peach Bottom, PA

NRC Result	1120	74,500	50,900	37,900	20	55	-----
#2 Scaled	1065	72,000	45,000	37,000	----	--	119.0
#3 Scaled	1065	72,000	45,000	37,000	----	--	119.0

PERRY, Units 1 & 2, Painesville, OH

NRC Result	1120	4,960	166,000	13,200	15	70	-----
#1 Scaled	1205	5,500	180,000	14,000	----	--	102.0
#2 Scaled	1205	5,500	180,000	14,000	----	--	86.8

PILGRIM, Unit 1, Plymouth, MA

NRC Result	1120	5,170	72,800	30,600	20	65	-----
#1 Scaled	670	3,000	30,000	23,000	----	--	81.8

POINT BEACH, Units 1 & 2, Two Creeks, WI

NRC Result	1120	1,290	39,000	12,400	12.5	40	-----
#1 Scaled	497	500	9,000	7,000	----	--	41.4
#2 Scaled	497	500	9,000	7,000	----	--	43.8

PRAIRIE ISLAND, Units 1 & 2, Red Wing, MN

NRC Result	1120	5,700	13,400	9,620	15	35	-----
#1 Scaled	520	2,000	4,000	4,000	----	--	48.3
#2 Scaled	520	2,000	4,000	4,000	----	--	49.5

QUAD CITIES, Units 1 & 2, Cordova, IL

NRC Result	1120	16,800	76,400	15,100	15	60	-----
#1 Scaled	800	12,000	41,000	12,000	----	--	65.1
#2 Scaled	800	12,000	41,000	12,000	----	--	65.1

RANCHO SECO, Clay Station, CA

NRC Result	1120	35,700	50,400	6,760	20	45	-----
Scaled	913	30,000	34,000	6,000	----	--	113.0

ROBINSON, Hartsville, SC

NRC Result	1120	3,400	19,600	4,410	20	30	-----
Scaled	665	2,000	8,000	3,000	----	--	42.5

ST. LUCIE, Units 1 & 2, Ft. Pierce, FL

NRC Result	1120	7,510	12,400	4,220	20	70	-----
#1 Scaled	777	5,000	6,000	3,000	----	--	54.3
#2 Scaled	777	5,000	6,000	3,000	----	--	59.1

SALEM, Units 1 & 2, Salem, NJ

NRC Result	1120	102,000	75,700	41,500	20	55	-----
#1 Scaled	1090	100,000	70,000	40,000	----	--	135.0
#2 Scaled	1115	100,000	75,000	40,000	----	--	150.0

SAN ONOFRE, Units 1, 2, & 3, San Clemente, CA

NRC Result	1120	27,800	24,300	19,200	17.5	35	-----
#1 Scaled	436	8,000	6,000	10,000	----	--	58.8
#2 Scaled	1100	27,000	23,000	18,000	----	--	186.0
#3 Scaled	1100	27,000	23,000	18,000	----	--	182.0

SEABROOK, Units 1 & 2, Seabrook, NH

NRC Result	1120	6,880	26,800	6,250	20	65	-----
#1 Scaled[16]	1150	7,000	27,000	6,000	----	--	163.0
#2 Scaled	1150	7,000	27,000	6,000	----	--	150.0

SEQUOYAH, Units 1 & 2, Daisy, TN

NRC Result	1120	29,500	60,600	4,630	20	30	-----
#1 Scaled	1148	29,000	61,000	4,700	----	--	95.8
#2 Scaled	1148	29,000	61,000	4,700	----	--	98.6

SHEARON HARRIS, Units 1 & 2, Apex, NC

NRC Result	1120	13,400	46,300	6,850	20	30	-----
#1 Scaled	900	11,000	31,000	6,000	----	--	68.5
#2 Scaled	900	11,000	31,000	6,000	----	--	47.8

SHOREHAM, Wading River, NY

NRC Result	1120	53,600	130,000	41,300	17.5	50	-----
Scaled	820	40,000	75,000	35,000	----	--	157.0

SOUTH TEXAS, Units 1 & 2, South Texas, TX

NRC Result	1120	15,200	8,770	3,900	25	35	-----
#1 Scaled	1250	18,000	10,000	4,000	----	--	112.0
#2 Scaled	1250	18,000	10,000	4,000	----	--	104.0

SUMMER, Unit 1, Fairfield, SC

NRC Result	1120	6,280	110,000	4,500	20	30	-----
#1 Scaled	900	5,000	73,000	4,000	----	--	68.2

SURRY, Units 1 & 2, Gravel Neck, VA

NRC Result	1120	42,900	69,500	28,000	20	55	-----
#1 Scaled	775	31,000	36,000	23,000	----	--	56.3
#2 Scaled	775	31,000	36,000	23,000	----	--	57.8

SUSQUEHANNA, Units 1 & 2, Berwick, PA

NRC Result	1120	70,600	53,900	29,200	20	55	-----
#1 Scaled	1050	67,000	47,000	28,000	----	--	143.0
#2 Scaled	1050	67,000	47,000	28,000	----	--	137.0

THREE MILE ISLAND, Units 1 & 2, Middletown, PA

NRC Result	1120	56,100	90,800	31,500	20	55	-----
#1 Scaled[17]	792	42,000	50,000	26,000	----	--	102.0
#2 Scaled[18]	880	46,000	57,000	28,000	----	--	122.0

TROJAN, Prescott, OR

NRC Result	1120	1,110	14,300	5,300	17.5	30	-----
Scaled	1130	1,000	14,000	5,000	----	--	89.7

TURKEY POINT, Units 3 & 4, Florida City, FL

NRC Result	1120	48,500	106,000	5,550	20	70	-----
#3 Scaled	666	29,000	45,000	4,000	----	--	43.6
#4 Scaled	666	29,000	45,000	4,000	----	--	48.6

VERMONT YANKEE, Vernon, VT

NRC Result	1120	19,300	11,100	27,800	15	35	-----
Scaled	514	7,000	3,000	17,000	----	--	68.8

VOGTLE, Units 1 & 2, Burke, GA

NRC Result	1120	241	40,800	4,510	20	70	-----
#1 Scaled	1100	200	39,000	4,000	----	--	70.3
#2 Scaled	1100	200	39,000	4,000	----	--	62.3

WATERFORD, Unit 3, St. Charles, LA

NRC Result	1120	90,400	253,000	9,230	20	40	-----
#3 Scaled	1155	96,000	279,000	9,000	----	--	131.0

WATTS BAR, Units 1 & 2, Rhea, TN

NRC Result	1120	5,340	11,100	4,580	20	30	-----
#1 Scaled	1100	5,000	11,000	4,000	----	--	85.6
#2 Scaled	1100	5,000	11,000	4,000	----	--	83.3

WPPSS, Unit 1, Richland, WA

NRC Result	1120	216	17,000	3,750	17.5	30	-----
#1 Scaled	1250	200	20,000	4,000	----	--	80.4

WPPSS, Unit 2, Benton, WA

NRC Result	1120	300	14,700	3,850	17.5	30	-----
#2 Scaled	1250	300	17,000	4,000	----	--	77.3

WPPSS, Unit 3, Olympia, WA

NRC Result	1120	173	13,800	3,750	17.5	30	-----
#3 Scaled	1240	173	16,000	4,000	----	--	73.7

WOLF CREEK, Burlington, KS

NRC Result	1120	1,100	3,130	3,620	25	35	-----
Scaled	1150	1,000	3,000	3,000	----	--	105.0

YANKEE ROWE, Rowe, MA

NRC Result	1120	11,200	16,800	29,800	17.5	50	-----
Scaled[19]	175	1,000	100	4,000	----	--	21.4

ZIMMER, Moscow, OH

NRC Result	1120	12,300	196,000	11,800	20	30	-----
Scaled	810	9,000	109,000	10,000	----	--	84.5

ZION, Units 1 & 2, Zion, IL

NRC Result	1120	14,300	181,000	17,100	15	70	-----
#1 Scaled	1100	14,000	155,000	17,000	----	--	146.0
#2 Scaled	1100	14,000	155,000	17,000	----	--	146.0

All figures obtained by the Subcommittee on Oversight and Investigation, House Committee on Interior and Insular Affairs, from the U.S. Nuclear Regulatory Commission from NUREG/CR-2239, SAND81-1549, "Technical Guidance for Siting Criteria Development", D.C. Aldrich, et. al., Sandia National Laboratory (DRAFT), and from NUREG/CR-2723, SAND82-1110, "Estimates of the Financial Consequences of Nuclear Power Reactor Accidents", D.R. Strip, Sandia National Laboratory (DRAFT), and from CRAC2 computer printouts which served as the statistical basis for these reports. These studies were performed by Sandia National Laboratory under contract to the NRC.

All accident consequence figures are based upon the occurrence of a release of radioactivity which is designated by NRC as "SST1". An "SST1" release is projected to result from a core melt accident in which all installed safety equipment fails and the reactor containment structure is breached directly to the atmosphere. The NRC estimates the probability of an SST1 release to be 1:100,000 per reactor year (the above values are thus conditional on the occurrence of an SST1 release). For comparison purposes, the 1975 Reactor Safety Study (WASH-1400) predicted that the probability of a "PWR2" release (similar in many respects to SST1) was 1:125,000.

The probability of the peak consequences is predicted to be lower than this probability by a factor of 100 to 10,000; the lower bound of this range would be about 1 in a billion, which is the probability level at which the Reactor Safety Study (WASH-1400) ceased calculating consequences. The oft-cited "worst case" values of 3,300 fatalities, 45,000 early injuries, 45,000 cancer deaths, and property damage of $14 billion from WASH-1400 were predicted to occur at a probability of 1:1

billion. There are very large uncertainties associated with such probabilities.

Actual site population and wind roses were used together with meteorological records for nearby National Weather Service stations (onsite meteorological data gathering systems were found to produce insufficiently complete data). A "summary evacuation" is assumed for 10 miles around each reactor; "summary evacuation" is a weighted summary of three evacuation scenarios involving an average travel speed of 10 mph away from the reactor with delay times before travel of 1, 3, and 5 hours (weighted 30%, 40%, and 30%, respectively, based on a "best fit" to data in an EPA report on evacuations).[20]

NOTES

1. Power level data taken from NUREG/CR-2239, Appendix A, pages A-2 through A-4. These power levels may differ from those commonly found in the NRC's "Gray Book" (NUREG-0020) and NRC's "Yellow Book" (NUREG-0030). If actual power levels differ from those listed by a significant amount, the estimated consequences would increase or decrease, depending upon the "direction" of the difference between the listed and actual values.

2. "Peak" means the highest calculated value from the CRAC2 computer printouts for the Sandia studies. Peak does not necessarily mean worst case results because the CRAC2 model is acknowledged by its authors to have uncertainties in its meteorological modelling capability. Since the CRAC2 model considers only one year's worth of data and does not model precipitation frequency beyond a distance of 30 miles from the reactor, the model may not adequately characterize the frequency of precipitation events. This is significant for peak consequences since the highest consequences from accidents are predicted to occur when a radioactive plume encounters rain over a relatively densely populated region. The CRAC2 meteorological model is, however, considerably improved from the original CRAC model.

3. Scaled costs taken directly from NUREG/CR-2723, Appendix A. Economic costs which are not included, however, are the cost of providing health care to the affected population, all onsite costs, litigation costs, direct costs of health effects, and indirect costs (NUREG/CR-2723, page 3). Indirect costs can be substantial; a separate report on accident consequences prepared for NRC by the Bureau of Economic Analysis, U.S. Department of Commerce under contract to NRC (NUREG/CR-2591) found that such costs could be substantial. Costs that were included in the NUREG/CR-2723

estimates were lost wages, relocation expenses, decontamination costs, lost property, and interdiction costs for property and farm land.

4. Early fatalities are deaths due to radiation exposure from causes other than cancer occurring within one year of the accident. The CRAC2 model, as did the original CRAC model used in the Reactor Safety Study (WASH-1400), uses an assumption regarding fatal doses that may be subject to question. CRAC2 assumes that the lethal dose to 50% of the population in 60 days (the so-called "LD-50/60 dose") is 510 Rads. This assumption is permitted, however, only because the model assumes that "supportive treatment" is available. Supportive treatment assumes the use of special sterile procedures, massive use of transfusions and antibiotics, and considerable medical attention. The Reactor Safety Study concluded that such a level of attention would be available only for 2,500 to 5,000 persons (even if the totality of such resources in the entire U.S. were mobilized). For a considerable number of the cases presented above, the total estimated number of fatalities far exceeds this available level of supportive treatment. Assuming only normal hospital treatment (characterized as "minimal treatment" in the Reactor Safety Study), the LD-50/60 dose becomes only 340 Rads. Moreover, more persons are exposed to this level than are exposed to 510 Rads. Thus, for a number of plants, the estimate of early fatalities may be significantly understated. The authors of the Reactor Safety Study concluded that changing the LD-50/60 from 510 Rads to 340 Rads would increase the number of early fatalities by a factor of 3 to 4 depending upon circumstances (NUREG-0340). The precise effect on the above estimates from such a change is unknown, but the number of early fatalities would certainly increase for those plants where the early fatality numbers estimated above are significantly greater than 5,000 persons.

5. Early injuries are radiation-related injuries occurring within one year of the accident which require hospital treatment or medical attention. Early injuries include such conditions as temporary sterility, thyroid nodules, prodromal vomiting, and cataracts.

6. Cancer deaths are predicted to occur over the lifetime of the exposed population, with the exception of leukemia which is assumed to have occured by 30 years after the accident.

7. Peak fatal radius is the largest calculated distance from the plant at which an early fatality occurs.

8. Peak injury radius is the largest calculated distance from the plant at which an early injury occurs.

9. NRC Result refers to the Sandia National Laboratories calculations using the CRAC2 code for the "base case" of an 1120-megawatt (electric) reactor.

10. Scaled means using correction factors based upon sensitivity studies in NUREG/CR-2239 to adjust the "NRC Result" for actual

power level of each reactor. The correction factors are specific to the particular consequence and are based upon the consequences occurring once out of every 100 SST1 releases (this is the closest to the peak value for which the study did a sensitivity analysis of the effect of power level on consequences). Thus, there are large uncertainties in the results; however, the results are believed to be the best available estimates for most sites since specific site/reactor studies have not been done for most reactors.

11. This result was not provided in NUREG/CR-2723.

12. The "Scaled" results for Big Rock Point have very large uncertainties due to the large difference in power level between this reactor and the base case reactor. The results are provided solely for the sake of completeness and because the NRC Result, calculated on the basis of an 1120-MWe reactor may be of interest in setting siting standards for future reactors.

13. Dresden Unit #1 has been shutdown for several years pending a chemical cleaning of the primary coolant system to remove accumulated radioactive contamination. There has been speculation in the media about whether this reactor will be decommissioned, but no firm decision by the operating utility appears to have been made regarding the future operability of Dresden Unit #1. In addition, this reactor is a very small reactor (see note 12).

14. Fort St. Vrain is also a very small reactor (see note 12). In addition, this reactor is a high-temperature gas-cooled reactor (HTGR) rather than a light-water cooled reactor as are the remaining reactors in this listing. HTGR's will have very different release characteristics than LWR's; the results are provided here for reasons similar to those discussed in note 12.

15. This is a small reactor; see note 12.

16. The NRC Result does not appear to have accounted for the large transient population which uses the beach near Seabrook during the summer. This transient population increases the population within 10 miles of Seabrook by nearly a factor of two. If the transient population was not accounted for in the Sandia study, the listed consequences may seriously understate the expected values.

17. TMI-1 is shutdown under an NRC order stemming from the March 28, 1979 accident at the adjacent TMI-2 reactor. An NRC hearing has been conducted regarding possible future operation of TMI-1; the matter is presently before the Atomic Safety and Licensing Appeal Board and the Commission for decision in the next several months.

18. TMI-2 was damaged in the March 28, 1979 accident which resulted in "severe core damage". A recent study by Oak Ridge National Laboratory (NUREG/CR-2497) estimated that the frequency of such accidents, based on historical data from 1969-1979, was between 1:222 to 1:588 per reactor year. While the future of TMI-2 is

officially undecided, it is highly doubtful that the reactor could be refurbished to resume operation.

19. This is another small reactor; see note 12.

20. It should be noted that the evacuation model in CRAC2 does not account for actual site conditions such as bottlenecks and terrain baarriers which can cause major evacuation routes to overlap the area likely to be covered by the plume once a release of radioactivity occurs. These factors can have a significant impact on calculated results (page 2-9, NUREG/CR-2239). Peak consequences should not be greatly affected, however, since they generally occur beyond 10 miles from the plant and evacuation ceases at 10 miles in the CRAC2 model. Increasing the evacuation distance to 25 miles could substantially reduce the peak consequences (e.g., from 57,000 early fatalities to 15,000 for a sensitivity study performed by Sandia), but the feasibility of a timely evacuation from so large an area is highly questionable.

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November 1, 1982

LIST OF SITES WITH THE HIGHEST SCALED CONSEQUENCES BASED ON NRC CRAC2 ACCIDENT CONSEQUENCE ANALYSIS

PEAK EARLY FATALITIES

	PLANT NAME	SCALED PEAK EARLY FATALITY ESTIMATE
	OPERATING REACTORS	
1/2	Salem, Units 1/2	100,000
3/4	Peach Bottom, Units 2/3	72,000
5/6	Susquehanna, Units 1/2	67,000
7	Indian Point, Unit 3	50,000
8	Indian Point, Unit 2	46,000
9	Three Mile Island, Unit 1	42,000
10/11	Dresden, Units 2/3	42,000
	Surry, Units 1/2	31,000
	Rancho Seco	30,000
	Turkey Point, Units 3/4	29,000
	Sequoyah, Units 1/2	29,000
	Haddam Neck	29,000
	San Onofre, Units 2/3	27,000
	REACTORS UNDER CONSTRUCTION	
	Waterford, Unit 3	96,000
	Limerick, Units 1/2	74,000
	Catawba, Units 1/2	42,000
	Shoreham	40,000
	Millstone, Unit 3	29,000

PEAK EARLY INJURIES

PLANT NAME	SCALED PEAK EARLY INJURY ESTIMATE
OPERATING REACTORS	
Fermi, Unit 2	340,000
Indian Point, Unit 3	167,000
Beaver Valley, Units 1/2	156,000
Zion, Units 1/2	155,000
Indian Point, Unit 2	141,000
Cook, Unit 2	88,000
Cook, Unit 1	80,000
Salem, Unit 2	75,000
Davis-Besse	73,000
Summer	73,000
Salem, Unit 1	70,000
Sequoyah, Units 1/2	61,000
Three Mile Island, Unit 1	50,000
REACTORS UNDER CONSTRUCTION	
Limerick, Units 1/2	610,000
Waterford, Unit 3	279,000
Perry, Units 1/2	180,000
Marble Hill, Units 1/2	150,000
Zimmer	109,000
Catawba, Units 1/2	88,000
Byron, Units 1/2	79,000
Shoreham	75,000
Braidwood, Units 1/2	63,300

SCALED PEAK COSTS

PLANT NAME	SCALED PEAK COSTS (BILLIONS 1980 $)
OPERATING REACTORS	
Indian Point, Unit 3	314
Indian Point, Unit 2	274
San Onofre, Unit 2	186
San Onofre, Unit 3	182
Diablo Canyon, Unit 2	158
Diablo Canyon, Unit 1	155
Salem, Unit 2	150
Zion, Units 1/2	146
Susquehanna, Unit 1	143
Susquehanna, Unit 2	137
Fermi, Unit 2	136
Salem, Unit 1	135
Millstone, Unit 2	135
REACTORS UNDER CONSTRUCTION	
Limerick, Unit 1	213
Limerick, Unit 2	197
Millstone, Unit 3	174
Seabrook, Unit 1	164
Shoreham	157
Seabrook, Unit 2	150
Nine Mile Point, Unit 2	134
Waterford, Unit 3	131