PDR

NOV 20 1992

MEMORANDUM FOR: Frank J. Congel, Director
Division of Radiation Safety
and Safeguards

THRU: LeMoine J. Cunningham, Chief
Radiation Protection Branch
Division of Radiation Safety
and Safeguards

'92 DEC -2 A5:13

FROM: Charles S. Hinson, Health Physicist
Radiation Protection Branch
Division of Radiation Safety
and Safeguards

SUBJECT: ERRATA FOR 1991 LWR OCCUPATIONAL DOSE DATA REPORT

Following the issuance of the "LWR Occupational Dose Data for 1991" memorandum on October 28, 1992, the staff was informed of an error in the 1991 plant dose reported for the Cooper Nuclear Station. The actual total dose for Cooper in 1991, as substantiated by plant personnel, should be 405 person-rem, not 14 person-rem as listed in Tables 1a, 3a, and 3b of the above listed report. This revised dose will increase the average dose per reactor for BWRs from 314 to 324. The average dose per reactor for LWRs will change from 253 to 257 person-rem per reactor.

Attached are those pages of the 1991 dose data memorandum containing revised data resulting from the change in 1991 doses for the Cooper Nuclear Station. Vertical lines in the right-hand column of each page indicate portions of the report which have been revised. These revised pages should be inserted into the original 1991 dose memorandum to replace the pages containing the incorrect data. Any questions on these corrections should be directed to Charles Hinson at (301) 504-1845.

/s/

Charles S. Hinson, Health Physicist
Radiation Protection Branch
Division of Radiation Safety
and Safeguards

Enclosure: As stated

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LWR OCCUPATIONAL DOSE DATA FOR 1991

This is a compilation and analysis of occupational radiation doses reported from light-water-cooled reactors (LWRs) for the year 1991. The information was derived from reports submitted to the Commission in accordance with 10 CFR 20.407.

In 1991 two new pressurized water reactors (PWRs) completed their first full year of commercial operation and are included in this year's summary for the first time (indicated by an asterisk in Tables 1 and 2). These new plants are Comanche Peak and Seabrook. No new boiling water reactors (BWRs) completed their first year of operation in 1991. Rancho Seco was removed from the compilation of reactor data this year since this reactor has been permanently shut down. Other reactors which are no longer included in the compilation of reactor data are Dresden 1, Humboldt Bay, Indian Point 1, LaCrosse, Three Mile Island 2, and Fort St. Vrain.

The total collective dose for all 111 LWRs included in 1991 was ~~28,136~~ 28,527 person-rem (see Figure 1). This is ~~8,456~~ 8,065 person-rem (~~23%~~ 22%) less than last year's value of 36,592 person-rem. The average collective dose per reactor for LWRs in 1991 was ~~259~~ 257 person-rem. This is ~~24%~~ 23% less than the 1990 LWR average of 333 person-rem per reactor (see Figure 1) and represents the largest drop in average collective LWR doses since 1984. The reason for the overall decline in average collective dose per reactor in past years has been the continued increase in the number of operating plants and the decline of the total collective dose at these plants (see Figure 2). The average measurable dose per worker for LWRs has experienced a similar trend, and in 1991 it decreased to 0.29 rem from the 1990 value of 0.33 rem (see Figure 3). The collective dose per gross megawatt-year (MWe-year) has decreased from a value of 0.54 in 1990 to 0.38 in 1991 (see Figure 4).

In 1991, the total collective dose for PWR units was 16,522 person-rem for 74 reactors. The resulting average collective dose per reactor for PWRs in 1991 was 223 person-rem per reactor (see Figure 1). This represents a 22% decrease from the 1990 value of 285 person-rem per reactor. The average number of personnel with measurable doses per PWR decreased from 933 in 1990 to 796 in 1991. The average measurable dose per worker for PWRs in 1991 is 0.28 rem. This is about 10% less than the 1990 value of 0.31 rem.

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In 1991, the total collective dose for BWR units was ~~11,614~~ person-rem for 37 reactors. The resulting average collective dose per unit for BWRs in 1991 was ~~314~~ 324 person-rem per unit. This is ~~26%~~ 24% lower than the 1990 value of 426 person-rem per unit. The average number of personnel with measurable doses per BWR decreased from 1,124 in 1990 to 1,040 in 1991. The average measurable dose per worker also decreased from 0.38 rem in 1990 to ~~0.30~~ 0.31 rem in 1991.

The compilation in Table 1a represents a breakdown of the collective dose incurred at each LWR that had completed at least one full year of commercial operation by the end of 1991. Table 1a also lists the reactor type and the annual whole body dose distributions of each of the 111 LWRs in this year's compilation. Table 1b presents the same type of dose breakdown for those LWRs which are either no longer in operation or have been in operation for less than one year. The collective dose figures listed in Table 1 (a and b) are either actual total dose figures submitted by the licensee (indicated by a double asterisk) or were derived from data submitted by the licensee in response to the requirements of 10 CFR 20.407.

Figure 1 shows the average collective dose figures for PWRs, BWRs, and LWRs for the years 1973-1991. For the eighteenth consecutive year, the average collective dose per reactor for BWRs has remained higher than that for PWRs. The average collective dose for LWRs in 1991 is the lowest average LWR collective dose in 22 years. Figure 2 shows the total number of operating reactors and the total collective dose per year plotted for the years 1973-1991. Although the number of plants has increased each year, the collective dose for the 111 plants operating in 1991 is lower than the collective dose in 1977 when there were only 57 operating reactors.

Table 2a lists the 74 PWRs in ascending order of collective dose per reactor for 1991. As stated previously, the PWR average collective dose per reactor in 1991 was 223 person-rem. The top fourteen PWR units in Table 2a reported collective doses in 1991 which were less than half of this 1991 average dose per reactor. Only five PWRs reported doses in 1991 which were at least twice the average dose per reactor. These units, which appear as the bottom five reactors in Table 2a, were Indian Point 2, Haddam Neck, Trojan, and Turkey Point units 3 and 4. Table 2a and Figure 4 also give the collective dose per gross MWe-year for PWRs to indicate their power generation performance as it relates to the collective dose incurred by the workers at these plants. In 1991, the

collective dose per MWe-year of 0.32 for PWRs was below 0.50 for the third year in a row. This indicates a better than 3:1 ratio of Mwe-years generated to the collective dose accumulated during 1991.

Tables 2a and 3a list the values of "CR" for each reactor which is defined to be the ratio of the annual collective dose delivered at individual doses exceeding 1.5 rem (cSv) to the total annual collective dose. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) recommends that this parameter remain in the range between 0.05 and 0.50. In 1991, only two reactors, Cooper Station and Duane Arnold, both BWRs, exceeded this recommended range.

Table 2b lists the three-year average doses per PWR in ascending order, as well as the collective dose per reactor for the last three years. Several PWRs, such as Yankee-Rowe and Prairie Island 1 and 2, have consistently achieved very low collective doses and therefore appear at the top of Table 2b. The four PWR sites (five units) with the highest doses in 1991 are indicated with an asterisk to give an indication of their performance over the last three years. Several of these PWRs are consistently among the highest dose plants as evidenced by their high three-year averages. Table 4 gives a breakdown of some of the major activities which contributed to the collective dose received at these high dose plants. It appears that the activities which most frequently contributed to these high collective doses were steam generator-related work, valve maintenance and repair, installation and removal of scaffolding and insulation, and in-service inspection work.

Table 3a lists the 37 BWRs in ascending order of collective dose per reactor for 1991. The average BWR dose per reactor in 1991 was ~~314~~ 324 person-rem. The top ~~twelve~~ eleven BWR units in Table 3a reported collective doses in 1991 which were less than half of the 1991 average collective dose per reactor. There was only one unit, Oyster Creek, that reported doses which exceeded twice the 1991 average dose per reactor. Table 3a and Figure 4 also give the collective dose per gross MWe-year for BWRs to indicate their power generation performance as it relates to the collective dose incurred by the workers at these plants. In 1991, the collective dose per MWe-year of 0.54 for BWRs was below 1.00 for the third consecutive year. As shown in Figure 4, this parameter continues to decrease at both types of reactors, but remains higher for BWRs than for PWRs. One contributing factor for this difference is the larger power generation capacity of most PWRs.

TABLE 1a. ANNUAL WHOLE BODY DOSES AT LICENSED NUCLEAR POWER FACILITIES
CY 1991

PLANT NAME	TYPE	Number of Individuals with Whole Body Doses in the Ranges (rems or cSv)													TOTAL NUMBER MONI-TORED	NUMBER WITH MEAS. EXPOSURE	TOTAL COLLECTIVE DOSE (Person-rem,cSv)
		No Mea-surable	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.00	1.00-2.00	2.00-3.00	3.00-4.00	4.00-5.00	5.00-6.00	6.00-7.00	7.00-12.00	>12.0			
ARKANSAS 1,2	PWR	1,547	1,164	425	288	114	43	30								3,611	2,064	351 **
BEAVER VALLEY 1,2	PWR	1,171	70	350	314	144	86	82	13							2,230	1,059	495 **
BIG ROCK POINT	BWR	30	231	25	36	41	20	58	19	4	1					465	435	226
BRAIDWOOD 1,2	PWR	1,428	504	354	426	172	91	87	7							3,069	1,641	550 **
BROWNS FERRY 1,2,3	BWR	2,563	822	482	330	136	38	7								4,378	1,815	354 **
BRUNSWICK 1,2	BWR	1,652	1,220	462	362	186	136	213	7							4,238	2,586	778 **
BYRON 1,2	PWR	1,488	446	269	189	87	60	26								2,565	1,077	268 **
CALLAWAY 1	PWR	972	209	55	15	1										1,252	280	21 **
CALVERT CLIFFS 1,2	PWR	1,167	1,561	261	119	23	6	4								3,141	1,974	132 **
CATAWBA 1,2	PWR	1,540	792	388	415	154	68	52	2							3,411	1,871	462 **
CLINTON	BWR	1,542	412	267	195	115	18	3								2,552	1,010	233
COMANCHE PEAK *	PWR	3,401	584	248	107	31	11	4								4,386	985	148
COOK 1,2	PWR	1,326	598	149	58	7	3									2,141	815	69 **
COOPER STATION	BWR	2,382	400	190	183	128	90	108								3,481	1,099	74 ** → 405
CRYSTAL RIVER 3	PWR	904	520	180	83	27	10	1								1,725	821	116
DAVIS-BESSE	PWR	973	487	255	122	56	47	33								1,973	1,000	216 **
DIABLO CANYON 1,2	PWR	2,080	773	531	379	196	89	71	1							4,120	2,040	546 **
DRESDEN 2,3	BWR	1,600	667	378	325	171	155	267	78	3						3,644	2,044	1,005 **
DUANE ARNOLD	BWR	1,721	125	57	46	20	14	41	33							2,057	336	202
FARLEY 1,2	PWR	591	616	345	250	195	81	106	32	20						2,236	1,645	648 **
FERMI 2	BWR	1,965	539	358	269	50	6	1								3,188	1,223	228
FITZPATRICK	BWR	1,242	796	155	112	69	47	85	5							2,511	1,269	333
FORT CALHOUN	PWR	766	162	52	42	13	10	5								1,050	284	57
GINNA	PWR	889	320	182	198	113	71	63								1,836	947	328 **
GRAND GULF	BWR	1,396	425	126	99	32	10	4	3							2,095	699	94 **
HADDAM NECK	PWR	786	371	195	178	123	81	193	27							1,954	1,168	590 **
HARRIS	PWR	912	384	180	148	85	48	27								1,784	872	226 **
HATCH 1,2	PWR	1,167	792	438	395	302	202	343	34	2						3,675	2,508	1,161 **
HOPE CREEK 1	BWR	952	922	281	237	122	66	69	3							2,652	1,700	373 **
INDIAN POINT 2	PWR	1,927	381	203	146	67	65	155	73	4						3,021	1,094	1,468 **
INDIAN POINT 3	PWR	759	191	56	46	6										1,058	299	40
KEWAUNEE	PWR	408	189	107	88	37	10	35	26	3						903	495	221
LASALLE 1,2	BWR	1,316	732	313	312	239	144	235	10							3,301	1,985	606 **
LIMERICK 1,2	BWR	2,143	830	243	63	8	1	6								3,294	1,151	106 **
MAINE YANKEE	PWR	637	220	74	66	37	16	13								1,063	426	105

* Indicates plants counted for the first time in 1991 after completing their first (full) year of operation.
** Indicates actual collective dose reported by facility, otherwise calculated by staff.

TABLE 1a. ANNUAL WHOLE BODY DOSES AT LICENSED NUCLEAR POWER FACILITIES (Continued)
CY 1991

PLANT NAME	TYPE	Number of Individuals with Whole Body Doses in the Ranges (rems or cSv)													TOTAL NUMBER MONI-TORED	NUMBER WITH MEAS. EXPOSURE	TOTAL COLLECTIVE DOSE (Person-rem,cSv)
		No Measurable	Meas. <0.10	0.10-0.25	0.25-0.50	0.50-0.75	0.75-1.00	1.00-2.00	2.00-3.00	3.00-4.00	4.00-5.00	5.00-6.00	6.00-7.00	7.00-12.00	>12.0			
YANKEE-ROWE	PWR	518	59	46	34	15	4	4								780	162	40 **
ZION 1,2	PWR	1,841	410	237	172	61	14	8								2,743	902	173 **
TOTALS: 74 PWRs		58,860	27,864	11,868	9,262	4,539	2,360	2,651	345	33						117,783	58,923	16,522
TOTALS: 37 BWRs		37,527	17,384	7,076	5,732	3,409	1,975	2,602	299	14	1					76,019	38,492	~~11,614~~ 12005
TOTALS: 111 LWRs		96,387	45,248	18,945	14,994	7,948	4,335	5,253	644	47	1					193,802	97,415	~~28,136~~ 28527

* Indicates plants counted for the first time in 1991 after completing their first full year of operation.
** Indicates actual collective dose reported by facility, otherwise calculated by staff.

TABLE 3a. BOILING WATER REACTORS LISTED IN ASCENDING ORDER OF COLLECTIVE DOSE PER REACTOR
CY 1991

Site Name	Collective Dose Per Reactor (rems or cSv)	Collective Dose Per Site (rems or cSv)	Average Dose Per Worker (rems or cSv)	Collective Dose Per Gross MWe-Yr	CR
COOPER STATION	~~14~~ 405	~~14~~ 405	~~0.01~~ 0.37	~~0.0~~ 0.7	~~5.79~~ 0.20
LIMERICK 1,2	53	106	0.09	0.1	0.04
GRAND GULF	94	94	0.13	0.1	0.11
VERMONT YANKEE	118	118	0.38	0.2	0.13
BROWNS FERRY 1,2,3	118	354	0.20	0.8	0.01
RIVER BEND 1	144	144	0.18	0.2	0.02
PERRY	146	146	0.24	0.1	0.10
NINE MILE POINT 1,2	146	292	0.19	0.2	0.10
DUANE ARNOLD	202	202	0.60	0.4	0.56
BIG ROCK POINT	226	226	0.52	3.8	0.48
FERMI 2	228	228	0.19	0.3	0.00
CLINTON	233	233	0.23	0.3	0.01
SUSQUEHANNA 1,2	254	507	0.27	0.3	0.07
QUAD CITIES 1,2	255	509	0.30	0.5	0.18
FITZPATRICK	333	333	0.26	0.8	0.23
HOPE CREEK 1	373	373	0.22	0.4	0.16
WASHINGTON NUCLEAR 2	387	387	0.36	0.8	0.21
BRUNSWICK 1,2	389	778	0.30	0.8	0.23
LASALLE 1,2	403	806	0.41	0.4	0.25
MILLSTONE POINT 1	409	409	0.35	1.9	0.18
MONTICELLO	465	465	0.48	1.1	0.29
PEACH BOTTOM 2,3	467	934	0.35	0.8	0.20
DRESDEN 2,3	503	1,005	0.49	1.5	0.40
HATCH 1,2	581	1,161	0.46	1.0	0.30
PILGRIM	605	605	0.21	1.5	0.14
OYSTER CREEK	1,185	1,185	0.38	3.4	0.34

TABLE 3B1. BOILING WATER REACTORS LISTED BY ASCENDING ORDER OF

THREE YEAR AVERAGE COLLECTIVE DOSE PER REACTOR

1991

Site Name	Collective Dose Per Reactor (Person-rem or person-cSv) 1989	1990	1991	Three Year Average Collective Dose per Reactor
LIMERICK 1,2	266	88	53	109
FERMI 2	255	83	228	189
BIG ROCK POINT	177	232	226	212
VERMONT YANKEE	288	307	118	238
COOPER STATION	343	379	~~14~~ 405	~~245~~ 376
BROWNS FERRY 1,2,3	219	437	118	258
NINE MILE POINT 1,2	282	350	146	259
SUSQUEHANNA 1,2	352	220	254	275
MILLSTONE POINT 1	462	131	409	334
PEACH BOTTOM 2,3	369	189	467	342
HOPE CREEK 1	465	196	373	345
PILGRIM	207	225	605*	346
MONTICELLO	507	94	465	355
GRAND GULF	498	482	94	358
CLINTON	372	553	233	386
RIVER BEND 1	558	489	144	397
QUAD CITIES 1,2	450	514	255	406
DUANE ARNOLD	194	861	202	419
WASHINGTON NUCLEAR 2	492	536	387	472
PERRY	767	638	146	517
LASALLE 1,2	693	474	403	523
HATCH 1,2	278	728	581*	529
FITZPATRICK	377	884	333	531
DRESDEN 2,3	565	700	503*	589
BRUNSWICK 1,2	893	774	389	685
OYSTER CREEK	910	310	1,185*	802
Annual BWR Averages:	432	426	~~314~~ 324	
Total Reactors Included:	36	37	37	

* Indicates high dose-per-reactor sites for 1991.