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**ISOE INFORMATION SHEET**  
**ANNUAL OUTAGE DURATION AND DOSES**  
**IN EUROPEAN REACTORS**

**ISOE European Technical Centre - CEPN Information Sheet No. 27**

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This Information Sheet presents, on the basis of a three-years rolling average for the period 1993-1999, an analysis of the evolution and dispersion of outage doses, durations and outage doses per day in European countries.

The data from the ISOE 1 database are available on a calendar year basis. Therefore, when an outage starts during one calendar year and ends during the next year, doses and duration for the outage as a whole have been reconstructed.

**1. Evolution per reactor type**

Table 1 gives the 3-Years rolling average of the outage dose, outage duration and outage dose per day, and the number of outages considered for the PWRs, BWRs and VVERs.

**Table 1. 3-Years rolling average of the outage dose, outage duration and outage dose per day**

	Years	BWR	PWR	VVER
Average outage dose (man.mSv)	1993-95	1449.70	1600.19	472.91
	1994-96	1385.40	1444.23	495.44
	1995-97	1515.95	1347.92	510.23
	1996-98	1539.03	1206.02	608.07
	1997-99	1302.89	1096.92	548.73
Average outage duration (No. of days)	1993-95	43.75	54.96	44.74
	1994-96	42.76	50.94	44.78
	1995-97	44.47	51.56	47.15
	1996-98	48.45	50.79	51.52
	1997-99	46.19	53.45	49.36
Average outage dose/day (man.mSv/day)	1993-95	33.13	29.12	10.57
	1994-96	32.40	28.35	11.07
	1995-97	34.09	26.14	10.82
	1996-98	31.77	23.75	11.80
	1997-99	28.21	20.52	11.12
<i>Total number of outages</i>	<i>1993-95</i>	<i>57</i>	<i>230</i>	<i>38</i>
	<i>1994-96</i>	<i>59</i>	<i>234</i>	<i>40</i>
	<i>1995-97</i>	<i>58</i>	<i>237</i>	<i>41</i>
	<i>1996-98</i>	<i>60</i>	<i>229</i>	<i>42</i>
	<i>1997-99</i>	<i>57</i>	<i>230</i>	<i>42</i>

As far as PWRs are concerned, the 3-Years rolling average outage dose shows a regular decrease from 1993 to 1999 (reaching -30% at the end of the period). During the same period, the average outage duration has fluctuated around 53 days ( $\pm 5\%$ ). Therefore, the dose decrease cannot be explained by the evolution of the outage length. On the contrary, there has been a continuous decrease of the outage dose per day (-30% for the whole period). As the data are on average over a large number of plants, several factors may have contributed to this reduction as e.g. work management may have allowed a reduction of the number of workers and the workload in high dose areas, work during outages may have been reduced by shifting work to the operational period, or big improvements may have allowed a reduction in dose rates.

Regarding BWRs, there is no regular tendency for the collective dose during the whole period: after a decrease, an 11% increase can be noticed from 1994 to 1998, followed by a 15% decrease in the last period. The same situation may be observed for the outage duration suggesting an impact of the duration on the outage dose.

Finally, VVERs have shown a regular increase in the average outage dose up to 1998 when it started to decrease. During the whole period, the outage dose per day remains quite stable and it is not surprising to find a correlation coefficient of 0.97 between the outage dose and the outage duration.

## 2. Evolution per country

Analysis has also been performed by country. All the detailed results are given in Annex 1.

### 2.1 Evolution of BWR outage dose per country

The evolution of the BWR outage dose appeared to be mainly influenced by the extensive maintenance programme (modernisation) performed in the Swedish BWR reactors. In the following figure, the increase in the outage dose in Sweden can clearly be noticed whereas the other European BWRs decreased quite regularly during the same period. It can also be seen that as the Swedish modernisation programme is reaching its end, the dose per outage starts to decrease in the last period. During the whole period the outage duration continuously increased in Sweden. The dose per day fluctuated around 37 man.mSv/day up to 1996-98, it then showed a significant decrease down to 29 man.mSv/day. Therefore, one may in the future expect a positive impact of the modernisation programme on the outage dose. It will be interesting to estimate the extra dose corresponding to the programme workload and the consecutive savings.

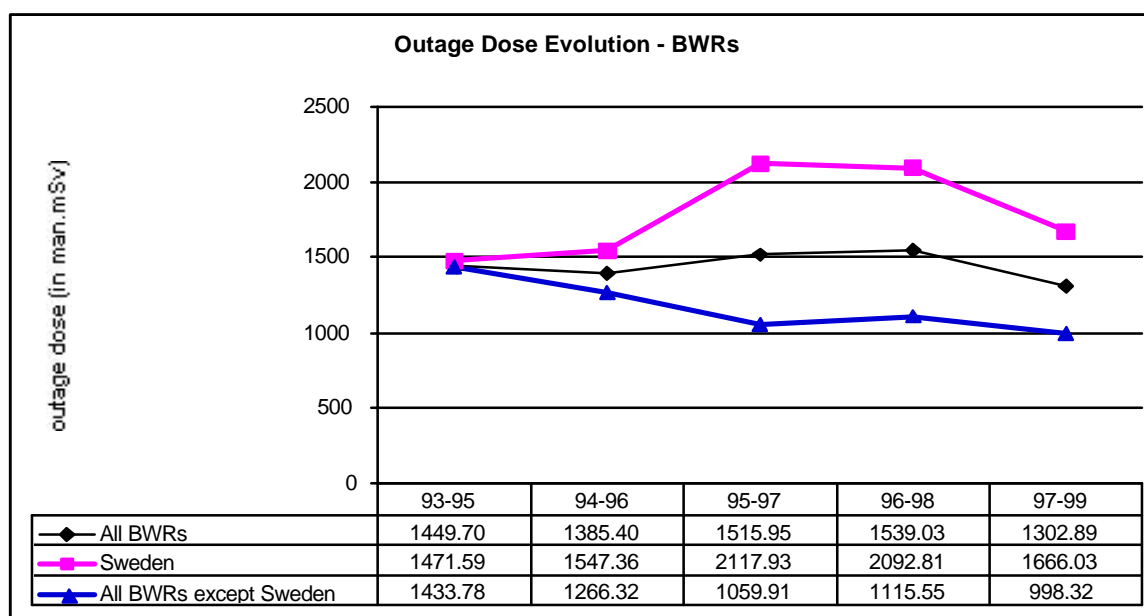


Figure 1. BWR outage dose evolution

As for the other countries (see Annex 1), a regular decrease may be observed in the outage doses both in Spain and Switzerland during the whole period and in Germany up to 1997. The lowest outage doses (around 700 man.mSv) are encountered in Finland and may be explained mainly by the very short duration of the outage (around 15/16 days, two times lower than the European average). The highest doses are the Spanish ones and correspond to very high doses per day (more than two times the European average). However an important improvement has been made during the period studied as the Spanish outage dose has decreased from more than 3 man.Sv to less than 2 man.Sv.

## **2.2 Evolution of PWR outage dose per country**

Most countries show a regular decrease in the outage dose during the period, except for the U.K. where the first outage doses were already very low (around 0.5 man.Sv). However, two groups of countries may be observed:

- Belgium, Sweden, Switzerland and the UK with outage doses around 0.5/0.6 man.Sv in the last period (1997-1999)
- France, Germany, Spain and the Netherlands with outage doses around 1.0/1.2 man.Sv in the last period (1997-1999)

In the first group Belgium, Sweden and Switzerland have good results both in terms of duration and dose per day; while the UK has only very good results in terms of the dose per day.

## **2.3 Evolution of VVER outage dose per country**

The observation made on the European average is confirmed by the country analysis (correlation between outage dose and duration). However, one can notice that Finland has outage doses two times higher than other countries, with outage durations between one third and one half less than the other countries. To draw conclusions, it would be necessary to analyse the amount of work performed in Finland, as well as the dose rates and compare these data with those of the other countries.

## **3. Evolution per sister unit group**

An analysis has also been performed for sister unit groups, as defined in ISOE, in order to facilitate benchmarking. All tables and graphs have been prepared excluding all the sister unit groups including only one reactor.

As an example of a rough analysis, Figure 2 shows the evolution of the 3-Years rolling average outage dose for the F32 (Framatome 3 loops 2nd generation) and W32 (Westinghouse 3 loops 2nd generation) sister groups as well as the evolution of the minimum value recorded. It appears that the average dose decreased for both F32 and W32 groups. However, W32 results remain lower than those of F32 both in average outage dose and in minimum value of outage dose. The lowest W32 outage dose records are those of Ringhals 4 (Sweden) and Doel 4 (Belgium).

These evolutions of the outage doses should be compared with those of the outage duration: an increase for both average and minimum durations for F32, while there is a decrease for W32 (Figure 3).

Figure 4 presents a synthesis of the evolution of outage doses per sister unit groups for all sister unit groups sorted by type and manufacturers.

One may notice a drastic decrease in the doses of the oldest generations both for BWRs and PWRs (see GE5, S72 for BWRs and F31, F32, S21, S41 and Westinghouse groups for PWRs)

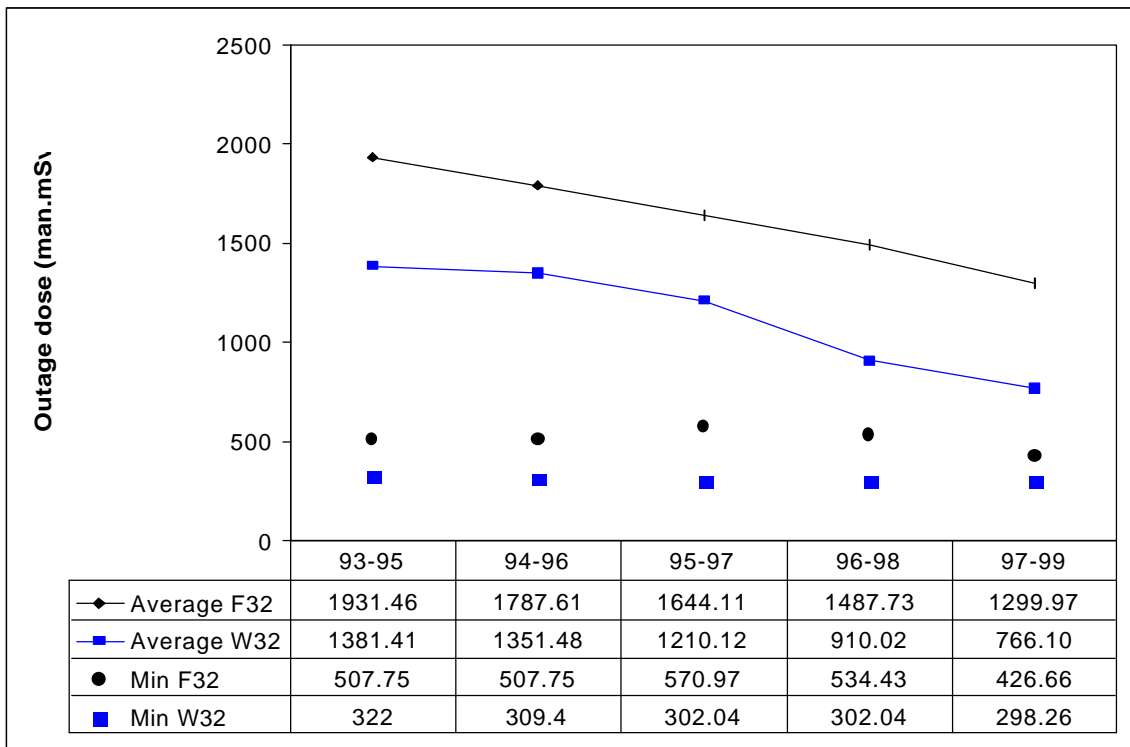


Figure 2. F32 and W32 average and minimum outage doses

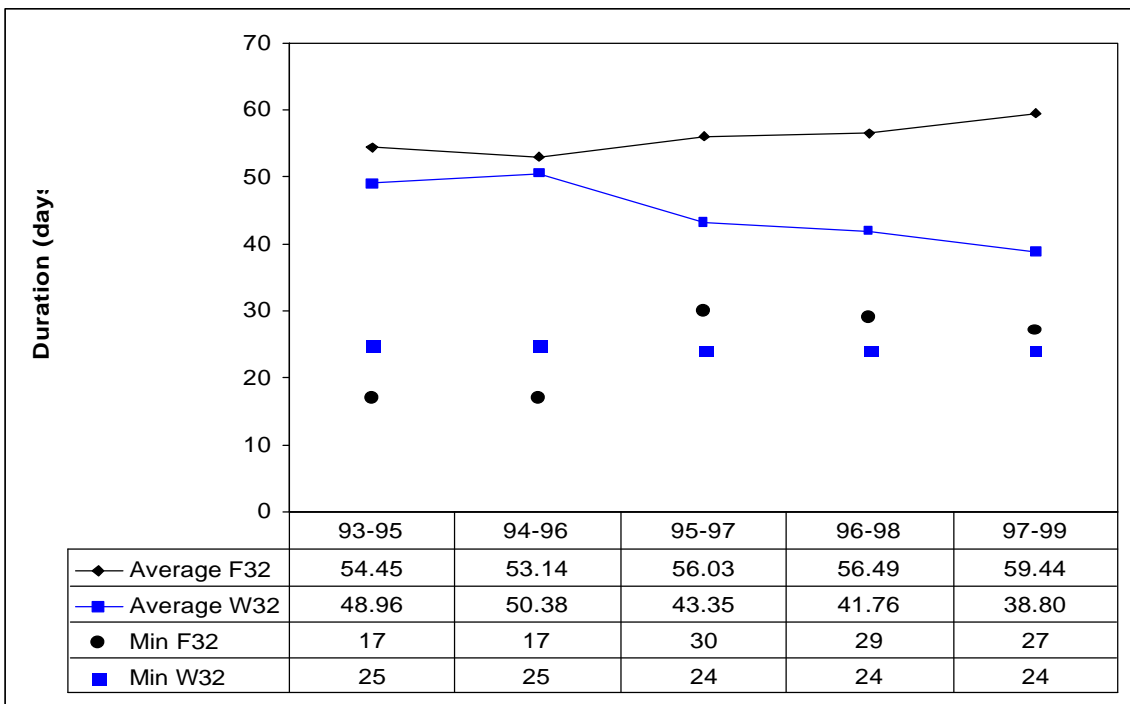


Figure 3. F32 and W32 average and minimum outage durations

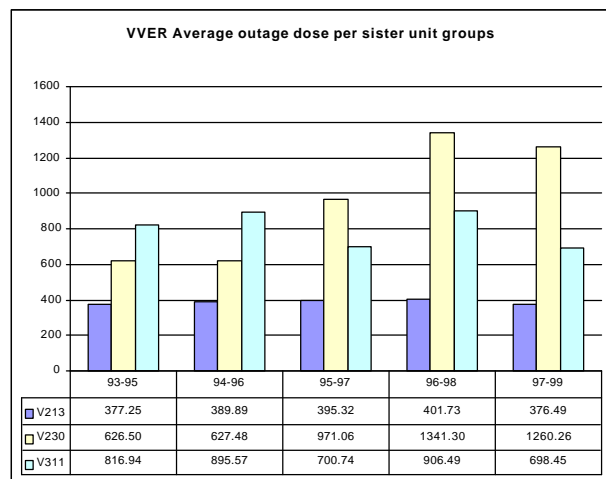
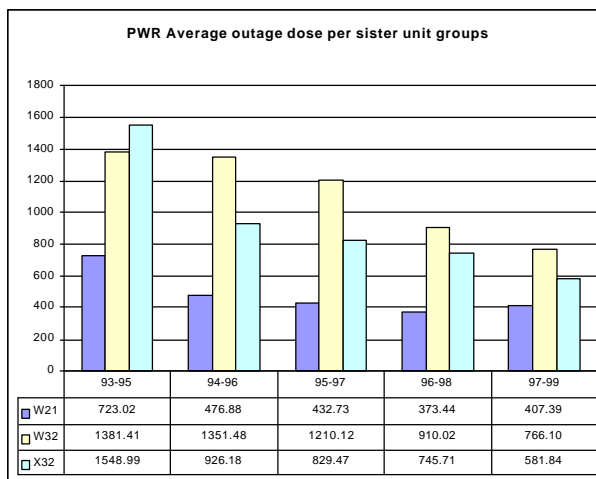
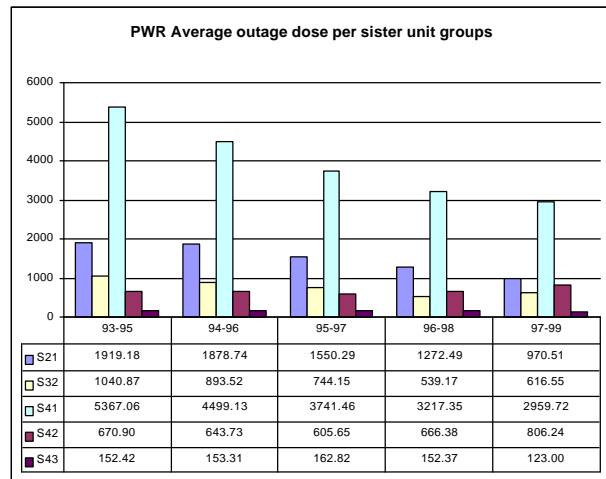
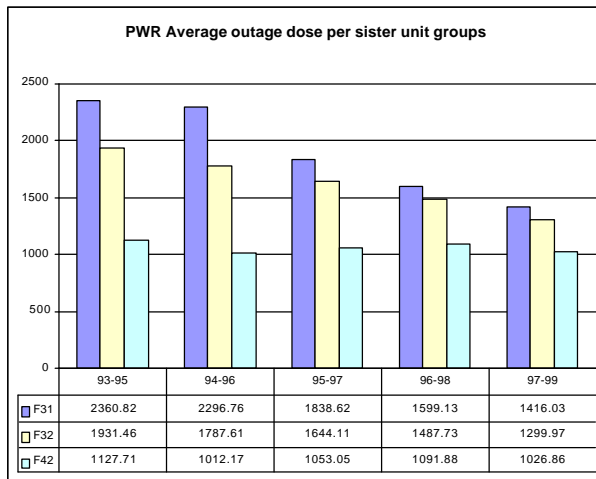
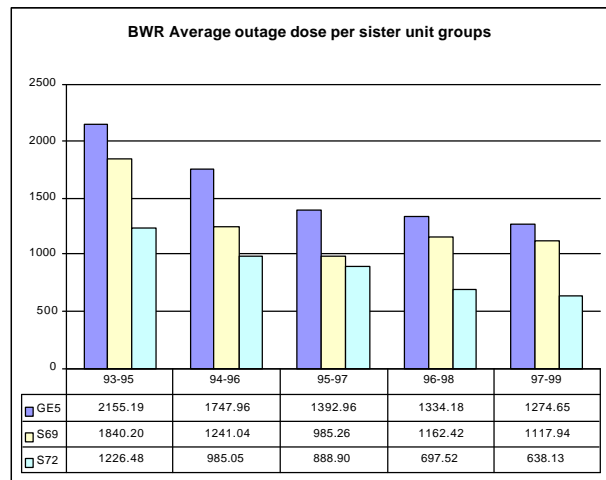
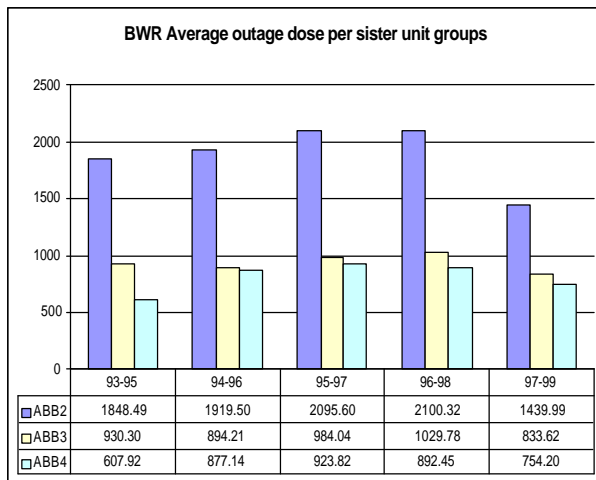


Figure 4. Evolution of the average outage dose by sister unit group (man.mSv)

More detailed information is made available in Annex 2. For each sister unit group the evolution of the minimum, average and maximum values are provided for both the outage dose and durations. The use of these tables will enable each unit to compare its results with those of its sister unit group and similar sister unit groups.



ANNEX 1

**Table. 3-Years rolling average of: outage dose, outage duration and outage dose per day (man.mSv) for countries operating BWRs**

	Years	Finland	Germany	Netherlands	Spain	Sweden	Switzerland
Average outage dose (man.mSv)	1993-95	742.27	1567.22	648.48	3359.00	1471.59	1221.74
	1994-96	744.96	1165.44	630.70	2984.03	1547.36	1212.55
	1995-97	625.31	946.72	660.77	2326.59	2117.93	1066.08
	1996-98	790.70	998.34	674.06	2326.59	2092.81	1038.70
	1997-99	673.01	926.02	-	1950.18	1666.03	869.82
Average outage duration (No. of days)	1993-95	15.50	61.67	52.33	46.33	39.29	39.50
	1994-96	15.67	46.87	57.00	43.25	45.36	41.33
	1995-97	15.83	41.20	56.50	34.25	54.96	40.33
	1996-98	17.67	50.35	56.00	34.25	57.54	42.67
	1997-99	15.50	46.80	-	33.25	56.88	37.67
Average outage dose/day (man.mSv/day)	1993-95	47.89	25.41	12.39	72.50	37.45	30.93
	1994-96	47.55	24.87	11.06	68.99	34.11	29.34
	1995-97	39.49	22.98	11.69	67.93	38.54	26.43
	1996-98	44.76	19.83	12.04	67.93	36.37	24.34
	1997-99	43.42	19.79	-	58.65	29.29	23.09
<i>Total number of outages</i>	1993-95	6	15	3	3	24	6
	1994-96	6	15	3	4	25	6
	1995-97	6	15	2	4	25	6
	1996-98	6	17	1	4	26	6
	1997-99	6	15	0	4	26	6

**Table. 3-Years rolling average of: outage dose, outage duration and outage dose per day (man.mSv) for countries operating PWRs**

	Years	Belgium	France	Germany	Netherlands	Spain	Sweden	Switzerland	UK
Average outage dose (man.mSv)	1993-95	1199.26	1702.93	1868.25	1064.70	1492.45	742.83	988.63	-
	1994-96	991.21	1570.22	1615.08	1049.77	1473.13	648.44	698.25	485.13
	1995-97	822.59	1467.47	1511.77	1443.76	1393.43	642.54	600.13	476.26
	1996-98	609.14	1378.11	1232.98	1370.20	1091.68	530.16	547.14	476.26
	1997-99	505.21	1231.01	1203.83	1145.36	936.75	486.52	588.57	551.08
Average outage duration (No. of days)	1993-95	54.63	59.18	41.66	42.33	46.71	62.33	54.50	-
	1994-96	51.20	56.39	36.66	41.00	47.50	40.56	37.63	55.00
	1995-97	43.63	58.18	33.50	79.00	51.59	38.89	37.13	52.00
	1996-98	38.63	60.10	29.58	73.00	46.00	31.56	34.43	52.00
	1997-99	32.71	64.69	29.19	67.33	46.75	30.78	41.29	57.50
Average outage dose/day (man.mSv/day)	1993-95	21.95	28.78	44.85	25.15	31.95	11.92	18.14	-
	1994-96	19.36	27.84	44.06	25.60	31.01	15.99	18.56	8.82
	1995-97	18.85	25.22	45.13	18.28	27.01	16.52	16.16	9.16
	1996-98	15.77	22.93	41.68	18.77	23.73	16.80	15.89	9.16
	1997-99	15.45	19.03	41.23	17.01	20.04	15.81	14.26	9.58
<i>Total number of outages</i>	1993-95	19	139	35	3	17	9	8	0
	1994-96	20	142	35	3	16	9	8	1
	1995-97	19	143	36	3	17	9	8	2
	1996-98	19	138	36	3	15	9	7	2
	1997-99	17	140	36	3	16	9	7	2

**Table. 3-Years rolling average of: outage dose, outage duration and outage dose per day (man.mSv)  
for countries operating VVERs**

	Years	Czech Rep.	Finland	Hungary	Slovak Rep.
Average outage dose (man.mSv)	1993-95	355.87	816.94	433.08	439.73
	1994-96	328.47	895.57	488.46	451.78
	1995-97	338.19	700.74	509.74	594.54
	1996-98	314.26	906.49	582.45	778.27
	1997-99	299.48	698.45	540.05	731.82
Average outage duration (No. of days)	1993-95	47.36	29.17	41.83	55.78
	1994-96	46.91	34.67	38.42	55.09
	1995-97	50.42	26.33	37.00	66.00
	1996-98	48.58	30.50	39.67	76.83
	1997-99	45.25	22.67	40.00	76.17
Average outage dose/day (man.mSv/day)	1993-95	7.51	28.01	10.35	7.88
	1994-96	7.00	25.83	12.71	8.20
	1995-97	6.71	26.61	13.78	9.01
	1996-98	6.47	29.72	14.68	10.13
	1997-99	6.62	30.81	13.50	9.61
<i>Total number of outages</i>	1993-95	11	6	12	9
	1994-96	11	6	12	11
	1995-97	12	6	12	11
	1996-98	12	6	12	12
	1997-99	12	6	12	12

**ANNEX 2**

**Table. 3-Years rolling average of outage dose and minimum & maximum recorded (man.mSv)  
by BWR sister unit groups**

Sister Unit Group	Years	Minimum	Average	Maximum
ABB2	1993-95	768.60	1848.49	3292.00
	1994-96	768.60	1919.50	5362.00
	1995-97	1358.70	2095.60	5362.00
	1996-98	1281.00	2100.32	5362.00
	1997-99	868.80	1439.99	1807.00
ABB3	1993-95	210.65	930.30	1938.10
	1994-96	210.65	894.21	1698.25
	1995-97	210.65	984.04	2234.00
	1996-98	425.20	1029.78	2234.00
	1997-99	142.69	833.62	2234.00
ABB4	1993-95	443.00	607.92	833.90
	1994-96	465.10	877.14	1626.12
	1995-97	465.10	923.82	1626.12
	1996-98	432.61	892.45	1626.12
	1997-99	432.61	754.20	1317.29
GE5	1993-95	1018.54	2155.19	3660.94
	1994-96	1018.54	1747.96	3060.35
	1995-97	851.29	1392.96	2216.94
	1996-98	724.63	1334.18	2216.94
	1997-99	724.63	1274.65	2216.94
S69	1993-95	565.54	1840.20	3392.83
	1994-96	565.54	1241.04	3392.83
	1995-97	565.54	985.26	2023.00
	1996-98	461.00	1162.42	2495.20
	1997-99	324.80	1117.94	2495.20
S72	1993-95	298.00	1226.48	1792.20
	1994-96	298.00	985.05	1792.20
	1995-97	382.70	888.90	1357.60
	1996-98	336.30	697.52	1040.60
	1997-99	336.30	638.13	912.20

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**Table. 3-Years rolling average of outage dose and minimum & maximum recorded (man.mSv)  
by PWR sister unit groups**

Sister Unit Group	Years	Minimum	Average	Maximum
F31	1993-95	1149.31	2360.82	4135.56
	1994-96	1327.58	2296.76	4135.56
	1995-97	749.24	1838.62	3044.20
	1996-98	738.00	1599.13	3105.00
	1997-99	520.70	1416.03	3105.00
F32	1993-95	507.75	1931.46	6272.90
	1994-96	507.75	1787.61	5491.37
	1995-97	570.97	1644.11	5491.37
	1996-98	534.43	1487.73	5491.37
	1997-99	426.66	1299.97	3375.44
F42	1993-95	440.43	1127.71	3899.10
	1994-96	314.00	1012.17	3590.74
	1995-97	314.00	1053.05	3590.74
	1996-98	314.00	1091.88	3590.74
	1997-99	298.95	1026.86	2678.35
S21	1993-95	755.45	1919.18	4334.62
	1994-96	755.45	1878.74	4334.62
	1995-97	755.45	1550.29	2713.00
	1996-98	534.78	1272.49	2713.00
	1997-99	188.30	970.51	2713.00
S32	1993-95	281.84	1040.87	2170.77
	1994-96	175.59	893.52	2170.77
	1995-97	175.59	744.15	2170.77
	1996-98	78.66	539.17	817.15
	1997-99	78.66	616.55	1372.56
S41	1993-95	2380.40	5367.06	8084.61
	1994-96	1462.50	4499.13	6406.30
	1995-97	1019.20	3741.46	6406.30
	1996-98	930.30	3217.35	6324.50
	1997-99	930.30	2959.72	4746.35
S42	1993-95	234.80	670.90	1496.80
	1994-96	179.52	643.73	1496.80
	1995-97	158.50	605.65	1581.00
	1996-98	158.50	666.38	2130.00
	1997-99	98.30	806.24	2922.00
S43	1993-95	99.99	152.42	279.35
	1994-96	99.99	153.31	267.88
	1995-97	99.99	162.82	267.88
	1996-98	92.91	152.37	267.88
	1997-99	83.81	123.00	234.76
W21	1993-95	370.00	723.02	2311.00
	1994-96	320.83	476.88	720.00
	1995-97	218.13	432.73	720.00
	1996-98	218.13	373.44	569.00
	1997-99	218.13	407.39	1102.00
W32	1993-95	322.00	1381.41	2615.26
	1994-96	309.40	1351.48	3517.88
	1995-97	302.04	1210.12	3517.88
	1996-98	302.04	910.02	3517.88
	1997-99	298.26	766.10	2849.56

**Table. 3-Years rolling average of outage dose and minimum & maximum recorded (man.mSv)  
by PWR sister unit groups (next)**

Sister Unit Group	Years	Minimum	Average	Maximum
X32	1993-95	693.54	1548.99	3169.21
	1994-96	693.54	926.18	1259.40
	1995-97	463.02	829.47	1259.40
	1996-98	463.02	745.71	1259.40
	1997-99	449.43	581.84	719.70

**Table. 3-Years rolling average of outage dose and minimum & maximum recorded (man.mSv)  
by VVER sister unit groups**

Sister Unit Group	Years	Minimum	Average	Maximum
V213	1993-95	107.56	377.25	1258.36
	1994-96	107.56	389.89	1718.05
	1995-97	107.56	395.32	1718.05
	1996-98	124.32	401.73	1718.05
	1997-99	121.77	376.49	1069.20
V230	1993-95	362.59	626.50	1194.81
	1994-96	362.59	627.48	1449.24
	1995-97	362.59	971.06	1449.24
	1996-98	376.98	1341.30	2727.51
	1997-99	497.89	1260.26	2727.51
V311	1993-95	340.24	816.94	1518.71
	1994-96	340.24	895.57	1791.20
	1995-97	340.24	700.74	1791.20
	1996-98	445.94	906.49	1791.20
	1997-99	445.94	698.45	1127.14

**Table. 3-Years rolling average of outage duration and minimum & maximum recorded (days)  
by BWR sister unit groups**

Sister Unit Group	Years	Minimum	Average	Maximum
ABB2	1993-95	31	54	86
	1994-96	31	59	96
	1995-97	36	66	96
	1996-98	34	58	96
	1997-99	34	72	135
ABB3	1993-95	11	21	39
	1994-96	11	20	29
	1995-97	11	22	37
	1996-98	11	22	37
	1997-99	9	19	37
ABB4	1993-95	19	26	36
	1994-96	20	32	48
	1995-97	20	33	48
	1996-98	22	32	48
	1997-99	22	29	37
GE5	1993-95	33	39	52
	1994-96	20	37	52
	1995-97	20	32	42
	1996-98	20	31	42
	1997-99	25	29	36
S69	1993-95	39	77	171
	1994-96	26	53	109
	1995-97	26	46	69
	1996-98	21	62	187
	1997-99	19	59	187
S72	1993-95	23	50	72
	1994-96	23	39	68
	1995-97	22	34	52
	1996-98	22	29	38
	1997-99	21	29	38

**Table. 3-Years rolling average of outage duration and minimum & maximum recorded (days)  
by PWR sister unit groups**

Sister Unit Group	Years	Minimum	Average	Maximum
F31	1993-95	42	76	175
	1994-96	42	66	113
	1995-97	39	60	98
	1996-98	33	57	145
	1997-99	33	58	147
F32	1993-95	17	54	172
	1994-96	17	53	172
	1995-97	30	56	172
	1996-98	29	56	221
	1997-99	27	59	221
F42	1993-95	28	62	117
	1994-96	28	59	132
	1995-97	39	61	132
	1996-98	39	68	155
	1997-99	39	77	233
S21	1993-95	32	48	85
	1994-96	25	44	85
	1995-97	24	62	157
	1996-98	20	48	157
	1997-99	16	44	157
S32	1993-95	25	36	58
	1994-96	20	30	49
	1995-97	17	28	49
	1996-98	17	28	61
	1997-99	17	35	70
S41	1993-95	46	66	84
	1994-96	30	59	84
	1995-97	19	49	84
	1996-98	19	48	68
	1997-99	19	48	62
S42	1993-95	25	35	48
	1994-96	24	32	44
	1995-97	17	28	44
	1996-98	17	29	56
	1997-99	14	29	58
S43	1993-95	18	28	43
	1994-96	16	26	37
	1995-97	16	25	37
	1996-98	16	22	34
W21	1993-95	52	28	160
	1994-96	39	27	61
	1995-97	38	18	61
	1996-98	33	18	48
	1997-99	36	18	90
W32	1993-95	25	49	213
	1994-96	25	50	213
	1995-97	24	43	92
	1996-98	24	42	92
	1997-99	24	39	77

**Table. 3-Years rolling average of outage duration and minimum & maximum recorded (days)  
by PWR sister unit groups (next)**

Sister Unit Group	Years	Minimum	Average	Maximum
X32	1993-95	28	47	94
	1994-96	28	35	41
	1995-97	20	38	63
	1996-98	20	37	63
	1997-99	18	31	63

**Table. 3-Years rolling average of outage duration and minimum & maximum recorded (days)  
by VVER sister unit groups**

Sister Unit Group	Years	Minimum	Average	Maximum
V213	1993-95	25	46	75
	1994-96	25	46	80
	1995-97	24	46	80
	1996-98	24	46	80
	1997-99	24	44	74
V230	1993-95	42	60	105
	1994-96	42	52	79
	1995-97	43	77	125
	1996-98	46	102	160
	1997-99	39	102	160
V311	1993-95	17	29	63
	1994-96	17	35	64
	1995-97	16	26	64
	1996-98	16	31	64
	1997-99	16	23	37



ANNEX 3

**SISTER UNIT GROUPS (referred to in this Information Sheet)**

*In italics are the units belonging to the group from outside ISOE European region*

<b>PWR</b>		Flamanville 2	France	Vandellos 2	Spain
<b>F31</b>		Golfech 1	France	<i>Kori 3</i>	<i>Korea</i>
Bugey 2	France	Golfech 2	France	<i>Kori 4</i>	<i>Korea</i>
Bugey 3	France	Nogent 1	France	<i>Summer</i>	<i>USA</i>
Bugey 4	France	Nogent 2	France	<i>Yonggwang 1</i>	<i>Korea</i>
Bugey 5	France	Paluel 1	France	<i>Yonggwang 2</i>	<i>Korea</i>
Fessenheim 1	France	Paluel 2	France	<b>X32</b>	
Fessenheim 2	France	Paluel 3	France	Doel 3	Belgium
<b>F32</b>		Paluel 4	France	Tihange 2	Belgium
Blayais 1	France	Penly 1	France	<b>V213</b>	
Blayais 2	France	Penly 2	France	Bohunice 3	Slovakia
Blayais 3	France	St. Alban 1	France	Bohunice 4	Slovakia
Blayais 4	France	St. Alban 2	France	Dukovany 1	Czech Republic
Chinon B1	France	<b>S21</b>		Dukovany 2	Czech Republic
Chinon B2	France	Borssele	Netherlands	Dukovany 3	Czech Republic
Chinon B3	France	Obrigheim	Germany	Dukovany 4	Czech Republic
Chinon B4	France	<b>S32</b>		Greifswald 5	Germany
Cruas 1	France	Gosgen	Switzerland	Mochovce 1	Slovakia
Cruas 2	France	Neckar 1	Germany	Mochovce 2	Slovakia
Cruas 3	France	Trillo	Spain	Paks 1	Hungary
Cruas 4	France	<b>S41</b>		Paks 2	Hungary
Dampierre 1	France	Biblis A	Germany	Paks 3	Hungary
Dampierre 2	France	Biblis B	Germany	Paks 4	Hungary
Dampierre 3	France	Unterweser	Germany	<i>Kola 3</i>	<i>Russia</i>
Dampierre 4	France	<b>S42</b>		<i>Kola 4</i>	<i>Russia</i>
Gravelines 1	France	Brokdorf	Germany	<i>Rovno 1</i>	<i>Ukraine</i>
Gravelines 2	France	Grafenrheinfeld	Germany	<i>Rovno 2</i>	<i>Ukraine</i>
Gravelines 3	France	Grohnde	Germany	<b>V230</b>	
Gravelines 4	France	Philippsburg 2	Germany	Bohunice 1	Slovakia
Gravelines 5	France	<b>S43</b>		Bohunice 2	Slovakia
Gravelines 6	France	Emsland	Germany	Greifswald 1	Germany
St. Laurent B1	France	Isar 2	Germany	Greifswald 2	Germany
St. Laurent B2	France	Neckar 2	Germany	Greifswald 3	Germany
Tricastin 1	France	<b>W21</b>		Greifswald 4	Germany
Tricastin 2	France	Beznau 1	Switzerland	<i>Kola 1</i>	<i>Russia</i>
Tricastin 3	France	Beznau 2	Switzerland	<i>Kola 2</i>	<i>Russia</i>
Tricastin 4	France	Doel 1	Belgium	<i>Kozloduy 1</i>	<i>Bulgaria</i>
<i>Daya Bay 1</i>	<i>China</i>	Doel 2	Belgium	<i>Kozloduy 2</i>	<i>Bulgaria</i>
<i>Daya Bay 2</i>	<i>China</i>	<i>Gimma</i>	<i>USA</i>	<i>Kozloduy 3</i>	<i>Bulgaria</i>
<i>Koeberg 1</i>	<i>South Africa</i>	<i>Mihama 1</i>	<i>Japan</i>	<i>Kozloduy 4</i>	<i>Bulgaria</i>
<i>Koeberg 2</i>	<i>South Africa</i>	<i>Point Beach 1</i>	<i>USA</i>	<b>V311</b>	
<i>Ulchin 1</i>	<i>Korea</i>	<i>Point Beach 2</i>	<i>USA</i>	Loviisa 1	Finland
<i>Ulchin 2</i>	<i>Korea</i>	<b>W32</b>		Loviisa 2	Finland
<b>F42</b>		Almaraz 1	Spain	<b>BWR</b>	
Belleville 1	France	Almaraz 2	Spain	<b>ABB2</b>	
Belleville 2	France	Asco 1	Spain	Barsebäck 1	Sweden
Cattenom 1	France	Asco 2	Spain	Barsebäck 2	Sweden
Cattenom 2	France	Doel 4	Belgium	Oskarshamn 2	Sweden
Cattenom 3	France	Harris 1	USA	<b>ABB3</b>	
Cattenom 4	France	Ringhals 3	Sweden	Forsmark 1	Sweden
Flamanville 1	France	Ringhals 4	Sweden		
		Tihange 3	Belgium		

Forsmark 2 Sweden

TVO 1 Finland

TVO 2 Finland

**ABB4**

Forsmark 3 Sweden

Oskarshamn 3 Sweden

**GE5**

Cofrentes Spain

Leibstadt 1 Switzerland

*Clinton* USA

*Grand Gulf 1* USA

*Perry 1* USA

*River Bend 1* USA

**S69**

Brunsbüttel 1 Germany

Isar 1 Germany

Krümme 1 Germany

Philippsburg 1 Germany

**S72**

Gundremmingen B Germany

Gundremmingen C Germany

