PROGRESS REPORT ON THE MANAGEMENT OF THE NEA ISOE SYSTEM

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ABSTRACT

The Information System on Occupational Exposure (ISOE) was launched by the Organisation for Economic Cooperation and Development (OECD), Nuclear Energy Agency (NEA) on 1 January, 1992, to facilitate the communication of dosimetric and ALARA implementation data among nuclear utilities around the world. After two years of operation the System has become a mature interactive network for transfer of data and experience. Currently, 37 utilities from 12 countries, representing 289 power plants, and 12 national regulatory authorities participate in ISOE. Agreements for cooperation also exist between the NEA and the Commission of the European Communities (CEC), and the Paris Center of the World Association of Nuclear Operators (WANO-PC). In addition, the International Atomic Energy Agency (IAEA) is acting as a co-sponsor of ISOE for the participation of non-NEA member countries. Three Regional Technical Centres, Europe, Asia, and Non-NEA member countries, serve to administer the system. The ISOE Network is comprised of three data bases and a communications network at several levels.

The three ISOE data bases include the following types of information: NEA1 - annual plant dosimetric information (annual operational collective dose, and annual outage collective dose, man-hours, and number of workers broken into 20 job categories and 75 sub-categories, etc.); NEA2 - plant operational characteristics for dose and dose rate reduction (primary water chemistry, cobalt replacement programs, ALARA organisation structure, start-up and shut-down procedures, etc.); and NEA3 - job specific ALARA practices and experiences.

The ISOE communications network has matured greatly during 1992 and 1993. In addition to having access to the above mentioned data bases, participants may now solicit information on new subjects, through the Technical Centres, from all other participants on a real-time basis. Information Sheets on these studies are produced for distribution to all participants. In addition, Topical Reports on areas of interest are produced, and Topical Meetings are held annually.

INTRODUCTION

In order to facilitate the exchange of techniques and experiences in occupational exposure reduction, the Nuclear Energy Agency (NEA) of the Organisation for Economic Cooperation and Development (OECD) launched the Information System on Occupational Exposure (ISOE) on 1 January 1992 after a one year pilot program. This three level data base joins utilities and regulatory agencies throughout the world, providing occupational exposure data for trending, cost-benefit analyses, technique comparison, and other ALARA analyses.

The ISOE Structure

The ISOE system consists of three data bases of occupational exposure information. The first, NEA1, contains for each participating reactor various radiation protection performance indicators: total annual collective dose, non-outage annual collective dose, outage annual collective dose divided into 20 job categories and 75 sub-categories, annual collective man-hours and number of workers associated with each job category and sub-category, and annual individual dose distribution are included. Although not all reactors provide data for all categories, all the data provided are updated annually.

The second data base, NEA2, contains for each participating reactor information concerning methods and techniques used for dose and dose rate control. Primary water chemistry, cobalt replacement/reduction programs, primary water filtering, surface preconditioning, decontamination, work practices, ALARA organisation and management, tools and procedures, and motivation and training practices are listed. The dosimetric effect of each practice is quantified as best possible. This type of information normally evolves rather than changes, thus this data base is updated by the participating utilities on an as needed basis. Information for this data base will be collected for the first time in 1994.

The third data base, NEA3, contains details on the dosimetric results of specific operations. Items as large as the removal of the reactor temperature detector bypass system, or as specific as reactor vessel head control rod drive penetration inspections have been the subjects of NEA3 reports. Important radiological aspects of the operation, and the name, address, and phone number of a contact person for further information are listed. The participating utilities are encouraged to complete NEA3 reports as often as they perform operations with interesting radiation protection aspects.

ISOE Software

To facilitate access to and interrogation of the data bases, the user-friendly Windows environment is used. The NEA1 and NEA3 questionnaires are computerized, and NEA1 is available in English, French, German, Spanish, Italian, Dutch, and Japanese. The NEA2 questionnaire will be computerized for use in 1994. A multi-layered key-word search routine facilitates the interrogation of the NEA3 data base, and can be used to generate lists of reports in an area of interest. Finally, the interrogation of the NEA1 data base, for numerical analyses of occupational dose data, will in 1994 be performed using a Windows-based system.

CURRENT STATUS OF PARTICIPATION

As ISOE nears the end of its second full year of successful operation, its list of participants continues to grow:

> Currently, 37 utilities from 12 countries, and 12 national regulatory authorities participate. Additional data for reactors in non-participating countries is collected from published reports such that the data base now represents 185 PWRs, 84 BWRs, 20 CANDU reactors (see Appendix I for a full list of participants).
>
> The Commission of the European Communities (CEC) and the NEA have signed a cooperative agreement such that the ISOE data base now also serves the European Community's data needs, and such that ISOE and CEC programs in occupational exposure remain complementary.
>
> Several European regulatory authorities are investigating the use of the ISOE format for their national occupational exposure reporting systems to avoid duplication of effort by utilities.

The Paris Center of the World Association of Nuclear Operators (WANO-PC) and the NEA have signed a Memorandum of Understanding to assure co-ordination of the activities of the two organizations in the field of occupational exposure.

The International Atomic Energy Agency (IAEA) and the NEA have established a cooperative agreement whereby the IAEA co-sponsors ISOE, acting as the ISOE Technical Centre for the participation of non-NEA countries. China, Mexico, and Hungary are participating in the one year trial run of this program.

The Nuclear Power Engineering Corporation (NUPEC) has agreed to act as the ISOE Technical Centre for Asian NEA member countries, notably Japan and Korea.

The Centre d'Etude sur l'Évaluation de la Protection dans le Domaine Nucléaire (CEPN) acts as the ISOE Technical Centre for European NEA member countries.

A North American Technical Centre, which will serve the United States and Canada, will be established during 1994, after a one year, small scale trial run.

Thus ISOE has a wide following and is the most complete occupational exposure data base in the world. The value of such a widely used system is its ability to efficiently facilitate the exchange of occupational exposure reduction experiences and practices among participants.

THE USE OF THE ISOE SYSTEM AND NETWORK

There are several diverse ways in which ISOE can be used by its participants. The ISOE System, consisting of the three data bases and their associated software, can be used for statistical and comparative studies, and as a source of good practices and experiences. The ISOE Network, which consists of all Participating Utilities and Authorities, Regional Coordinators for certain countries, and the ISOE Technical Centres, serves as an open line of communication for the real time exchange of data, experiences, policies, practices, etc. In addition, ISOE Expert Groups are established from time to time to perform specific studies based on participant's needs. More regularly, the Annual ISOE Steering Group meeting includes a Topical Session during which current issues of interest to the participants are presented and discussed.

Use of The ISOE System

As described earlier, the three ISOE data bases contain annual operational dosimetry data (NEA1), plant configurational and administrative data (NEA2), and operational experience reports (NEA3). These data bases can be used individually, or together, to perform interesting studies.

<u>NEA 1</u>

At the end of each calendar year, operational occupational exposure data is collected from all Participating Utilities for the NEA 1 data base, and is summarized and analyzed. This data is most useful for trending and comparative studies. The evolution of average annual collective dose per reactor, as shown in Figure 1 for PWRs and Figure 2 for BWRs, is an example of the type of trending which can be performed. These types of studies are published each year by the NEA in an Annual ISOE Report[1, 2]. More detailed analyses are also possible.

Figure 1: Average Annual Collective Dose per Reactor (PWR)

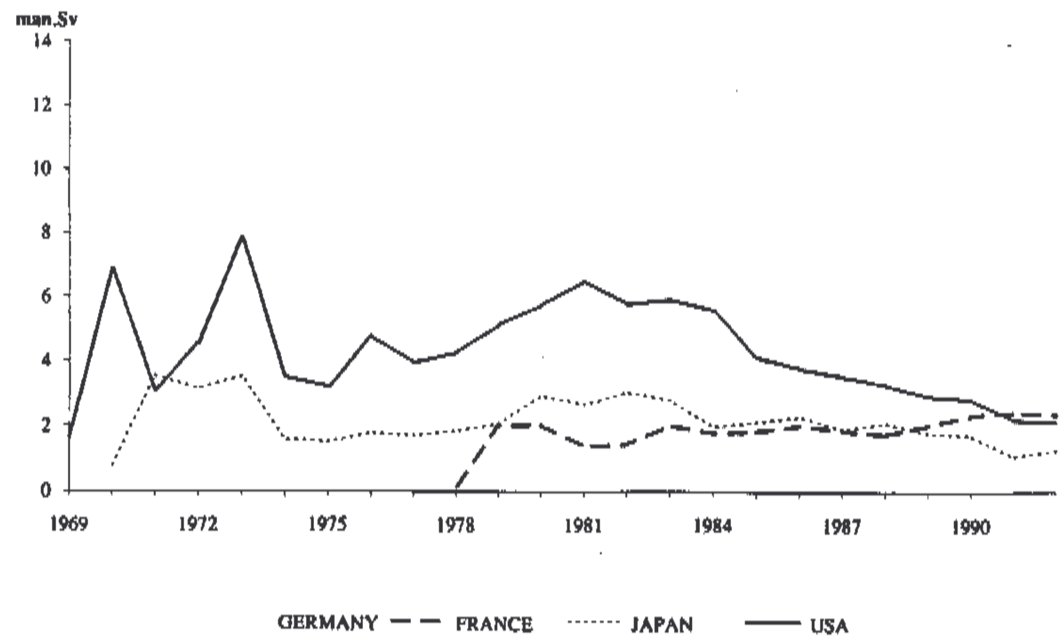
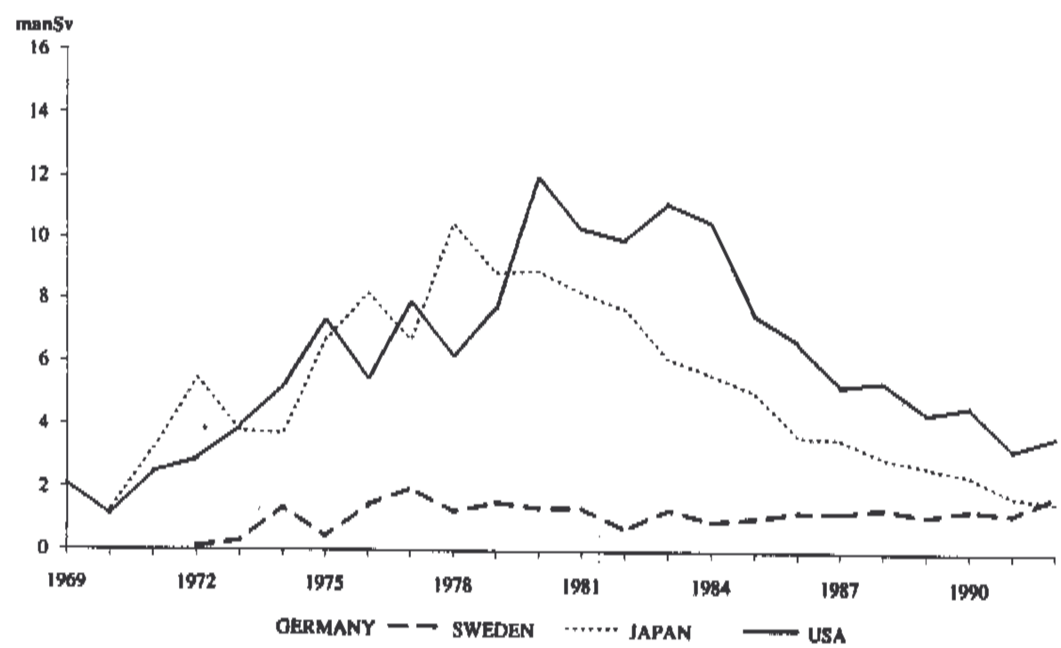


Figure 2: Average Annual Collective Dose per Reactor (BWR)



For Example, ISOE data through 1991 was used by the Centre d'étude sur l'Evaluation de la Protection dans le domaine Nucléaire (CEPN) to study, for the NEA, the effect of reactor age and size on occupational exposure[1]. Tables 1 to 3 show the results of this study for PWRs, BWRs, and CANDUs in Europe, North America, and Asia. Although it is difficult to draw concrete conclusions from such a study, partly due to the irregular statistics of small sample sizes, the trend for modern and intermediate age reactors, of large and medium size, is that average annual collective doses increase with age and decrease with size. The decreasing of average annual collective dose inversely with age may be due to the progressive buildup of corrosion products. The decrease with size may be because larger plants are often of more modern design, thus incorporating design improvements.

Another study was performed the following year, again by the CEPN, on the effect of fuel cycle length on average annual collective doses[2]. The average full cycle time, operation time, and refuelling outage time were plotted against average annual collective dose per country (see Tables 4 and 5, and Figures 3 to 8). Fuel cycle lengths were taken from the ELECNUC[3] data base. In order to correctly account for different full cycle lengths, the annual collective dose used for comparison purposes has been averaged over three years (1990 to 1992). Again, concrete conclusions are difficult, however, it is clear that these simple averages, for all ages and sizes of reactor together, do not support an argument that longer cycles result in smaller collective doses. Looking simply at Figures 7 and 8, refuelling outage length versus annual collective dose, the trend appears to show an increasing dose with increasing refuelling outage length. However significant fluctuations in average annual collective dose make it difficult to link this increasing trend uniquely to increases in refuelling outage length.

In addition to annual collective dose data, the NEA 1 data base contains doses by task. European countries are currently the only participants who routinely supply this data. Doses for three such tasks, General Work, Scaffolding, and Insulation, are listed as their percentage of total outage dose in Tables 6 to 7, for PWRs and BWRs, for the years 1990 through 1992. These tasks, known collectively as Services, typically account for significant fractions of the total outage dose. As can be seen from these tables, there is significant variation from country to country. Although further study is necessary to fully understand these variations, these tables demonstrate that some participants have found effective ways to control Services doses.

All three of the studies discussed above show interesting trends in occupational dosimetry, and are intended to demonstrate the range of studies that can be performed using the ISOE NEA 1 data base. Further detailed studies, sorting data by reactor make, age, model, etc., may provide more definitive conclusions, and can be performed by participants based on their needs, using the ISOE data base and software.

NEA 2

Data for the NEA 2 data base will be collected for the first time during 1994. Interesting aspects of this data base, such as the type of primary system water chemistry used, start-up and shut-down procedures, or the use of "standard" shielding and scaffolding configurations, can be used in a comparative fashion by participants. Combined with historical data from the NEA 1 data base, the dosimetric success of various operating regimes and procedures can be studied.

NEA 3

The last of the data bases, NEA 3, is a repository for brief reports on good, and bad, practices, procedures and experiences. The data base can be interrogated at any time by participants, using key-word search software, to learn from the experiences of others. As important as the data contained in each NEA3 report is the name and address of the author for follow-up and in depth questions.

Table 1
Average Annual Collective Dose (man Sv) for PWRs
as a Function of Reactor Size and Age
for Europe, North America, and Asia

Plant Age	Small Plants (<700 MWe)	Medium Plants (700-1000 MWe)	Large Plants (>1000 MWe)
Europe			
Modern	-	1.25 (3)	0.9 (18)
Intermediate	-	2.3 (25)	1.4 (10)
Old	2.3 (10)	3.2 (19)	5.7 (3)
North America			
Modern	-	2.3 (1)	1.9 (11)
Intermediate	-	2.9 (1)	2.5 (7)
Old	1.9 (8)	2.4 (24)	1.8 (8)
Asia			
Modern	0.4 (1)	-	0.8 (1)
Intermediate	1.2 (1)	0.9 (4)	-
Old	1.7 (2)	2.1 (3)	5.5 (2)

Plant Age
Modern: 1 - 5 years
Intermediate: 6 - 10 years
Old: > 10 years

Table 2
Average Annual Collective Dose (man Sv) for BWRs
as a Function of Reactor Size and Age
for Europe, North America, and Asia

Plant Age	Small Plants (<700 MWe)	Medium Plants (700-1000 MWe)	Large Plants (>1000 MWe)
Europe			
Modern	-	-	-
Intermediate	-	3.0 (2)	1.3 (7)
Old	1.9 (8)	1.6 (5)	1.0 (1)
North America			
Modern	-	1.9 (2)	1.7 (5)
Intermediate	-	-	3.1 (6)
Old	4.6 (7)	3.8 (10)	2.6 (5)
Asia			
Modern	-	0.3 (1)	0.4 (1)
Intermediate	0.5 (1)	-	2.6 (3)
Old	3.7 (4)	3.6 (3)	2.7 (2)

Table 3
Average Annual Collective Dose (man Sv) for CANDUs as a Function of Reactor Size and Age
for North America

Plant Age	Small Plants (<700 MWe)	Medium Plants (700-1000 MWe)	Large Plants (>1000 MWe)
North America			
Modern	-	0.4 (2)	-
Intermediate	0.4 (6)	0.4 (3)	-
Old	1.2 (4)	0.7 (4)	-

Plant Age
Modern: 1 - 5 years
Intermediate: 6 - 10 years
Old: > 10 years

Table 4
Average Collective Dose per Reactor Year,
Full Cycle, Operation Cycle, and Refueling Cycle Length
for PWRs for 1990 and 1992

Country	Average Collective Dose per Reactor year (man Sv)	Average Full Cycle Length (days)	Average Operation Cycle Length (days)	Average Refueling Outage Length (days)
Belgium	1.51	386	347	39
Finland	1.30	382	344	38
France	2.38	433	338	95
Germany	2.12	401	323	78
Netherlands	1.68	380	320	60
Spain	2.02	393	349	44
Sweden	1.01	360	316	44
Switzerland	1.5	361	312	49
Europe	2.14	413	336	77
Japan	1.39	478	363	115
United States	2.44	559	477	82

Table 5
Average Collective Dose per Reactor Year,
Full Cycle, Operation Cycle, and Refueling Cycle Length
for BWRs for 1990 and 1992

Country	Average Collective Dose per Reactor year (man Sv)	Average Full Cycle Length (days)	Average Operation Cycle Length (days)	Average Refueling Outage Length (days)
Finland	0.90	367	350	17
Germany	2.18	440	381	59
Netherlands	0.88	353	308	44
Spain	4.20	546	482	64
Sweden	1.44	363	331	32
Switzerland	2.04	366	327	39
Europe	1.89	394	353	41
Japan	2.20	507	382	125
United States	3.76	610	511	99

Table 6
Average Percentage of the Total Outage Dose
Spent on Services for PWRs in Europe

Country	1990 (%)	# of Plants	1991 (%)	# of Plants	1992 (%)	# of Plants
General Work						
Belgium	21.44	7	15.96	7	8.31	5
Finland	3.80	2	3.95	2	15.20	2
France	15.80	39	14.24	43	14.53	43
Germany	8.85	2	8.66	4	15.96	5
Netherlands	11.28	1	15.38	1	5.43	1
Spain	15.10	6	17.15	4	14.12	5
Sweden	4.73	3	13.51	2	8.28	3
Scaffolding						
Belgium	1.95	1	2.13	3	2.86	5
Finland	-	-	-	-	3.48	2
France	2.92	39	2.91	43	3.09	42
Germany	1.50	3	2.47	5	3.53	5
Netherlands	4.89	1	7.86	1	5.93	1
Spain	1.81	5	2.27	4	3.16	6
Sweden	1.52	3	0.72	2	1.39	3
Insulation						
Belgium	6.71	5	8.98	3	5.60	6
Finland	-	-	-	-	10.18	2
France	5.68	39	6.40	43	7.36	43
Germany	6.36	3	8.83	5	4.59	5
Netherlands	11.72	1	12.79	1	6.03	1
Spain	5.98	6	6.04	4	7.83	7
Sweden	3.50	3	4.12	2	9.97	3

Table 7
Average Percentage of the Total Outage Dose
Spent on Services for BWRs in Europe

Country	1990 (%)	# of Plants	1991 (%)	# of Plants	1992 (%)	# of Plants
General Work						
Germany	17.37	2	11.71	3	27.40	4
Netherlands	21.73	1	23.43	1	-	-
Spain	16.22	2	13.77	1	12.06	1
Sweden	6.92	9	9.99	9	8.83	7
Scaffolding						
Germany	3.05	3	0.51	1	7.15	3
Netherlands	-	-	-	-	-	-
Spain	2.17	2	1.42	1	3.77	1
Sweden	2.57	9	3.40	8	4.43	7
Insulation						
Germany	6.35	5	9.61	3	28.02	4
Netherlands	-	-	-	-	-	-
Spain	4.86	2	5.75	1	5.49	1
Sweden	8.88	9	11.15	9	18.86	7

Figure 3: Average Full Cycle Length and Average Collective Dose per Reactor Year (PWR, 1990 - 1992)

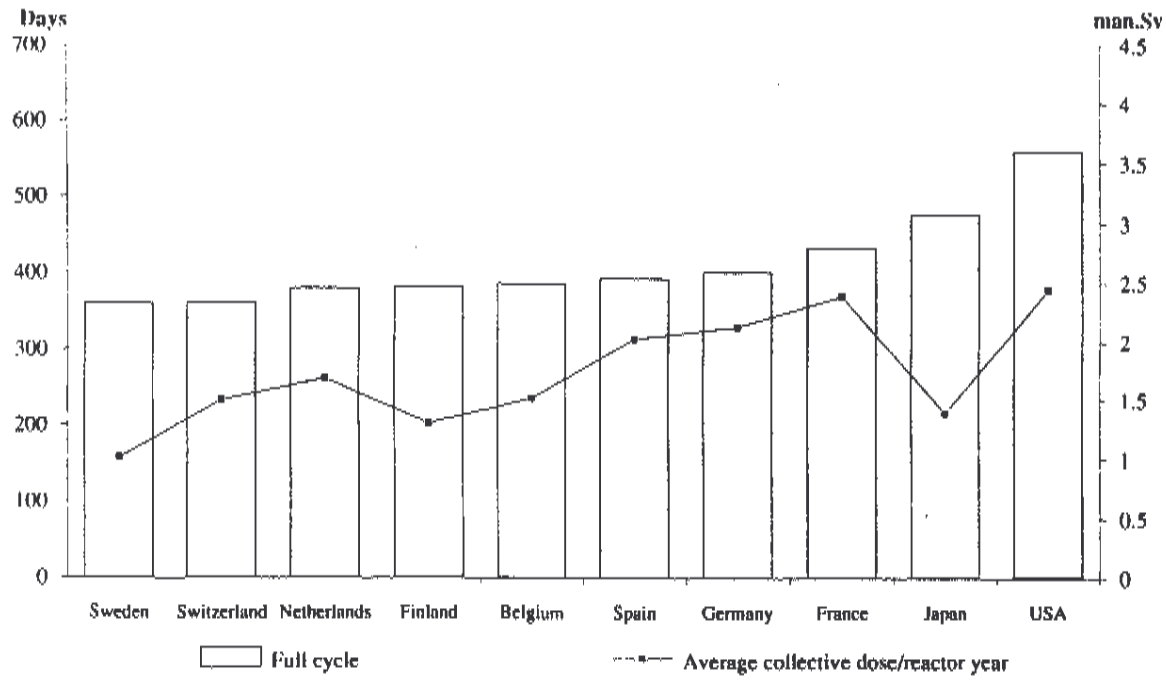


Figure 4: Average Full Cycle Length and Average Collective Dose per Reactor Year (BWR, 1990 - 1992)

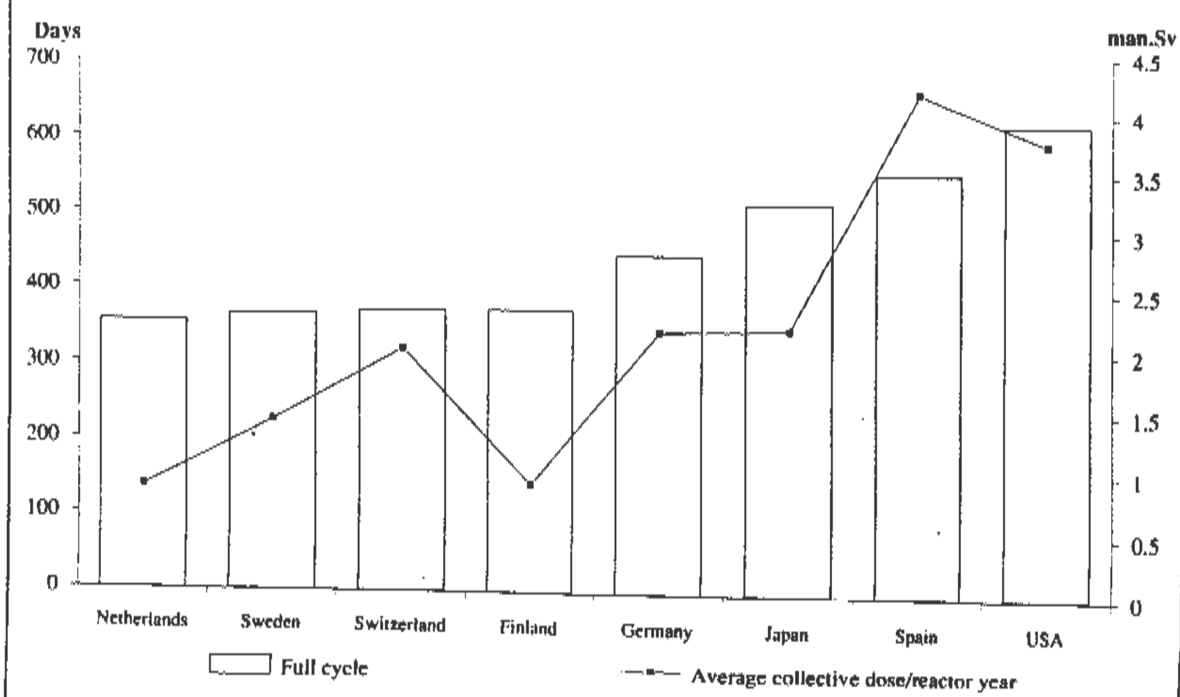


Figure 5: Average Operation Cycle Length and Average Collective Dose per Reactor Year (PWR, 1990 - 1992)

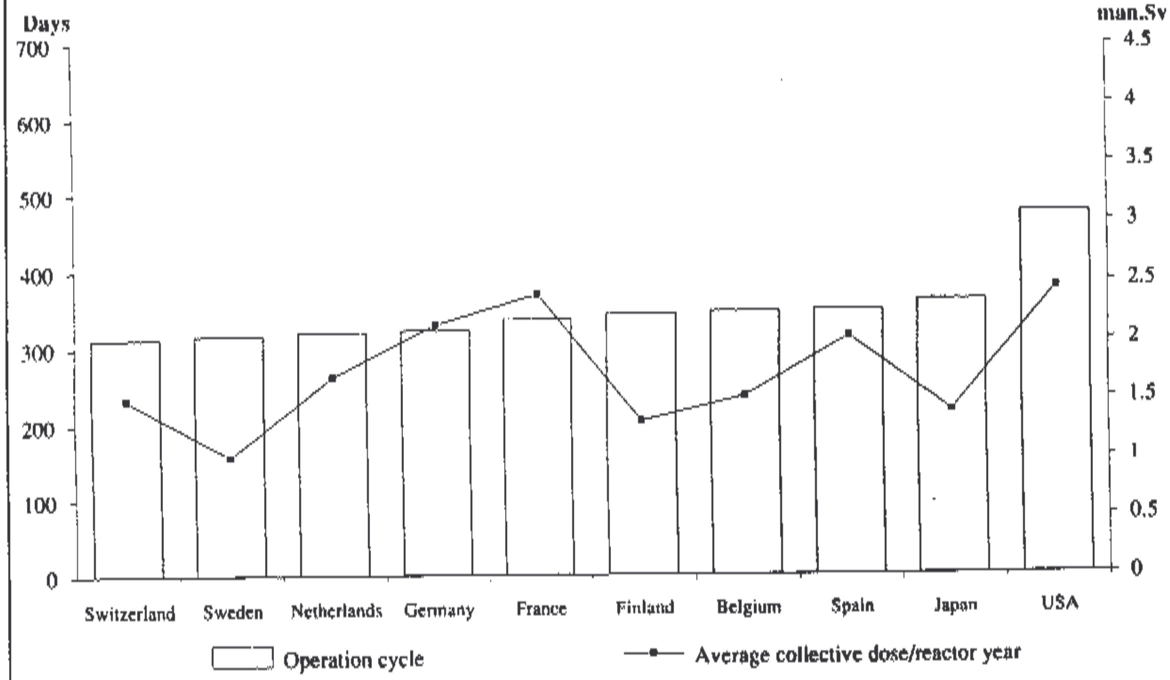


Figure 6: Average Operation Cycle Length and Average Collective Dose per Reactor Year (BWR, 1990 - 1992)

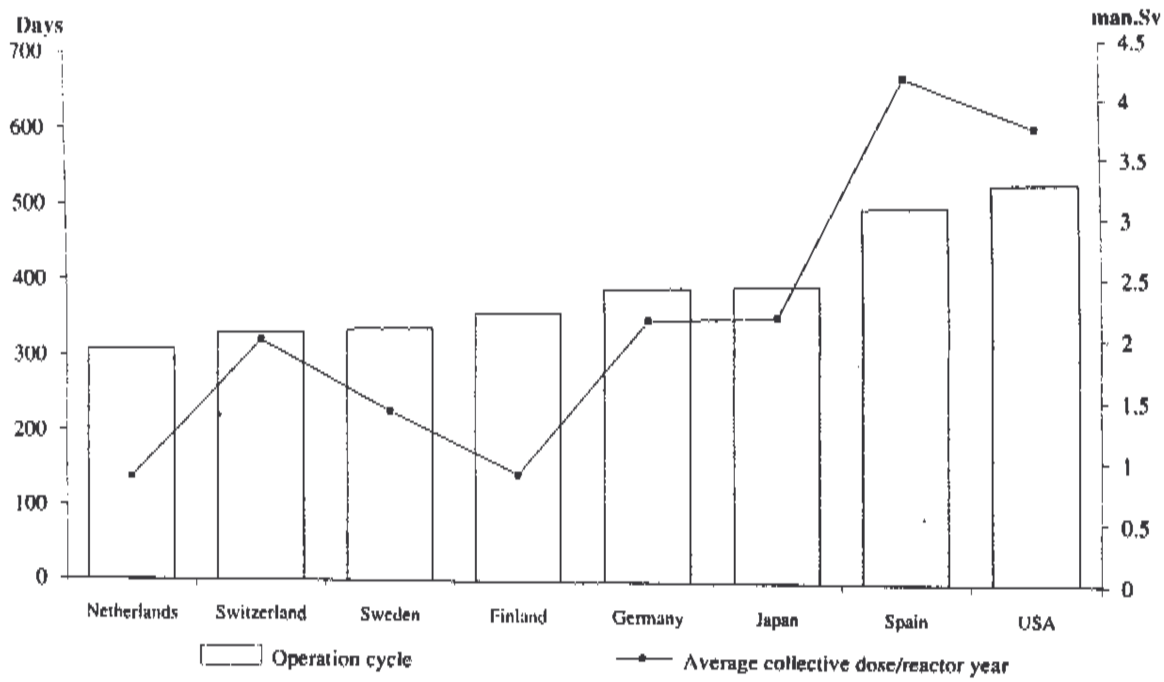


Figure 7: Average Refueling Outage Length and Average Collective Dose per Reactor Year (PWR, 1990 - 1992)

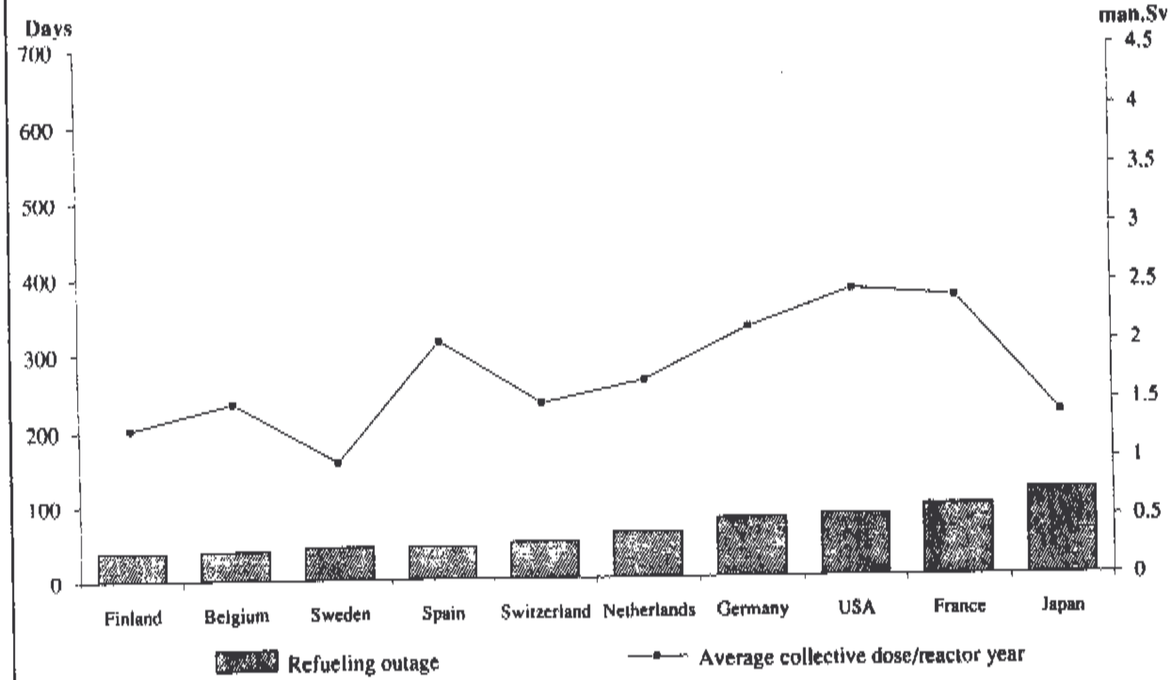
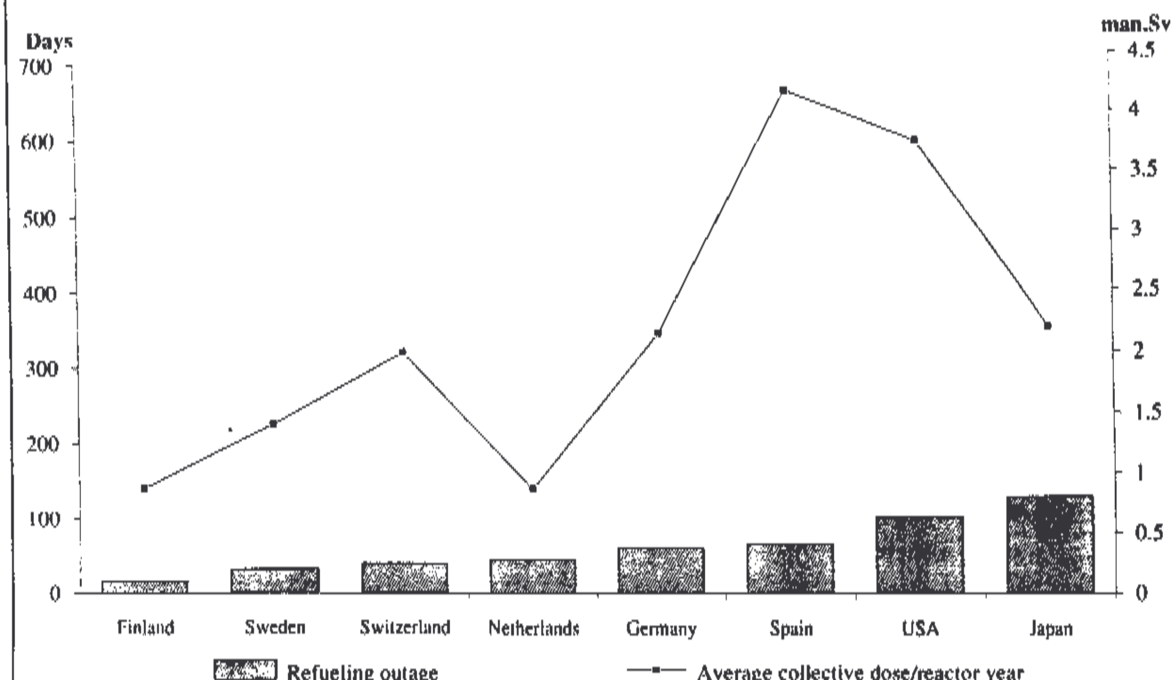


Figure 8: Average Refueling Outage Length and Average Collective Dose per Reactor Year (BWR, 1990 - 1992)



In addition, in the case where several NEA 3 reports have been submitted on the same subject, Topical Reports can be prepared comparing the various experiences. For example, several NEA3 reports were submitted by French and Swedish reactors, summarizing their experiences in reactor vessel head inspection and repair, prompted by the discovery of cracks in the thermal sleeves of control rod drive vessel head penetrations. The French found dose rate reduction factors to be superior using mechanical brushing (reductions from 2 to 10) than those attained using high pressure water decontamination (factor of 1.65). Ambient dose rates both under and on the vessel head were reduced by factors of 3 to 5 by the use of specially adapted shielding. In conjunction with this work, both the Swedish and the French found the removal and replacement of thermal insulation on the vessel head to be dosimetrically costly, such that the Swedish have replaced old style insulation with modern quick-disconnect insulation to facilitate future inspections and refuellings. The French have designed special scaffolding to speed installation. Robotics is in development in both countries.

Another interesting Topical Report concerned the removal of the reactor temperature detector bypass system. Seventeen NEA3 reports on the subject were found and compared.

A Topical Report to be completed in 1994 will compare the steam generator replacement operations at Doel in Belgium, North Anna in the United States, Dampierre and Bugey in France, and Beznau and Ringhals in Sweden.

The ISOE Network

The ISOE network consists of all participating utilities and authorities, the ISOE Technical Centres, and national ISOE coordinators. Participants interested in the experience of others in specific areas not already covered by NEA 3 reports may request that the Technical Centres solicit the needed information. Participating utilities, authorities, and national ISOE coordinators are then contacted by the Technical Centres and the resulting information is passed on to the requestor and made available to all other participants. Recent examples of the use of this network system have included a utility's request for information concerning the decontamination of the residual heat removal (RHR) system for the replacement of an RHR heat exchanger channel head; an authority's request for information concerning the dosimetric impact of vessel head inspections in France, Switzerland, Sweden, and Belgium; a utility's request for information regarding experience in reactor vessel decontamination, a utility's request for experience in refuelling pool decontamination, and a utility's request for experience in the repair of fuel storage rack anti-seismic snubbers. In all these cases, the ISOE network was questioned by the European ISOE Technical Centre (the CEPN), and the information collected from participating utilities was passed on to the requestor within a very short period. Topical Reports will be written on these subjects and distributed to all participants.

ISOE Expert Groups

Based on the needs of the ISOE participants, as decided by the ISOE Steering Group, Expert Groups may be established to study specific questions. Two such Expert Groups are currently at work.

The first Expert Group is investigating dosimetry recording and reporting practices to better understand, and thus analyze, the data supplied to ISOE. For example, whether or not background is subtracted from reported doses, what dose recording level is used and how are doses below this level reported, are extremity or skin doses recorded and reported, are neutron doses recorded and reported, etc., are the types of questions which need to be answered so that valid analyses of the ISOE data can be performed.

The second Expert Group is trying to quantify the impact of "work management" on occupational exposure. In that most radiation protection practices must be justified, often in monetary terms, in order to gain management support, techniques and approaches to quantification are being studied. In addition, this Expert Group will also be addressing the somewhat related question of the impact of regulatory requirements on occupational exposures. This study is intended to provide data for the ongoing discussion of nuclear safety versus occupational exposure.

Both of these Expert Groups will produce ISOE Technical Reports, based on their studies, which will be distributed to participants and, based on the recommendation of the ISOE Steering Group, may be issued as NEA reports.

ISOE Technical Sessions

Each year the ISOE Steering Group meets to discuss administrative and organizational issues associated with ISOE. In addition, a Topical Session, like a small workshop, is held during which "invited papers" on topics of current interest are presented by participants and discussed. Topics such as lessons learned during steam generator replacement, failed fuel prevention programs, and rework prevention programs, will be discussed at upcoming meetings.

CONCLUSIONS

After two years of operation and expanding participation, the ISOE system appears to have reached the "critical mass" necessary to efficiently provide its users with a very broad range of detailed information. Continued growth, and efforts by all participants to deliver timely and useful information, will help to foster the dedication necessary to keep ISOE an up-to-date conduit for occupational exposure experience throughout the world.

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2. ISOE, "Nuclear Power Plant Occupational Exposures in OECD Countries: 1969 - 1992," OECD, (in preparation).
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