Radiation Protection

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Occupational Exposures at Nuclear Power Plants

OECD Nuclear Energy Agency
International Atomic Energy Agency

ISOE

INFORMATION SYSTEM ON OCCUPATIONAL EXPOSURE

Fourteenth Annual Report of the ISOE Programme, 2004

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NEA No. 6164

NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full member. NEA membership today consists of 28 OECD member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

FOREWORD

Throughout the world, occupational exposures at nuclear power plants have been steadily decreasing since the early 1990s. An increased focus on plant operational procedures and work-management practices, improved water chemistry, technological advances, regulatory pressures, and exchange of information and experience have contributed to this downward trend. However, with the ageing of the world's nuclear power plants, the task of maintaining occupational exposures at low levels has become increasingly difficult. In addition, economic pressures have led plant operation managers to streamline refuelling and maintenance operations as much as possible, thus augmenting scheduling and budgetary pressures on the task of reducing operational exposures.

In response to these pressures, radiation protection personnel have found that occupational exposures are best managed through proper job planning, implementation, and review to ensure that exposures are "as low as reasonably achievable" (ALARA). A prerequisite for applying the principle of optimisation to occupational radiation protection is the appropriate and timely exchange of data, techniques and experience on doses and dose reduction methods. To facilitate this global approach to work management and occupational exposure reduction, the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) launched the Information System on Occupational Exposure (ISOE) on 1 January 1992 after a two-year pilot programme. The objective of ISOE is to provide a forum for radiation protection experts from utilities and national regulatory authorities to discuss, promote and coordinate international co-operative undertakings for the radiological protection of workers at nuclear power plants.

Participation in ISOE includes representatives from both utilities (public and private) and from national regulatory authorities. Since 1993, the International Atomic Energy Agency (IAEA) has co-sponsored the ISOE Programme, thus allowing the participation of utilities and authorities from non-NEA member countries. In 1997, NEA and IAEA formed a Joint Secretariat in order to leverage the strengths of both organisations for the benefit of the ISOE Programme. Four ISOE Technical Centres (Europe, North America, Asia and IAEA) manage the programme's day-to-day technical operations.

The ISOE Programme includes the world's largest occupational exposure database, a network of utility and authority radiation protection experts, and supporting technical centres for the analysis and exchange of information and experience. First, occupational exposure data and experience are collected annually from all participants to form the ISOE Databases. Due to the varied nature of the data collected, three distinct but linked databases are used for data storage, retrieval and analysis. Second, in creating the network necessary for data collection, close contacts have been established among utilities and authorities from all over the world, thus creating an ISOE Network for the direct exchange of operational experience. Since its inception, ISOE participants have used this dual system of databases and communications networks to exchange occupational exposure data and information for dose trend analyses, technique comparisons, and cost-benefit and other analyses promoting the application of the ALARA principle in local radiation protection programmes.

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EXECUTIVE SUMMARY

Since 1992, the ISOE programme has facilitated and supported the optimisation of worker doses in nuclear power plants through a communication and experience exchange network for radiation protection managers of nuclear power plants and national authorities world wide, and through the development and publication of improved work management procedures. This Fourteenth Annual Report of the ISOE Programme, 2004 represents the status of the ISOE Programme at the end of December 2004.

At the end of 2004, the ISOE programme included 71 Participating Utilities in 29 countries. The ISOE database itself included information on occupational exposure levels and trends at 478 reactor units (403 operating and 75 in cold-shutdown or some stage of decommissioning) in 29 countries. This database thus covers 91% of the total number of power reactors (442) in commercial operation throughout the world. In addition, the regulatory authorities of 25 countries participate actively in ISOE. During 2004, the Korean PWR Ulchin 5 (1 000 MWe), the Czech VVER Temelin 1 and 2 (1 000 MWe) and Russian VVER Kalinin 3 (1 000 MWe) started commercial operations.

In 2004, the average annual dose for operating power reactors maintained a fairly low level with a slight decreasing trend to 0.75 man·Sv for pressurised water reactors (PWR), 1.45 man·Sv for boiling water reactors (BWR), and 0.98 man·Sv for pressurised heavy water reactors (PHWR/CANDU), with an average dose for all reactors of 0.92 man·Sv.

In addition to information on operating reactors, the ISOE database contains dose data from 75 reactors which are shutdown or in some stage of decommissioning. As the reactors represented in the database are of different type and size, and are generally at different phases of their decommissioning programmes, it is very difficult to identify clear dose trends and to draw definitive conclusions.

While the collection and analysis of occupational exposure data is a main pillar of the ISOE programme, the ISOE programme also consists of an important information exchange component. To this end, the web-based ISOE Information Network (www.isoe-network.net) was formally launched during 2004 and work began on the migration of the ISOE databases to a web-based application for integration into the ISOE website. An ad-hoc group on the future directions was also established to look at how the ISOE programme can best meet the needs of end users. Strong utility involvement in this group will help increase the usefulness and effectiveness of its recommendations and actions.

The 2005 International ISOE ALARA Symposium was held in Ft. Lauderdale, Florida, organised by the ISOE North American Technical Centre, and co-sponsored by the OECD/NEA and IAEA. The symposium, focused on “Industry Operational Experiences”, continued the tradition of providing a global forum to promote the exchange of ideas and management approaches to maintaining occupational radiation exposures “as low as reasonably achievable” (ALARA). The broad international participation in this workshop shows the continued interest in optimisation of radiation protection and occupational exposure issues.

Recent developments and principal events in ISOE participating countries are summarised in chapter 2.5 of this report. Details of the continued growth of the ISOE programme, as well as the programme of work for 2005 are provided in Chapter 3.

SYNTHÈSE DU RAPPORT

Depuis 1992, le programme ISOE facilite la mise en œuvre de l'optimisation de la radioprotection des travailleurs dans les centrales nucléaires, par le biais d'un réseau de communication et d'échanges de retour d'expérience entre les responsables de la radioprotection des centrales nucléaires et les représentants des autorités réglementaires du monde entier, et à travers le développement et la publication de procédures de gestion du travail. Ce 14ème rapport annuel du système ISOE présente l'état du programme ISOE à fin décembre 2004.

À la fin 2004, le programme ISOE inclut 71 exploitants de 29 pays. La base de données contient des informations sur les expositions professionnelles et leurs évolutions pour 478 réacteurs (403 en fonctionnement et 75 en arrêt à froid ou en cours de démantèlement) dans ces 29 pays. La base couvre ainsi 91 % de l'ensemble (441) des réacteurs de puissance en fonctionnement dans le monde. De plus, les autorités réglementaires de 25 pays participent activement au programme ISOE. En 2004, les réacteurs suivants ont été mis en service commercial : Ulchin 5 (REP 1 000 MWe) en Corée, Temelin 1 et 2 (VVER 1 000MWe) en république Tchèque, Kalinin3 (VVER 1 000 MWe) en Russie.

En 2004, la dose collective moyenne annuelle des réacteurs en fonctionnement s'est maintenue à un niveau bas et a continué sa tendance à la baisse, atteignant 0,92 Homme·Sv en moyenne et 0,75 Homme·Sv pour les réacteurs à eau pressurisée (REP), 1,45 Homme·Sv pour les réacteurs à eau bouillante (REB) et 0,98 Homme·Sv pour les réacteurs CANDU.

Par ailleurs, la base de données ISOE contient également des données de doses collectives pour 75 réacteurs en arrêt à froid ou en phase de démantèlement. Étant donné que les réacteurs présents dans la base de données sont de types et de puissances très différents et sont en général à des stades différents de leur programme de démantèlement, il est très difficile de mettre en évidence des tendances sur l'évolution des expositions et d'en tirer des conclusions.

La collecte et l'analyse des données d'exposition professionnelle représentent le cœur du système ISOE, mais le programme ISOE poursuit aussi un objectif prioritaire d'échanges d'informations. À cette fin un réseau Internet (ISOE Information Network: www.isoe-network.net) a été officiellement mis en place durant l'année 2004. Les travaux de transfert des bases de données ISOE sur ce réseau Internet sont en cours. Par ailleurs, un groupe de travail ad hoc a aussi été mis en place pour étudier comment le système ISOE pourrait répondre au mieux aux attentes de ses utilisateurs finaux. Une forte implication des exploitants dans ce groupe de travail est une garantie qu'il émettra des recommandations utiles et efficaces.

Le symposium international ISOE ALARA a eu lieu en 2005 à Ft. Lauderdale en Floride. Il a été organisé par le Centre technique Nord Américain, et co-sponsorisé par l'OCDE/AEN et l'AIEA. Le symposium, dont le thème était « Expériences industrielles opérationnelles », a perpétué la tradition et promu les échanges d'idées et d'expérience de management en vue de réduire les expositions « aussi bas que raisonnablement possible » (ALARA). La large participation internationale dans ce symposium montre la continuité de l'intérêt en matière d'optimisation de la radioprotection et de discussions sur les sujets touchant aux expositions professionnelles.

Les développements récents et les principaux évènements qui ont eu lieu dans les pays participants à ISOE sont décrits dans le chapitre 2.5 de ce rapport. Les détails concernant l'évolution du programme ISOE ainsi que les activités programmées en 2005 sont décrits dans le chapitre 3.

ZUSAMMENFASSUNG

Seit 1992 fördert das ISOE- Programm die Optimierung des Strahlenschutzes für beruflich strahlenexponierte Personen durch den weltweiten Informations- und Erfahrungsaustausch zwischen Strahlenschutzfachleuten bei Kernkraftwerksbetreibern und Aufsichtsbehörden sowie durch die Entwicklung und Veröffentlichung von verbesserten Arbeitsmethoden. Dieser 14. Jahresbericht beschreibt den Stand des ISOE- Projektes für den Berichtszeitraum 2004.

Am Ende des Jahres 2004 waren 71 Betreiber aus 29 Ländern am ISOE- Programm beteiligt. Die ISOE Datenbank enthielt Informationen über berufliche Strahlenexpositionen und Trends in 478 Kernkraftwerken (403 in Betrieb befindliche und 75 endgültig abgeschaltete bzw. im Rückbau befindliche). Die Datenbank umfasst damit 91% der weltweit existierenden kommerziellen Kernkraftwerke (442 Blöcke). Aufsichtsbehörden aus 25 Ländern sind aktiv im ISOE- Programm eingebunden. In 2004 nahmen die koreanische DWR-Anlage Ulchin (1 000 MWe), die tschechische WWER- Anlage Temelin 1 und 2 (1000 MWe) und die russische WWER- Anlage Kalinin 3 (1 000 MWe) ihren kommerziellen Betrieb auf.

In 2004 lag die mittlere jährliche Dosis für die in Betrieb befindlichen KKW auf einem anhaltend niedrigen Niveau mit einer leicht abfallenden Tendenz zu 0,75 Personen SV bei DWR- Anlagen, 1,45 Personen Sv bei SWR- Anlagen und 0,98 Personen Sv bei CANDU- Anlagen. Die mittlere Dosis für alle Anlagen betrug 0,92 Personen Sv.

Die in der ISOE- Datenbank erfassten 75 in der Stilllegung befindlichen Anlagen unterscheiden sich weitgehend in Größe, Bauart und in ihrem aktuellem Zustand. Daher ist es für diese Anlagen schwierig, eindeutige Dosistrends festzustellen und Bewertungen abzugeben.

Die Hauptaufgabe des ISOE- Programms besteht in der Sammlung und Bewertung von Daten der beruflichen Strahlenexposition und stellt ein wichtiges Instrument zum Informationsaustausch dar. Daher wurde in 2004 ein WEB- basiertes ISOE- Netzwerk (www.isoe-network.net) geschaffen. Mit der Integration der Datenbank in dieses Netzwerkes wurde begonnen. Außerdem wurde eine ad-hoc Arbeitsgruppe gebildet, die sich mit Fragen der zukünftigen ISOE- Ausrichtung befasst und die durch eine starke Einbindung der Betreiber zu einer Steigerung des Nutzens und der Effektivität beitragen soll.

In 2005 fand ein internationales ISOE ALARA Symposium in Ft. Lauderdale, Florida, statt, das vom ISOE North American Centre mit Unterstützung durch OECD/NEA und IAEA organisiert wurde. Das Symposium konzentrierte sich auf das Thema „Technische Betriebserfahrungen" und setzte die Tradition fort, ein globales Forum für den Austausch von Ideen und Lösungen zur praktischen Umsetzung des ALARA- Prinzips „As Low As Reasonably Achivable" zu bieten. Die große internationale Beteiligung demonstrierte das ungebrochene Interesse an der Optimierung des Strahlenschutzes.

Aktuelle Entwicklungen und Ereignisse in den einzelnen Ländern sind im Kapitel 2.5 dargestellt. Einzelheiten zur laufenden Entwicklung des ISOE- Programms sowie das Arbeitsprogramm des Jahres 2005 sind in Kapitel 3 beschrieben.

正 文 摘 要

自 1992 年以来，“职业照射信息系统计划”在世界范围内通过核电厂和国家当局辐射防护管理人员的通讯和经验交流网络以及通过制订和发布经改进的工作管理程序，促进并支持了核电厂工作人员的剂量优化工作。“职业照射信息系统计划”2004 年第 14 期“年度报告”介绍了该计划截至 2004 年 12 月底的状况。

到 2004 年底，“职业照射信息系统计划”已包括 29 个国家的 71 个参项电力公司。职业照射信息系统数据库本身包含了 29 个国家 478 台反应堆机组（403 台正在运行，75 台处于冷停堆或某一退役阶段）的职业照射水平和趋势的资料。因此，该数据库涵盖了全世界正在商业运行的动力堆总数（442 座）的 91%。此外，25 个国家的监管机构积极参加了职业照射信息系统。2004 年期间，韩国压水堆蔚珍 5 号（100 万千瓦（电））、捷克水-水型动力堆 Temelin 1 号和 2 号（100 万千瓦（电））和俄罗斯水-水型动力堆 Kalinin 3 号（100 万千瓦（电））开始商业运行。

2004 年，正在运行动力堆的年平均剂量保持在一个相当低的水平并略有下降趋势。压水堆的年平均剂量达到 0.75 人·希；沸水堆 1.45 人·希；加压重水堆（坎杜堆）0.98 人·希；而所有反应堆的平均剂量为 0.92 人·希。

除了有关正在运行反应堆的资料外，职业照射信息系统数据库还包括 75 座已关闭或处于某一退役阶段的反应堆的剂量数据。由于该数据库中的这些反应堆的类型不同，规模各异，而且基本上都处在退役计划的不同阶段，因此，很难确定清晰的剂量趋势和得出明确的结论。

尽管收集和分析职业照射数据是“职业照射信息系统计划”的一个主要支柱，但该计划也包括一个重要的信息交流部分。为此，2004 年正式启用了网基“职业照射信息系统信息网络”（www.isoe-network.net），而且将职业照射信息系统数据库移至网基应用的工作已经开始，以便纳入职业照射信息系统网站。还设立了一个研究今后发展方向的特别小组，以考虑“职业照射信息系统计划”如何能够最好地满足最终用户的需求。电力公司大力参与该小组的工作将有助于增强小组所提建议和行动的有用性和有效性。

由职业照射信息系统北美技术中心组织并由经合组织/核能机构和原子能机构共同协办的“2005 年职业照射信息系统‘合理可行尽量低原则’国际专题讨论会”在美国佛罗里达州劳德代尔堡举行。这次专题讨论会以“工业运行经验”为重点，继续秉承传统，为促进意见交流和保持职业辐射照射“合理可行尽量低”管理方案的交流提供了一个全球论坛。国际上对这次讲习班的广泛参与表明对辐射防护最优化和职业照射问题的持续关注。

概　　略

1992 年以来、ISOE プログラムは、原子力発電所の放射線防護管理者および国の規制者による世界規模でのコミュニケーションと経験交換ネットワーク、 および改良された作業管理手順書の作成と発行を通じ、原子力発電所における作業線量の最適化を促進し、支援しています。 この ISOE プログラムの第 14 年次報告書 2004 は 2004 年 12 月末における ISOE プログラムの状況を示したものです。

2004 年末には、ISOE プログラムには 29 カ国の 71 加盟事業者が含まれていました。ISOE データベース自体には、29 カ国の 478 基の原子炉 (403 基は運転中、75 基は低温停止または廃止措置段階) における職業被ばくレベルおよび傾向に関する情報が含まれていました。その結果、このデータベースは全世界の商用運転中の原子炉の総数 (442 基) の 91%に相当します。さらに、25 カ国の規制当局が ISOE に積極的に参加しています。2004 年には、韓国の PWR Ulchin 5 (1000MWe) チェコの VVER Temelin 1 と 2 (1000MWe)、およびロシアの VVER Kalinin 3 (1000MWe) が商用運転を始めました。

2004 年の、全原子炉における平均線量は 0.92 人・Sv で、運転中の原子炉における平均年間線量は、加圧水型原子炉 (PWR) では 0.75 人・Sv、沸騰水型原子炉 (BWR) では 1.45 人・Sv、重水型原子炉 (PHWR/CANDU) では 0.98 人・Sv と若干減少傾向にあり、かなり低いレベルに維持されました。

運転中の原子炉に関する情報に加え、ISOE データベースには、停止または廃止措置段階にある 75 基の原子炉からの線量データが含まれています。 データベースに登録されている原子炉は炉型や規模が異なっており、全般的に、廃止措置プログラムの実施段階も異なっているので、線量傾向を明確に特定して、決定的な結論を出すことは非常に困難です。

職業被ばくデータの収集と分析は、ISOE プログラムの主要な柱ですが、ISOE プログラムはまた、重要な情報交換部分から成ります。 このために、ウェブベースの ISOE 情報ネットワーク (www.isoe-network.net) は 2004 年の間に正式に発足され、ISOE ウェブサイトで統合するために ISOE データベースをウェブベースのアプリケーションへ移行する作業が始まりました。 ISOE プログラムがどのようにしてエンドユーザのニーズを最もよく満たすことができるかを検討するために、今後の方向性に関する専門家グループも設立されました。電気事業者がこのグループへ強くかかわり合うことによって、その勧告と活動の有用性と有効性は増加するでしょう。

2005 年国際 ISOE ALARA シンポジウムが、ISOE 北米テクニカルセンターによって組織され、OECD/NEA と IAEA による共催で、フロリダ州フィート・ローダーデイルで開催されました。「産業界の運転経験」に焦点を合わせたこのシンポジウムは、職業放射線被ばくを「合理的に達成可能な限り低く(ALARA)」維持するための意見や管理手法の交換を促進するために、グローバル・フォーラムを提供するという伝統を続けました。このワークショップへの広い国際的な参加は、放射線防護と職業被ばく問題の最適化に継続的に関心があることを示しています。

ISOE 加盟国の最近の進展と主な出来事は、この報告書の第 2.5 章で要約されています。 ISOE プログラムの継続的な発展に関する詳細は、2005 年の作業プログラムと同様に、第 3 章に記述されています。

ОСНОВНЫЕ ИТОГИ

С 1992 года в рамках программы ИСПО оказывается содействие и поддержка деятельности по оптимизации получаемых работниками АЭС доз облучения посредством использования сети связи и обмена опытом, предназначенной для руководителей служб радиационной защиты на АЭС и национальных компетентных органов во всем мире, а также путем разработки и публикации усовершенствованных процедур управления рабочим процессом. Настоящий четырнадцатый Ежегодный доклад программы ИСПО за 2004 год отражает положение дел с осуществлением программы ИСПО на конец декабря 2004 года.

В конце 2004 года программа ИСПО охватывала 71 участвующее энергопредприятие в 29 странах. База данных ИСПО, как таковая, включала информацию об уровнях и тенденциях, касающихся профессионального облучения, на 478 реакторных блоках в 29 странах (из которых 403 находятся в эксплуатации и 75 - в состоянии холодного останова или на определенной стадии снятия с эксплуатации). Таким образом, эта база данных охватывает 91% общего числа энергетических реакторов (442), находящихся в промышленной эксплуатации во всем мире. Кроме того, в работе ИСПО активно участвуют регулирующие компетентные органы 25 стран. В течение 2004 года была начата коммерческая эксплуатация корейского реактора PWR "Ульчин"-5 (1000 МВт эл.), чешского ВВЭР "Темелин"-1 и 2 (1000 МВт эл.) и российского ВВЭР-3 на Калининской АЭС (1000 МВт эл).

В 2004 году средняя годовая доза при эксплуатации энергетических реакторов сохранялась на довольно низком уровне с небольшой тенденцией к снижению – до 0,75 чел.-Зв по реакторам с водой под давлением (PWR); 1,45 чел.-Зв по реакторам с кипящей водой (BWR) и 0,98 чел.-Зв по реакторам с тяжелой водой под давлением (PHWR/CANDU), причем. средняя доза по всем реакторам составила 0,92 чел.-Зв.

В дополнение к информации о находящихся в эксплуатации реакторах база данных ИСПО содержит также данные о дозах по 75 реакторам, которые находятся в состоянии останова или на определенной стадии снятия с эксплуатации. Поскольку в базе данных представлены реакторы различных типов и мощностей, которые, как правило, находятся на различных стадиях снятия с эксплуатации, определение четких тенденций изменения дозы и формулирование окончательных выводов представляются весьма затруднительными.

Хотя основным направлением программы ИСПО является сбор и анализ данных, касающихся профессионального облучения, в нее также включен такой важный компонент, как обмен информацией. В этих целях в течение 2004 года было официально начато использование помещенной в Интернете Информационной сети ИСПО (www.isoe-network.net) и началась работа по миграции баз данных ИСПО на помещенную в Интернете прикладную программу с целью их интеграции в веб-сайт ИСПО. Была также создана специальная группа по будущим направлениям деятельности для рассмотрения вопроса о том, как программа ИСПО может наилучшим образом удовлетворить потребности конечных пользователей. Активное участие энергопредприятий в работе этой группы поможет повысить полезность и результативность ее рекомендаций и деятельности.

RESUMEN EJECUTIVO

Desde 1992 el programa ISOE ha facilitado y apoyado la optimización de las dosis ocupacionales en centrales nucleares a través del intercambio de información y experiencia entre los jefes de Protección Radiológica y los Organismos Reguladores de las distintas centrales nucleares de todo el mundo y a través del desarrollo y publicación de procedimientos de gestión de mejora de trabajos. Este décimo cuarto informe anual del ISOE 2004 presenta el estado del programa ISOE a final de diciembre del año 2004.

A finales de dicho año, el programa ISOE ha contado con la participación de 79 centrales nucleares de 29 países. La base de datos del ISOE incluye información sobre los niveles de dosis ocupacionales y tendencias de 478 reactores nucleares (403 en operación actualmente y 75 en parada fría o en alguna fase de desmantelamiento) de 29 países. Esta base de datos cubre el 91% del número total de reactores nucleares comerciales en operación en todo el mundo (442). Además, también participan activamente en el ISOE los Organismos Reguladores de 25 países. Durante el 2004 los siguientes reactores nucleares han comenzado a operar: la unidad 5 de la central PWR Ulchin (1 000 MWe), las unidades 1 y 2 de la central Checa VVER Temelin (1 000 MWe) y la unidad 3 de la central rusa VVER Kalinin (1 000 MWe).

En 2004, la media anual de dosis para los reactores nucleares en operación alcanzó un nivel bastante bajo con una ligera tendencia a la baja. La dosis media anual para los reactores de agua a presión (PWR) ha sido de 0,75 Sv·persona, para los reactores de agua en ebullición (BWR) ha sido de 1,45 Sv·persona y para los reactores de agua pesada a presión (PHWR/CANDU) ha sido de 0,98 Sv·persona. El valor medio de todos los tipos de reactor fue 0,92 Sv·persona.

Además de información sobre reactores en operación, la base de datos del ISOE contiene datos sobre 75 reactores que están parados o en algún estado de desmantelamiento. Como estos reactores incluidos en la base de datos son de diferentes tipos y tamaños y están en diferentes fases de desmantelamiento, es muy difícil identifican tendencias de dosis y llegar a conclusiones definitivas.

Aunque la recopilación y análisis de datos sobre dosis ocupacionales es el pilar principal del programa ISOE, éste también incluye un importante componente de intercambio de información. En este momento, el ISOE dispone de una red de información sobre una plataforma web (www.isoe-network.net) que fue formalmente iniciada durante el 2004. Actualmente se está trabajando en la migración de los datos de la base de datos a la plataforma web para disponer de un sistema integrado en dicho entorno ISOE-network. Un grupo ad-hoc ha sido constituido para definir la dirección futura del programa ISOE en el intento de adaptarlo lo mejor posible a las necesidades de los usuarios finales. La implicación de representantes de centrales nucleares en este grupo ayudará a aumentar la utilidad y efectividad de sus recomendaciones y acciones.

El 2005 International ISOE ALARA Symposium tuvo lugar en Ft. Lauderdale, Florida, organizado por el Centro técnico de Norte América y patrocinado por la OECD/NEA y la IAEA. Este congreso se centró especialmente en la experiencia operacional de la industria, continuando con la tradición de proporcionar un foro global para la promoción del intercambio de ideas y líneas de gestión y actuación para conseguir mantener las dosis ocupacionales “tan bajas como sea razonablemente alcanzable” (ALARA). La amplia participación internacional en este foro muestra el continuo interés en la optimización de la protección radiológica y las exposiciones ocupacionales.

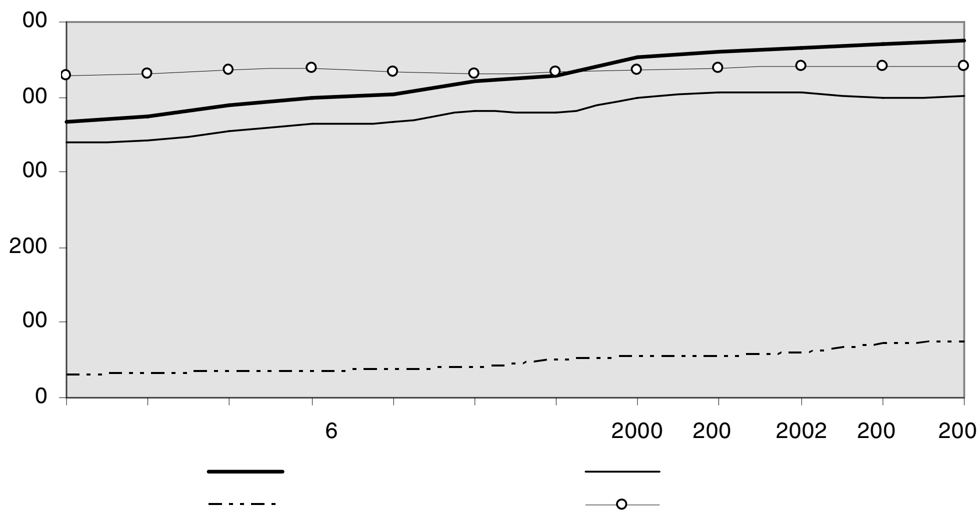
Los progresos más recientes y los sucesos principales acaecidos en los países participantes en el ISOE se resumen en el capítulo 2.5 de este documento. Detalles del continuo crecimiento del programa ISOE, así como del programa de trabajo para 2005 se detallan en el capítulo 3.

1. STATUS OF PARTICIPATION IN THE INFORMATION SYSTEM ON OCCUPATIONAL EXPOSURE

The Information System on Occupational Exposure (ISOE) Programme includes the world’s largest occupational exposure database, and a network of utility and authority radiation protection experts for the exchange of information and experience. Since the inception of the ISOE Programme in 1992, ISOE participants have used this dual system of databases and communications networks to exchange occupational exposure data and information for dose trend analyses, technique comparisons, and cost-benefit and other analyses promoting the application of the ALARA principle in local radiation protection programmes.

Since 1992, the number of actively participating commercial nuclear power plants has continued to increase (Figure 1). At the same time, the extent to which participating units supply their occupational exposure data to the database has also grown. As a result, the ISOE system continues to be the world’s most complete commercial nuclear power plant occupational exposure database.

Figure 1: Total number of reactors included in ISOE (1993-2004)



At the end of 2004, the ISOE programme included 71 Participating Utilities in 29 countries (328 operating reactor units; 38 shutdown units). The ISOEDAT database itself included occupational exposure data from a total of 478 reactors (403 operating and 75 in cold-shutdown or some stage of decommissioning). In addition, 26 regulatory authorities from 25 countries participate actively in the ISOE Programme. The participation of 403 operating commercial nuclear reactors in the ISOE programme represents some 91% of the 442 power reactors in commercial operation throughout the world. During 2004, the Korean PWR Ulchin 5 (1 000 MWe), the Czech VVER Temelin 1 and 2 (1 000 MWe) and Russian Kalinin Unit 3 (1 000 MWe) started commercial operations. Annex 2 provides a complete list of the units, utilities and authorities officially participating in the programme. Table 1 below summarises total participation by country, type of reactor and reactor status.

Table 1: Participation summary (as of December 2004)

Operating reactors participating in ISOE							
Country	**PWR**	**BWR**	**PHWR**	**GCR**	**LWGR**	**FBR**	**Total**
Armenia	1	–	–	–	–	–	1
Belgium	7	–	–	–	–	–	7
Brazil	2	–	–	–	–	–	2
Bulgaria	4	–	–	–	–	–	4
Canada[1]	–	–	22	–	–	–	22
China	5	–	–	–	–	–	5
Czech Republic	6	–	–	–	–	–	6
Finland	2	2	–	–	–	–	4
France	58	–	–	–	–	–	58
Germany	12	6	–	–	–	–	18
Hungary	4	–	–	–	–	–	4
Japan[2]	23	31	–	–	–	–	54
Korea[3]	16	–	4	–	–	–	20
Lithuania	–	–	–	–	2	–	2
Mexico	–	2	–	–	–	–	2
Netherlands	1	–	–	–	–	–	1
Pakistan	1	–	1	–	–	–	2
Romania	–	–	1	–	–	–	1
Russian Federation	15	–	–	–	–	1	16
Slovak Republic	6	–	–	–	–	–	6
Slovenia	1	–	–	–	–	–	1
South Africa	2	–	–	–	–	–	2
Spain	7	2	–	–	–	–	9
Sweden	3	8	–	–	–	–	11
Switzerland	3	2	–	–	–	–	5
Ukraine	13	–	–	–	–	–	13
United Kingdom	1	–	–	–	–	–	1
United States	33	18	–	–	–	–	51
Total	**226**	**71**	**28**	**–**	**2**	**1**	**328**
Operating reactors not participating in ISOE, but included in the ISOE database							
Country	**PWR**	**BWR**	**PHWR**	**GCR**	**LWGR**	**FBR**	**Total**
United Kingdom	–	–	–	22	–	–	22
United States	36	17	–	–	–	–	53
Total	**36**	**17**	–	**22**	**–**	**–**	**75**
Total number of operating reactors included in the ISOE database							
	PWR	**BWR**	**PHWR**	**GCR**	**LWGR**	**FBR**	**Total**
Total	**262**	**88**	**28**	**22**	**2**	**1**	**403**

1. In 2004, 17 CANDUs were in operation; Bruce A1, A2, and Pickering A1, A2, A3 were in a laid-up state.
2. Includes 1 BWR in pre-operational phase (Higashidori Unit 1).
3. Includes 1 PWR in pre-operational phase (Ulchin 6).

Definitively shutdown reactors participating in ISOE						
Country	**PWR**	**BWR**	**PHWR**	**GCR**	**LWGR**	**Total**
Bulgaria	2	–	–	–	–	2
Canada	–	–	2	–	–	2
France	1	–	–	6	–	7
Germany	2	1	–	1	–	4
Italy	1	2	–	1	–	4
Japan	–	–	–	1	–	1
Netherlands	–	1	–	–	–	1
Russian Federation	2	–	–	–	2	4
Spain	–	–	–	1	–	1
Sweden	–	1	–	–	–	1
Ukraine	–	–	–	–	3	3
United States	4	3	–	1	–	8
Total	**12**	**8**	**2**	**11**	**5**	**38**
Definitively shutdown reactors not participating in ISOE but included in the ISOE database						
Country	**PWR**	**BWR**	**PHWR**	**GCR**	**LWGR**	**Total**
Germany	5	3	–	1	–	9
United Kingdom	–	–	–	18	–	18
United States	6	3	–	1	–	10
Total	**11**	**6**	–	**20**	–	**37**
Total number of definitively shutdown reactors included in the ISOE database						
	PWR	**BWR**	**PHWR**	**GCR**	**LWGR**	**Total**
Total	**23**	**14**	**2**	**31**	**5**	**75**

Number of **Utilities** Officially Participating:	**71**
Number of **Countries** Officially Participating:	**29**
Number of **Authorities** Officially Participating:	**26**

2. OCCUPATIONAL DOSE STUDIES, TRENDS AND FEEDBACK

One of the most important aspects of the ISOE Programme is the tracking of annual occupational exposure trends for benchmarking and comparative analysis. Using the ISOE database, which contains annual occupational exposure data supplied by all participating utilities, various exposure trends can be displayed by country, by reactor type, or by other criteria such as sister-unit grouping. The summary below provides highlights of the general trends and outcomes from the database supplemented as necessary by information from the country reports.

2.1 Occupational exposure trends in operating reactors

In general, the annual average collective dose per operating reactor unit has consistently decreased over the time period covered in the ISOE database, with the 2004 averages maintaining the fairly low level reached in last few years. In spite of some yearly variations, there is a clear downward dose trend in most reactors, although a slight increase in the PHWR dose can be seen since the lows achieved in 1996-1998.

A summary of the average annual exposure trends over the past three years for participating countries and by technical centre regional groupings is shown in Table 2, based on data reported and recorded in the ISOE database as of December 2005. Figures 2 to 5 show the 2004 data in a bar-chart format, ranked from highest to lowest average dose. Figures 6 and 7 show the trends in average collective dose per reactor type for 1992-2004. In 2004, the average annual dose maintained a fairly low level with a slight decreasing trend to 0.78 man·Sv for pressurised water reactors (PWR), 1.45 man·Sv for boiling water reactors (BWR), and 0.98 man·Sv for pressurised heavy water reactors (PHWR/CANDU). The average for all reactors including gas cooled (GCR) and light water graphite reactors (LWGR) was 0.92 man.Sv.

In the European region, the 2004 average collective dose per reactor for PWRs was around 0.66 man·Sv per reactor, with most countries showing a stable or decreasing trend over the last three years. Both Finland and the Netherlands showed increases compared to 2003. The average collective dose per reactor for European BWRs was around 0.84 man·Sv. Most of these reactors have seen a slight increase, with the exception of Sweden and Spain which showed substantial decreases.

In the Asian region, the average collective dose for PWRs was 1.03 man·Sv. In Japan, the fiscal year 2004 has continued the increase of the total collective dose for PWRs. The BWR collective dose for 2004 has seen a substantial decrease to 1.58 man·Sv compared to 2002-2003. The dosimetric trend for both PWRs and PHWRs in Korea show an increase for 2004.

For the North American region, the average 2004 dose for US PWRs of 0.72 man·Sv was lower than the 2002-2003 values. The value of 3.54 man·Sv for Mexican BWRs is significantly higher than the North American average of 1.68 man·Sv. In Canada, the average 2004 PHWR/CANDU dose of 0.89 man·Sv was lower than the 2002-2003 values, but did not included data from 4 reactors.

In countries participating through the IAEA Technical Centre, the PWR average collective dose per reactor was about 0.99 man·Sv, with most countries showing decreases from 2003. The average dose for Romanian PHWRs was 0.66 man·Sv.

Due to the complex parameters driving the collective doses and the varieties of the contributing plants, the above discussion and figures do not support any conclusions with regard to the quality of radiation protection performance in the countries addressed. More detailed discussion and analyses of dose trends in various countries can be found in Chapter 2.5 of this report.

2.2 Annual outage dose in European reactors

The evolution in the average annual outage dose for European reactors over the last 10 year period is shown in Figures 8 a-c. The decreasing trend over this time period for PWRs and BWRs can be clearly observed.

Evolution of PWR outage dose per country

Most countries show a regular decrease in the outage dose during the period. However, two groups of countries may be observed:

- Belgium, Spain, Sweden, Switzerland, Netherlands and the UK with outage doses around 300 to 500 man·mSv in the last periods (2001-2003 and 2002-2004), and

- France and Germany with outage doses around 900 man·mSv in the last periods (2001-2003 and 2002-2004).

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

Evolution of VVER outage dose per country

During the period, VVER reactors from the Czech Republic showed a low average outage dose, which falls below 200 man·mSv for the first time. In addition to the Czech reactors, since 2001-2003 the Slovak reactors have also shown good results with an average outage dose around 270 man·mSv.

Evolution of BWR outage dose per country

Within the countries operating BWRs, the very good results of Finland are noteworthy both in terms of average outage dose (500 man·mSv) and outage duration (12 man·mSv/day).

Table 2: Evolution of average annual collective dose per unit by country and reactor type, 2002-2004 (man·Sv)

	PWR			BWR			PHWR		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
Armenia	0.95	0.86	1.16						
Belgium	0.41	0.38	0.41						
Brazil	0.68	1.11	n/a						
Bulgaria	0.62	0.73	1.04						
Canada [4]							0.90	1.57	0.89
China	0.65	0.83	0.57						
Czech Republic	0.20	0.20	0.16						
Finland	1.31	0.47	1.25	0.56	0.54	0.74			
France	0.97	0.89	0.79						
Germany [5]	1.23	1.04	0.90	0.76	0.93	1.06			
Hungary	0.80	0.76	0.38						
Japan [6]	1.00	1.07	1.25	2.10	2.38	1.58			
Korea	0.52	0.51	0.59				0.63	0.89	1.07
Mexico				1.90	1.91	3.54			
Netherlands	0.34	0.26	0.79						
Pakistan	0.28	0.73	n/a				2.52	3.82	n/a
Romania							0.55	0.82	0.66
Russian Fed.	1.24	1.18	1.00						
Slovak Republic	0.29	0.31	0.29						
Slovenia	0.58	0.80	0.69						
South Africa	0.83	1.02	0.43						
Spain	0.50	0.43	0.31	1.52	2.22	0.46			
Sweden	0.51	0.54	0.58	1.34	1.23	0.63			
Switzerland	0.51	0.34	0.48	1.03	1.04	1.44			
Ukraine	1.53	1.47	1.18						
United Kingdom	0.29	0.35	0.03						
United States	0.87	0.93	0.72	1.74	1.61	1.57			
Average	**0.89**	**0.88**	**0.78**	**1.71**	**1.77**	**1.45**	**0.91**	**1.54**	**0.98**
By Region:									
Europe	0.83	0.74	0.66	1.08	1.15	0.84			
Asia	0.83	0.86	1.03	2.10	2.38	1.58	0.63	0.89	1.07
North America	0.87	0.93	0.72	1.75	1.62	1.68	0.90	1.57	0.89
IAEA	1.11	1.15	0.99				1.54	2.32	0.66

	GCR			LWGR		
Lithuania				4.40	4.27	3.41
United Kingdom [7]	0.11	0.07	0.03			

1. Dose is calculated for 14 reactors in 2002, 17 in 2003, 13 in 2004.
2. Dose for 2003 is calculated including NPP Stade (KKS), which was shutdown in November 2003.
3. Dose for 2004 - BWR is calculated for 31 reactors.
4. Dose is calculated for 18 reactors in 2002, 14 reactors in 2003 and 2004.

Figure 2: 2004 PWR average collective dose per reactor by country

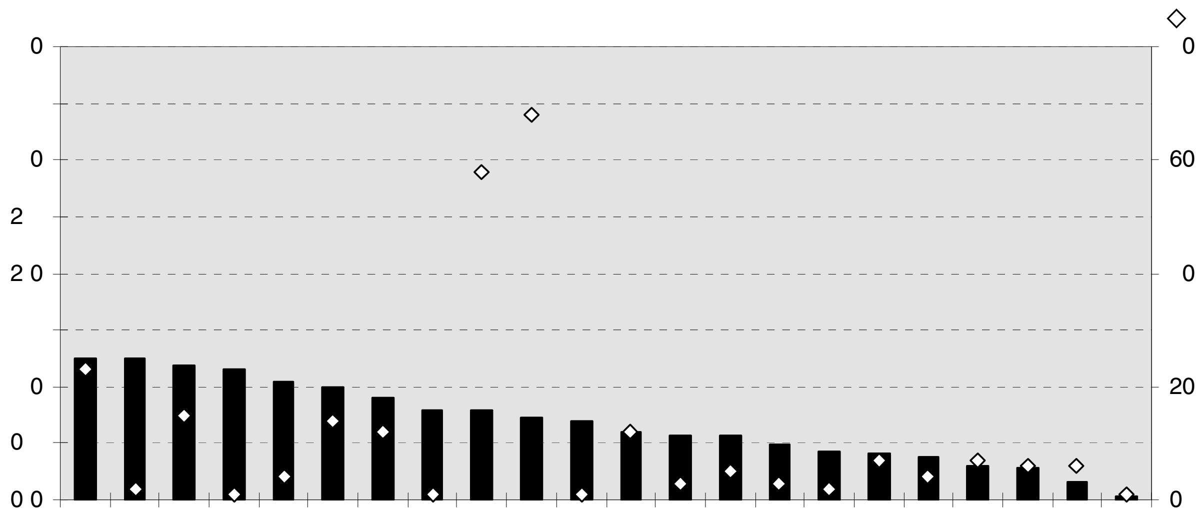


Figure 3: 2004 BWR average collective dose per reactor by country

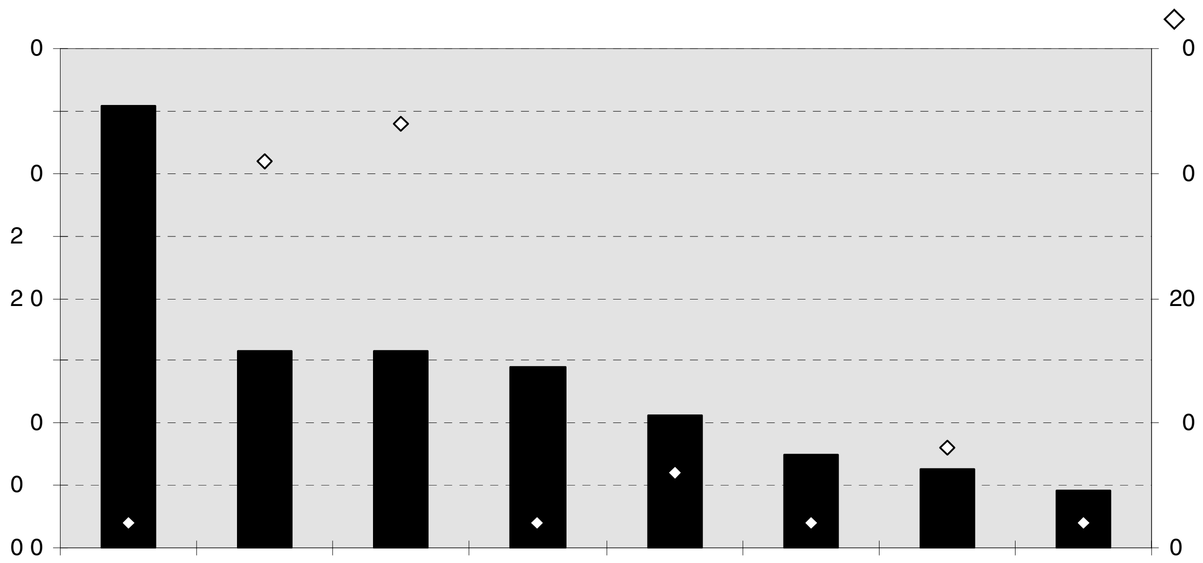


Figure 4: 2004 PHWR average collective dose per reactor by country

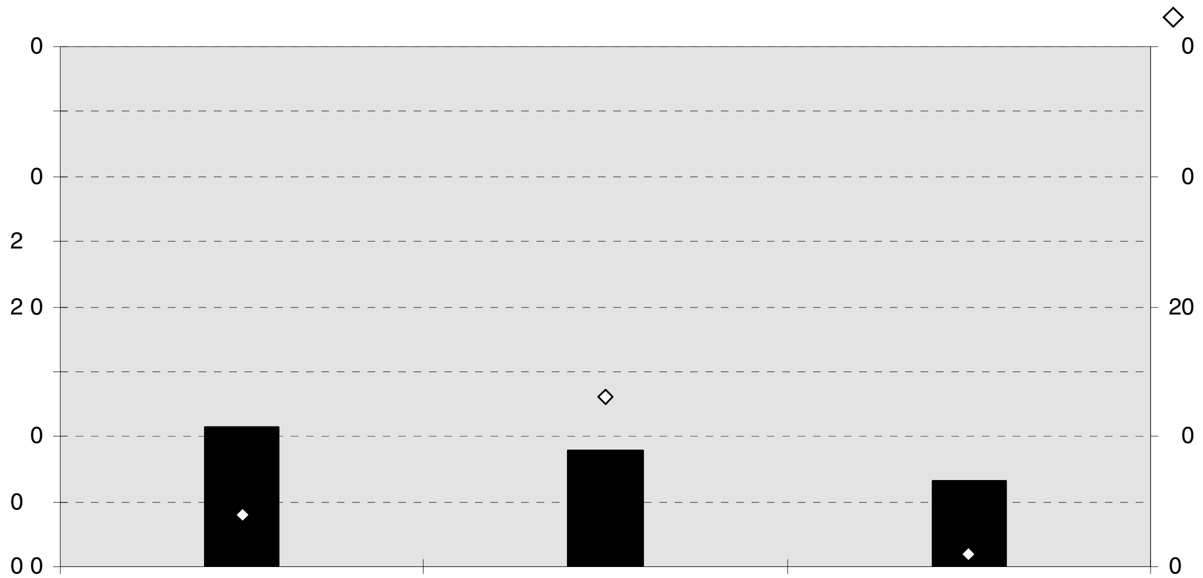


Figure 5: 2004 average collective dose per reactor type

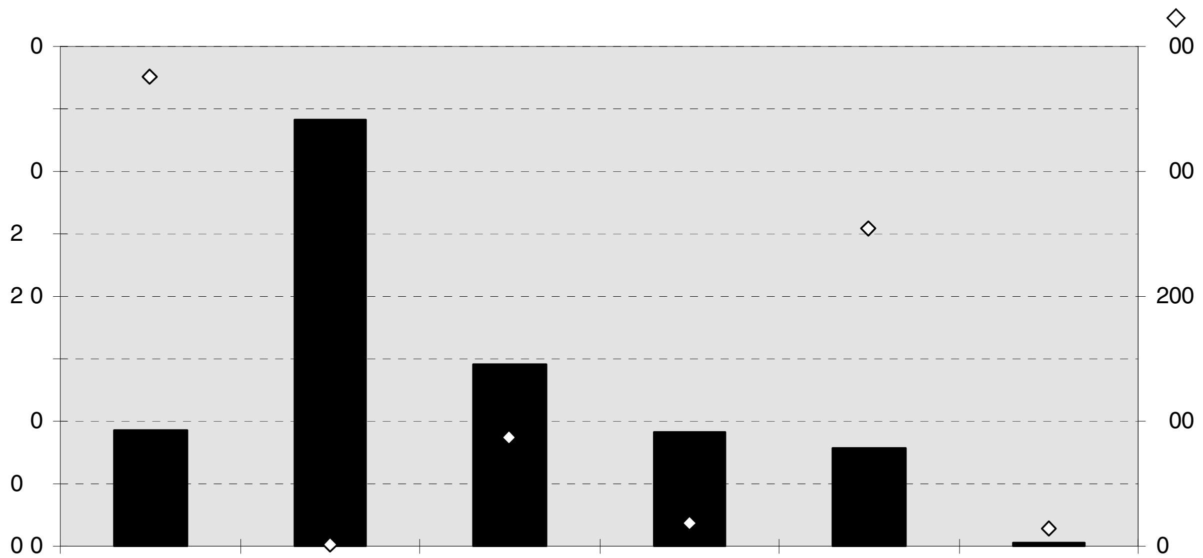


Figure 6: Average collective dose per reactor for operating reactors included in ISOE by reactor type, excluding LWGRs (1992-2004)

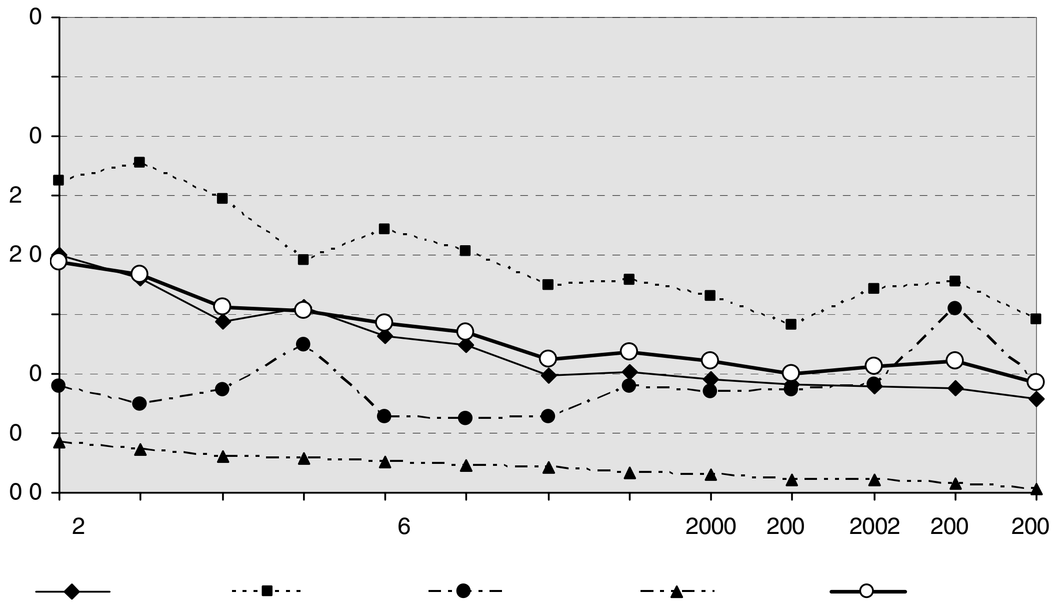


Figure 7: Average collective dose per reactor for all operating reactors included in ISOE by reactor type (1992-2004)

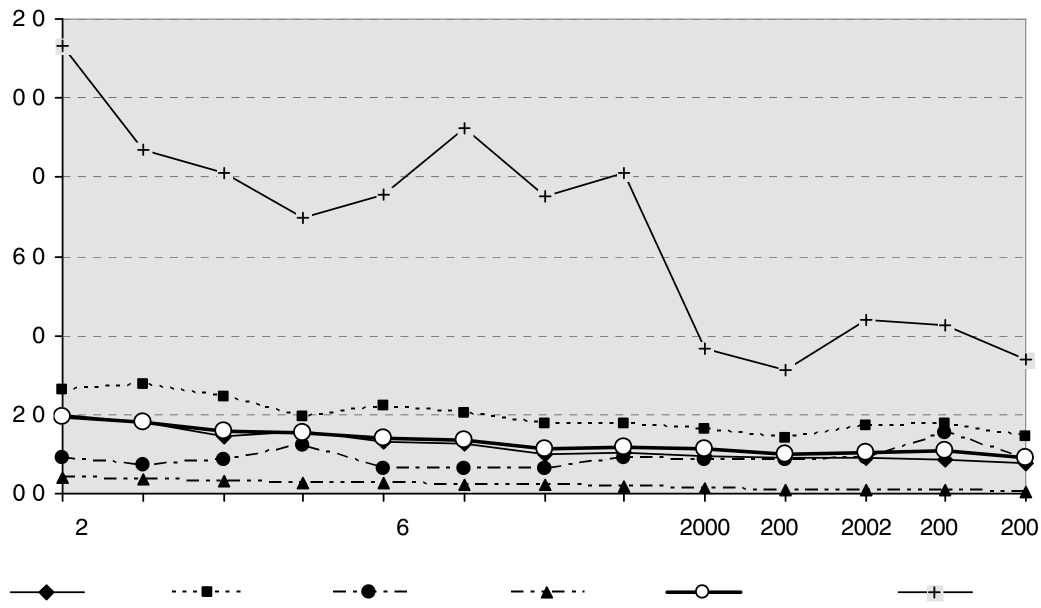
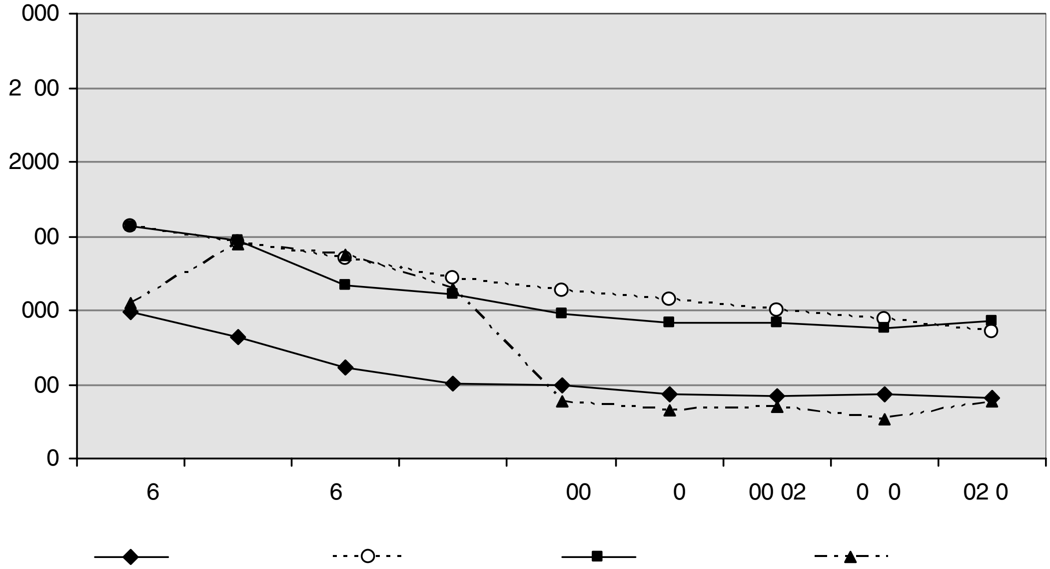
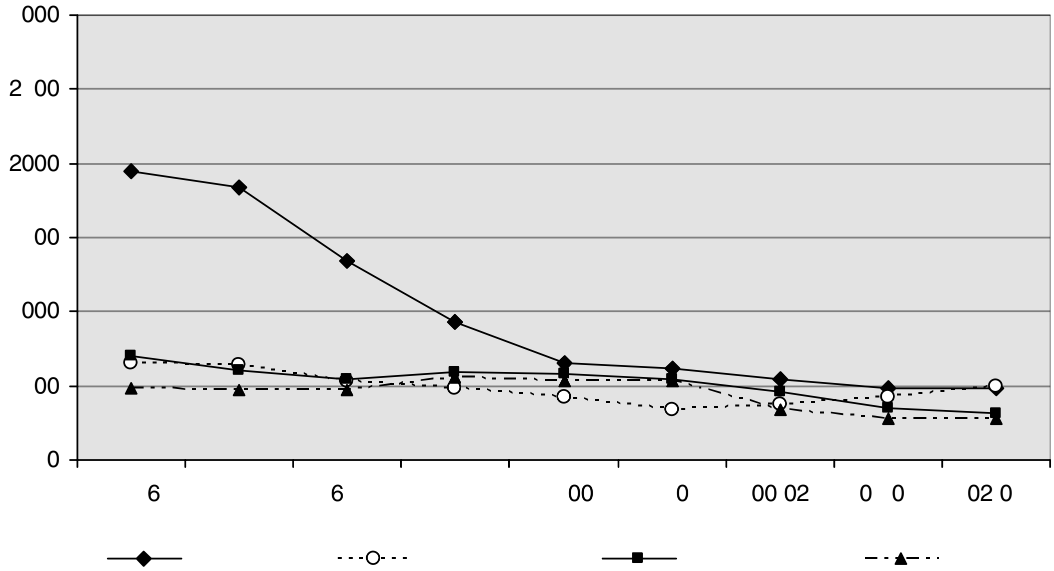
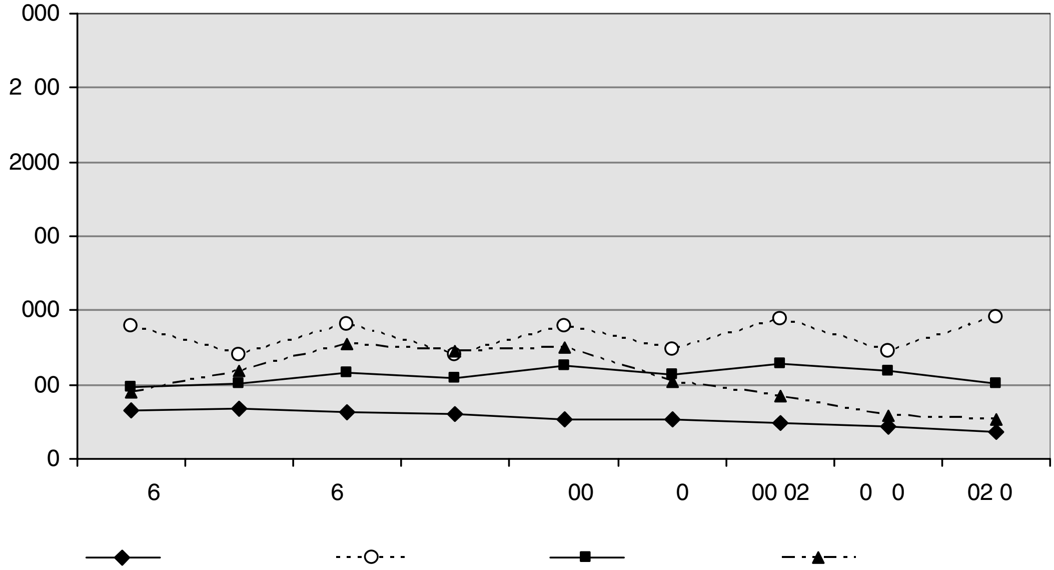


Figure 8: Average outage collective dose per reactor type and per country (man.mSv)



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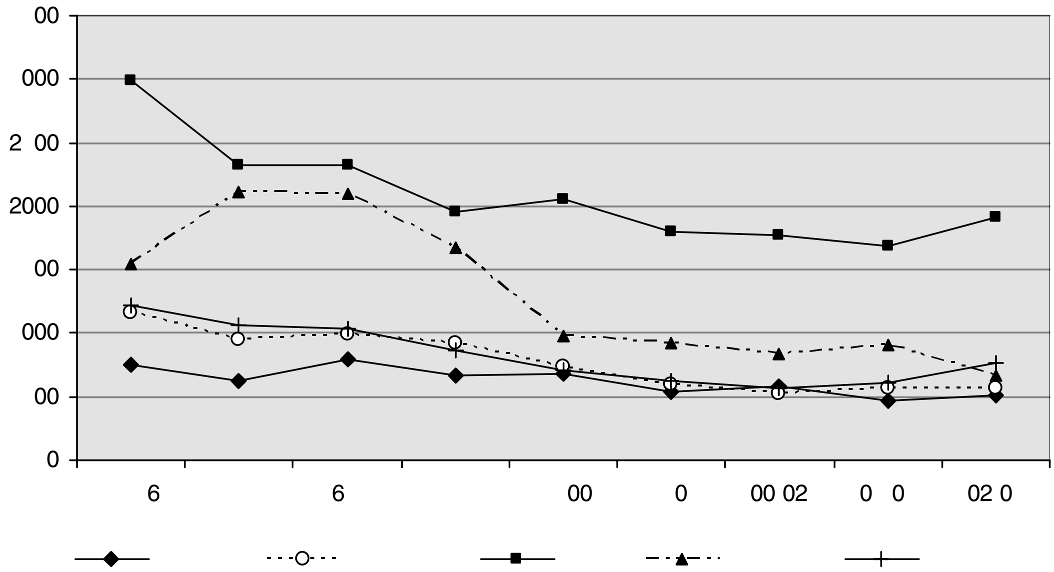
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2.3 Occupational exposure trends in reactors in cold shutdown or in decommissioning

The ISOE database contains dose data from 75 reactors which are shutdown or in some stage of decommissioning. The average collective dose per reactor for these reactors saw a reduction over the years 1992 to 2003, with a slight increase in 2004. However, the reactors represented in these figures are of different type and size, and are, in general, at different phases of their decommissioning programmes. For these reasons, and because these figures are based on a limited number of shutdown reactors, it is impossible to draw definitive conclusions.

Table 3 shows the average annual collective dose per unit by country and type of reactor for the years 2002 to 2004 for reporting reactors. Figures 9-12 summarise the average collective dose per reactor for shutdown reactors for the years 1993-2004 by type (PWR, BWR and GCR).

Table 3: Number of shutdown units and average annual dose (man·mSv) per unit by country and reactor type for the years 2002-2004

	2002		**2003**		**2004**	
	No.	**Dose**	**No.**	**Dose**	**No.**	**Dose**
PWR						
France	1	12	1	5	1	5
Germany	1	66	1	38	2	213
Italy	1	5	1	0.2	1	90
United States	8	284		n/a		n/a
VVER						
Bulgaria			2	73	2	35
Germany	5	48	5	47	5	36
Russian Fed.	2	313	2	340	2	178
BWR						
Germany	1	816	1	273	1	325
Italy	2	20	2	43	2	27
Netherlands	1	22	1	92	1	97
Sweden	1	61	1	57	1	64
United States	5	120		n/a	1	576
GCR						
France	6	7	6	6	6	5
Germany	2	17	2	21	2	19
Italy	1	43	1	47	1	54
Japan	1	178	1	20	1	50
Spain	1	33	1	47	1	0
United Kingdom	4	114		n/a		n/a
LWGR						
Ukraine	3	4472	3	3525		n/a

Figure 9: Average collective dose per shutdown reactor: PWRs

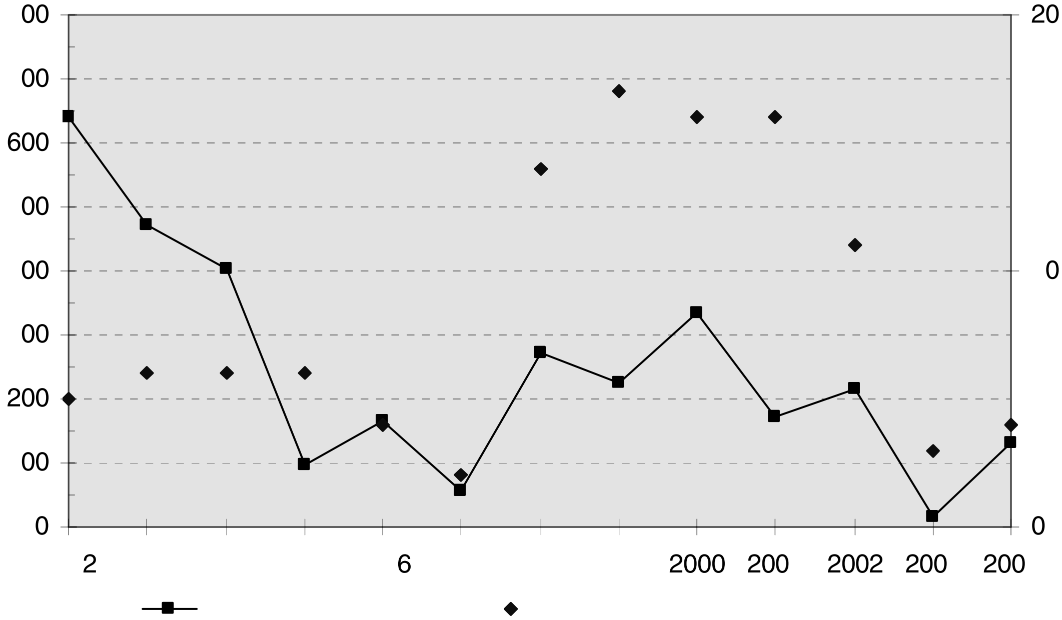


Figure 10: Average collective dose per shutdown reactor: BWRs

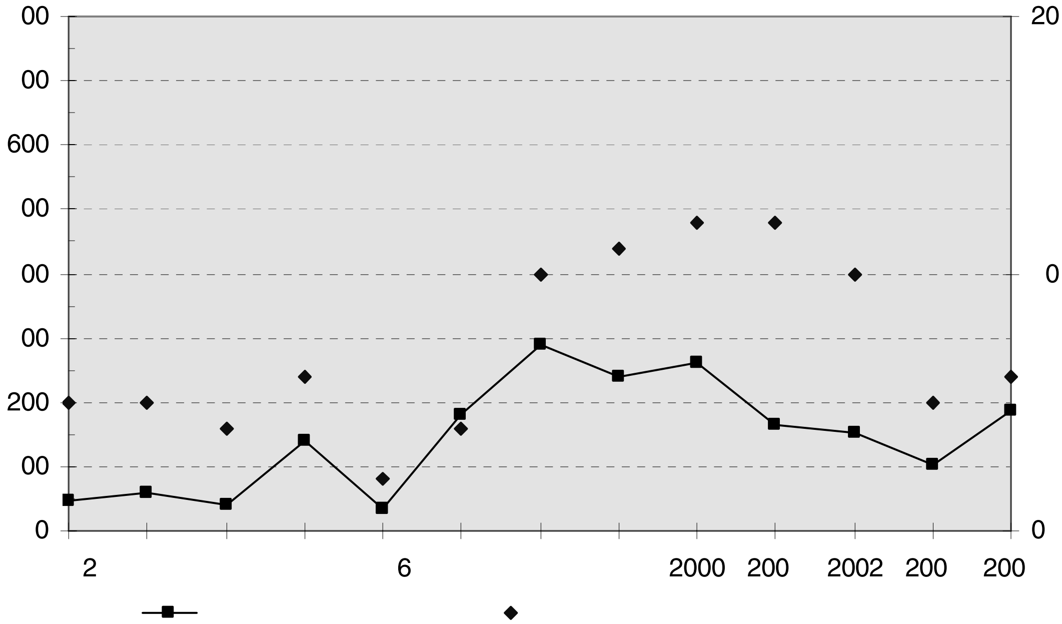


Figure 11: Average collective dose per shutdown reactor: GCRs

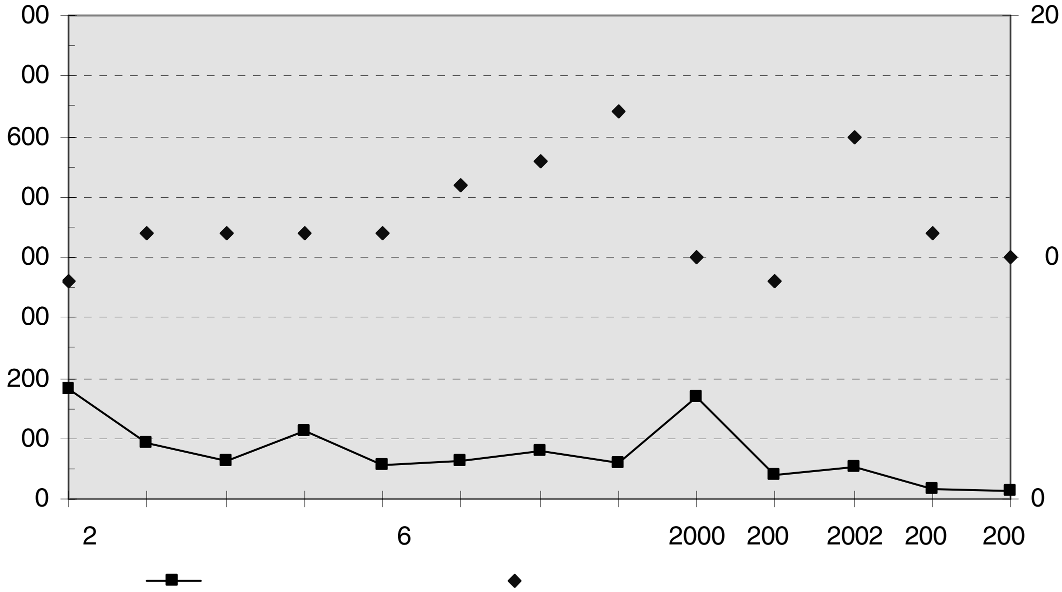
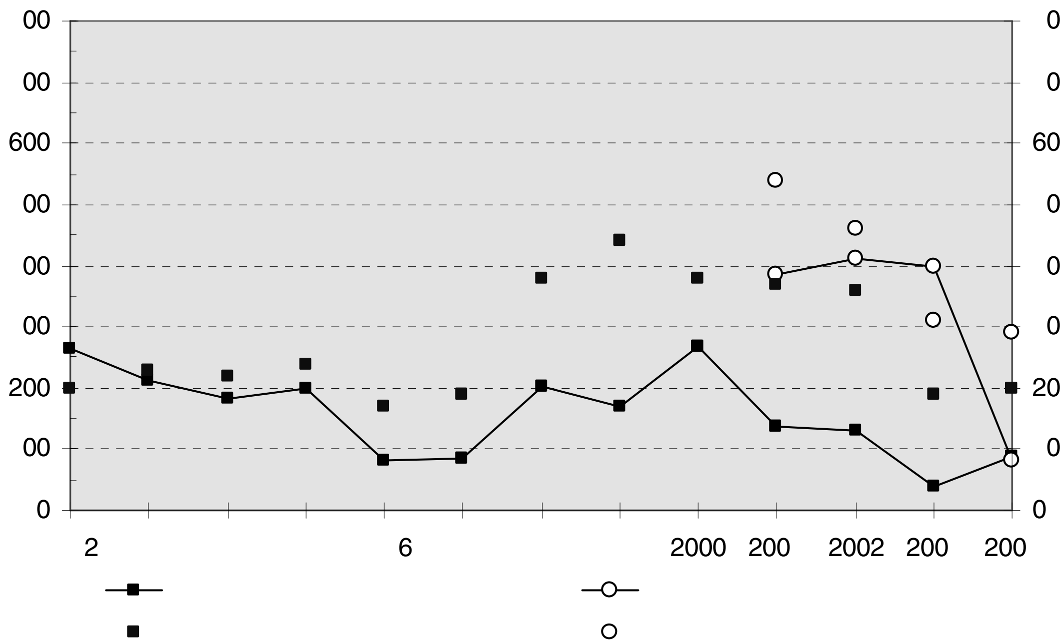


Figure 12: Average collective dose per shutdown reactor: PWR, BWR, GCR and all types



2.4 2005 ISOE International ALARA Symposium

The NATC conducted the 2005 International ISOE ALARA Symposium on industry occupational experience in Fort Lauderdale, Florida (USA) on 9-12 January 2005, with attendance of over 180 individuals from 11 countries. The Symposium was sponsored by IAEA, OECD/NEA and NATC. Electric Power Research Institute (EPRI) collaborated with NATC in hosting the meeting. NATC provided the overall management of the symposium and EPRI provided technical papers for the third day. The Symposium objective was to achieve international exchange on major dose activities at operating nuclear power plants. The first major pressuriser repair at San Onofre, steam generator replacements at Palo Verde and reactor vessel head replacements at 3 US NPPs were discussed. A paper was presented by EDF on the effective management of individual doses to less than 16 mSv/yr. Tokyo Electric Power Company discussed management initiatives to reduced annual occupational doses at Japanese BWRs.

The V.C. Summer NPS (PWR: South Carolina, USA) won the NATC's 2004 ISOE World Class ALARA Performance Award. The Site Vice President, Plant and Radiation Protection Managers and ALARA Coordinator presented plenary speeches accepting the award. The Site Vice President stated that ALARA programmes cannot be effective without strong, continuous support from site senior management, who need to support site ALARA programmes with significant funding to achieve short and long term dose reduction objectives. A DVD of the Symposium plenary speeches is available upon request from NATC.

2.5 Principal events of 2004 in ISOE participating countries

As with any summary data, the information presented in Sections 2.1-2.4 above provides only a broad overview and graphical presentation of average numerical results from the year 2004. Such information serves to identify broad trends and helps to highlight specific areas where further study might reveal interesting detailed experiences or lessons. However, to help to enhance this numerical data, the following section provides a short list of important events which took place in participating countries during 2004 and which may have influenced the occupational exposure trends. These are presented as reported by the individual countries*.

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* Due to the various approaches in national reporting, no attempt has been made to standardise the dose units used by each country.

ARMENIA

Summary of national dosimetric trends

For the year 2004, the dosimetric trends at the Armenian NPP have increased for collective dose, which is conditioned by certain works performed during the ANPP outage, in particular transport-technological operations with spent fuel during refueling, in-service and non-destructive testing activities, and isolation works.

Annual collective doses after restart of Armenian NPP (man·Sv)

Years	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Collective dose	4.18	3.46	3.41	1.51	1.57	0.96	0.66	0.95	0.86	1.08

Events influencing dosimetric trends

In-service inspections, decontamination works and some works related to medium activity radioactive waste management.

Number and duration of outages

One outage (~90 days). Maintenance and repairing works in safety systems (in-service inspections and etc) were performed. The planned exposure doses were agreed with the regulatory body. The planned collective dose before outage was 1.53 man·Sv. The real collective dose was 1.08 man·Sv. For this stage the maximum individual dose equivalent was 20.0 mSv.

Major evolutions

No major evolutions are registered.

Component or system replacement

During the outage, no components or systems were replaced.

Unexpected events

For the year 2004, unexpected events were not registered.

2005 Issues of concern

The ventilation purification system changing in 2005 is foreseen which can not impact on general dosimetric trend.

Regulatory plans

To review the authorisation of radiation control system activity due to system modernisation.

BELGIUM

Summary of national dosimetric trends

Collective doses for the year 2004 (in man·mSv)

Tihange	Tihange 1	Tihange 2	Tihange 3	Total
Plant Personnel	148.7	55.9	72.7	277.3
Contractor's Personnel	725.1	34.8	482.8	1242.7
Total	**873.8**	**90.7**	**555.5**	**1520**

Doel	Doel 1 + 2	Doel 3	Doel 4	WAB
Plant Personnel	94.6	78.3	31.3	26.1
Contractor's Personnel	639.2	327.2	167.5	52.4
Total	**733.8**	**405.5**	**198.8**	**78.5**

Collective doses in Tihange are stable compared to 2003. There were 2 outages in 2004 (Tihange 1: fuel leakages problematic and Tihange 3: normal outage) as in 2003 (Tihange 2 and 3). For Doel 1 and Doel 2, the annual dose is for the two units together, because there is only one dosimetry system for both units. They have a joined controlled area.

Events influencing dosimetric trends

The outages are responsible for the major part of the collective doses: more than 80% of the collective dose in Tihange is due to outages.

Number and duration of outages

Unit	Outage information	Number of workers	Collective dose (man·mSv)
Tihange 1	Outage duration 49 days, No exceptional work	1077	768.8
Tihange 2	NO OUTAGE	-	-
Tihange 3	Outage duration 34 days, No exceptional work	1107	496.3
Doel 1	Outage duration 32 days, No exceptional work	-	277
Doel 2	Outage + SG replacement: duration : 66 days	-	214+195
Doel 3	Outage duration : 26 days No exceptional work	-	377
Doel 4	Outage duration : 34 days No exceptional work	-	175

Major evolutions: component or system replacements

Doel 2: Steam generator replacement

Plans for major work in the coming year 2005

Tihange 1: Normal outage
Tihange 2: Normal outage
Tihange 3: No outage
Doel 4: Re-racking of fuel storage facility

BULGARIA

Summary of national dosimetric trends

Trends and data for year 2004 are presented on the following table and graphs. The average individual effective dose was 0.8 mSv. The maximum individual effective dose (for a person from external organisation) for 2004 was 19.9 mSv.

Collective doses per reactor for 2004 at Kozloduy NPP (man·mSv)

Site	Reactor	Type	Outage duration [days]	Collective dose man mSv		Comments
				Outage	Yearly	
EP-1	Kozloduy 1	WWER 440			45.28	shut down
	Kozloduy 2	WWER 440			23.98	shut down
	Kozloduy 3	WWER 440	59	858.8	1120.69	
	Kozloduy 4	WWER 440	31	667.98	945.47	
EP-2	Kozloduy 5	WWER 1000	105	1257.5	1225.5	modernisation
	Kozloduy 6	WWER 1000	86	722.76	757.9	modernisation
Average	**Kozloduy NPP**				**686.47**	

The prolonged duration of outages for units 3, 5 and 6 is considered the only reason for the higher collective dose than 2003. ALARA programmes were implemented on each unit. No unexpected events and /or safety related issues during the operation of KNPP occurred.

During 2004, units 1 and 2 were operated in state E (cold shutdown). Some maintenance activities on safety related systems were performed.

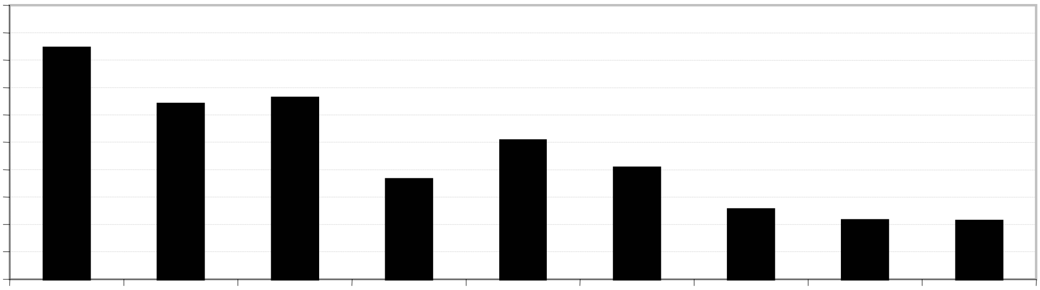
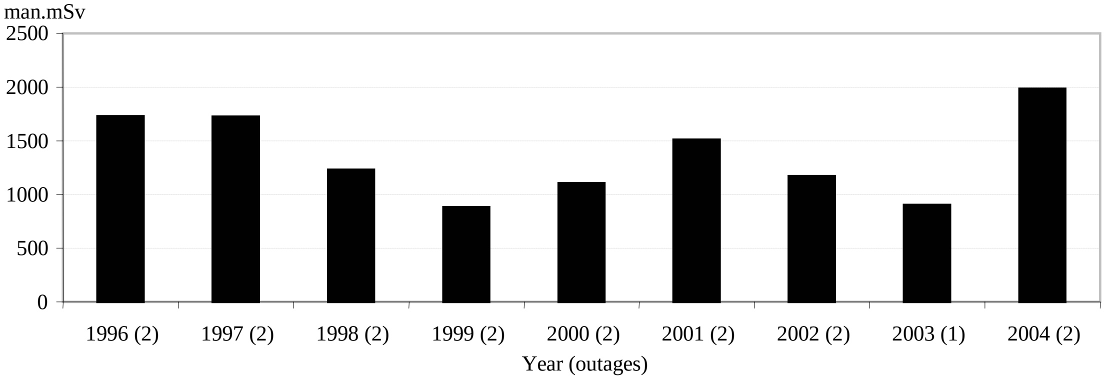


Figure 1

Collective dose EP-2 (1996-2004)



CANADA

Bruce Power

2004 annual dose summary: Bruce A 1-4 and Bruce B 5-8

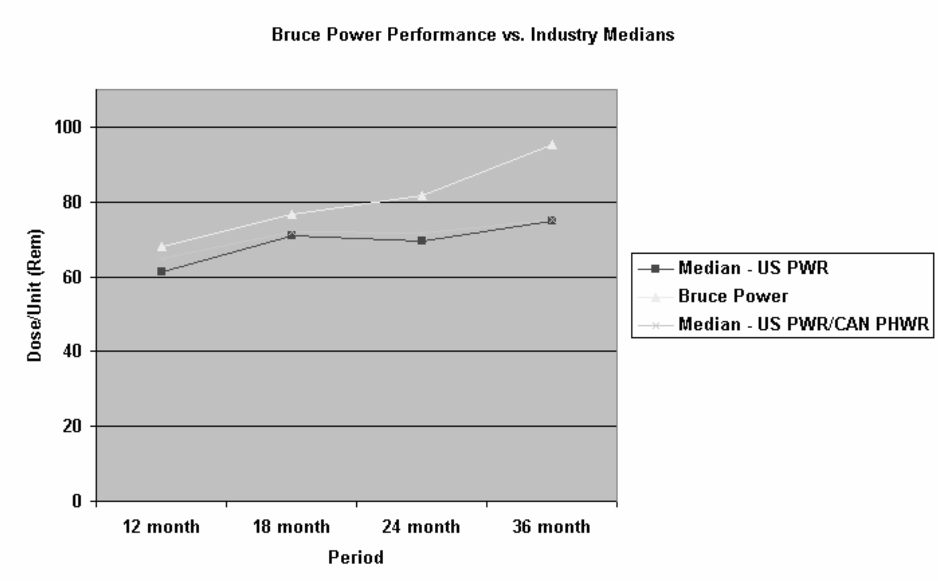
	Dose (mSv)		
Facility	**EXT whole body**	**INT whole body**	**Grand total**
BP TOTAL	3445.27	749.50	4194.77
Bruce A*	1146.12	329.44	1475.56
Bruce B*	2299.15	403.62	2702.77

2004 summary of radiological performance and proposed initiatives

Benchmarking

Bruce Power dose performance continues to be above the industry median in class. The class comparisons for Bruce Power are obviously other sister pressurised heavy water reactor systems and pressurised water reactor systems. Our 18-month average of 76.8 Rem per unit is above the current industry target of 65 Rem per unit.

Although the facility remains above the industry median a significant improvement has been made over the last thirty-six months as evidenced by the graph "Bruce Power Performance vs. Industry Medians". Taking the 36 month rolling Bruce Power average and comparing it to the 18 month rolling Bruce Power average an improvement of approximately 19 Rem per unit can be observed. In addition the trend continues to show improving performance.



Benchmarking activities are an important part of the yearly work program at Bruce Power. Several industry seminars and conferences attended during 2004 contributed to performance improvement initiatives. Work with OPG has continued to become an important part of our benchmarking activities. Some of the benchmarking activities for 2004 include:

- COG sponsored quarterly CANDU Radiation Protection Managers meetings.
- International ALARA symposium sponsored by ISOE and NATC.
- Quarterly ALARA Managers meetings with OPG (re-established in 2004)
- First annual CANDU ALARA symposium sponsored by NATC.
- Second annual Bruce Power Industry Radiological Operating Event Analysis Training Session conducted by Dr. David Miller – Head of NATC.
- INPO RP Managers working meetings (Comanche Peak Generating Stations)
- New Radiation Protection Mangers Training – INPO.
- One of our managers is the newly elected ISOE Country Coordinator for Canada.

Bruce Power staff attendance at these meetings and service to the industry through organisations such as the ISOE continue to afford the Bruce Station the opportunity to learn from other organisations in order to continue the trend of improved dose performance.

Successes in dose reduction – 2004

Boiler hot-spot handling – Continued improvements in the methods of handling hot spot mitigation/shielding have yielded dose reductions and decreased risk profiles for boiler maintenance. In 2003 the radiation protection outage support organisation took over sole responsibility for handling of hot spot shielding and mitigation in boilers. This initiative was as a result of a WANO SER from 2003 related to mitigation of a boiler hot spot at Bruce A re-start.

In the initial stages of implementation all boiler hot spots were candidates for removal. This work method resulted in dose consumption beyond what was necessary in some boilers due to the work involved. Amendments were made to work methods and the resultant process balances the options, the work involved, and personnel experience, to determine the best course of action. A health physicist working with the outage support organisation evaluates a hot spot located in post-wash boilers and decisions are made as to the best method to deal with the hot spots. Several Rem of occupational dose has been saved by choosing the option which best fits the maintenance. The principle of having a single group of individuals which handles this work has certainly prevented a repeat of the 2003 event and ensured that work methods can be consistently improved.

Horizontal flux detector replacements at Bruce Unit 5 – Work method improvements contributed an approximate saving of 4-5 Rem of occupational dose during horizontal flux monitor maintenance in Unit 5. Due to some early life chemistry problems in Unit 5 at Bruce B, the area in which horizontal flux monitoring capability is maintained has higher than normal dose rates as compared to sister units. The work methods used in previous similar maintenance evolutions yielded dose estimations of approximately 6 Rem for completion of the maintenance. Improvements to the work methods allowed the job to be completed for 1.5 Rem.

Bruce A Unit 4 Outage – Bruce Unit 4 had its first maintenance outage in 2004 following return to service. The stretch target of 75 Rem was met with a final collective estimated dose of 73 Rem. Only four of the eighteen associated REP groups exceeded their target with some notable dose performances in an ambitious boiler and feeder inspection program.

Pre-heater platform maintenance – A programme to replace temporarily installed pre-heater platforms with permanent installations in each reactor vault was undertaken in 2004. This programme was as a result of numerous occupational safety issues associated with the temporary design. Initial dose estimates of 38 Rem were developed and the work was completed for 30. Lessons learned meetings following the maintenance identified several key improvement areas that were included in the planning for Units 5 and 7 in 2005. The resultant execution improvements could yield an approximate 40% improvement over initial estimates.

Gentilly-2

2004 annual dose summary: Gentilly-2

	Dose (mSv)				
Site	**Outage**	**Online**	**External**	**Internal**	**Grand total**
G-2		X	1826.9	765.8	2592.7
G-2	X		395.4	63.6	459.0

In 2004, Gentilly-2 had a small unplanned outage of 14 days to replace the spacers located between the pressure tube and the calandria tube for a specific channel.

New Brunswick Power

2004 annual dose summary: Point Lepreau Station

Total megawatts generated	4 299 744 MWe.h
Total site dose	919.0 mSv
Maintenance outage dose	771.7 mSv
Internal dose	122.1 mSv (tritium)

In 2004, a new teledosimetry system was tested. Improvements in equipment and procedures were identified. To improve accounting of dose received, a link was made between the electronic dosimeter system and the SAP work management system. When workers obtain an ED, they enter their SAP Order/Operation number. At least daily, the ED computer dumps ED results into the SAP system automatically, providing individual worker results for each Operation. Also, software programs were developed to allow supervisors to track what their workers were receiving and to verify they were using the ED/SAP system properly.

CZECH REPUBLIC

Dukovany NPP

Summary of national dosimetric trends

The total collective effective dose (CED) at Dukovany NPP in 2004 was 0.560 man·Sv. CED for utility employees was 0.042 man·Sv, for contractors' employees 0.518 man·Sv. The total number of exposed radiation workers was 1952 (592 utility employees and 1360 contractors). Four units of VVER-440, Model 213 are in operation at Dukovany NPP. The average annual collective dose per unit in the year 2004 was 0.140 man·Sv. The total value of CED for 2004 year is the lowest value during whole time of the Dukovany NPP operation. The maximal individual effective dose was 5.37 mSv, which was reached by one of the contractor workers performing the steam generator insulation work during the planned outages.

Events influencing dosimetric trends

The main contributions to the collective dose at Dukovany NPP were 4 planned outages.

	Outage information	**CED (man·Sv)**
Unit 1	33 days, standard maintenance outage with refuelling	0.146
Unit 2	55 days, standard maintenance outage with refuelling	0.150
Unit 3	32 days, standard maintenance outage with refuelling	0.135
Unit 4	30 days, standard maintenance outage with refuelling	0.109

The actual collective dose at all outages in 2004 was the lowest during last ten years also. This value was reached due to optimised water chemistry, very good radiation protection ensuring, and due to the lower number of the works with high radiation risk.

Unexpected events

There was no unusual or extraordinary radiation event in the year 2004 at Dukovany NPP.

Temelín NPP

Summary of national dosimetric trends

There are two units, WWER 1 000 MWe type V320, in commercial operation since 11 October 2004. There was the second refuelling outage on the unit one last year. Unit two was in the first refuelling.

The CED at Temelín NPP during the year 2004 determined from primary film dosimetry was 0.427 man·Sv. CED for utility employees was 0.044 man·Sv, CED for contractors' employees was 0.384 man·Sv. The total number of exposed radiation workers was 1 758 (499 utility employees and 1 259 contractors).

Major evolutions

The main contributions to the total collective effective dose at Temelín NPP were 2 planned refuelling outages.

	Outage information	CED (man·Sv)
Unit 1	89 days, standard maintenance outage with refuelling	0.293
Unit 2	61 days, standard maintenance outage with refuelling	0.127

Note: Values of CED determined during outages are from EPD (electronic personal dosimeters).

Very low values of outages and total effective doses represent results of good primary chemistry water regime, well organised radiation protection structure and strict implementation of ALARA principles during the working activities related to the works with high radiation risk.

The maximal individual effective dose 8.93 mSv was received by a contractor worker performing dismantling and mounting works on the upper part of the reactor during the 2004 outages.

Unexpected events

No unusual or extraordinary radiation eveSummary of national dosimetric trends

NPP.

FINLAND

Summary of national dosimetric trends

Dose trends at Finnish NPPs (man·Sv)

	2004	2003	2002
Olkiluoto 1 (BWR)	1.062	0.274	0.809
Olkiluoto 2 (BWR)	0.452	0.758	0.312
Average	0.757	0.516	0.560

Loviisa 1 (VVER-440)	2.003	0.609	1.041
Loviisa 2 (VVER-440)	0.489	0.332	1.573
Average	1.246	0.471	1.307

Events influencing dosimetric trends 2004

Olkiluoto

At unit 1 the annual outage was a service outage and at unit 2 a refuelling outage with durations of 15 days and 9 days respectively. The collective dose accumulation of Olkiluoto outages was 1.309 man·Sv.

The most significant task in perspective of dose accumulation was NDT inspections of reactor system piping at OL1 causing some 0.1 man·Sv. The replacement of all rigid and spring suspensions of one of the main steam lines on both units was started and continues till 2006.

Issues of concern in Olkiluoto 2005

The turbine island modernisation (OL2) will be done in 2005. Moisture separator reheaters and high pressure turbines will be changed.

Loviisa

At unit 1 the 2004 outage was an extended inspection outage scheduled every eight years. This is the longest outage type with a planned duration of some 42 days. However, 2004 the outage lasted for 47 days due to delays related to RPV inspections and some valve repair work. The most significant tasks in respect of radiation protection were magnetite removal from the secondary sides of all six steam generators (163 man·mSv), insulation work (364 man·mSv) and decontamination/cleaning (244 man·mSv). The total collective dose accumulation of the outage was 1934 man·mSv.

At unit 2 the 2004 outage was a normal refueling outage with duration of 23 days. The total collective dose accumulation was 444 man·mSv, renovation and insulation related tasks being the most significant task groups.

The highest individual dose in year 2004 was 15.8 mSv.

Other issues in Loviisa

Improvement projects started in the past few years continue on site. These include construction of liquid waste solidification plant, renewal of plant I&C systems and renewal of plant information management systems.

The renewal project of body contamination monitors was started by installing new equipment at one of the exits of RCA in summer 2004. The project includes integration of access control and electronic dosimetry into the monitoring system as well as double monitoring with gamma detectors at the second monitoring point. The project will be completed by year 2006 as the solidification plant will be taken into use.

Regulatory issues

The activities of STUK have been concentrated on the regulatory issues concerning modifications in the old NPPs and the licensing of the new NPP unit. The regulations (guide YVL 7.11) dealing with the approval of RP instrument has been up-dated in 2004.

FRANCE

Summary of national dosimetric trends

Collective doses

The average collective dose was 0.8 man·Sv per reactor in 2004 for a target of 0.85 man·Sv. The 2004 result is 10% lower than the 2003 result (0.89 man·Sv). The average 2004 collective dose for the 3-loop reactors (34 reactors) was about 0.96 man·Sv. The average 2004 collective dose for the 4-loop reactors (24 reactors) was about 0.54 man·Sv. The number of short outages was 22 in 2004, and the number of standard outages was 19.

There were 6 ten-yearly outages in 2004. One Steam Generators Replacement was realised in 2004 (Tricastin 4).

Individual doses

At the end of 2004, only 34 workers from highly exposed specialities (insulation, scaffolding, welding, mechanics) were recorded with over 16 mSv on 12 rolling months. At the end of 2004, there were no workers with a 12 month dose over 18 mSv, and 39 workers over 16 mSv.

Events influencing dosimetric trends, number of outages

EDF 3-loop reactors: In 2004, the lowest collective dose for a standard outage was Blayais 1 with 0.49 man·Sv. The lowest dose for a short outage was Dampierre 3 with 0.23 man·Sv. The highest outage dose was Dampierre 4 with 2.59 man·Sv for a ten yearly outage. In 2004, 2 reactors had no outage and 3 reactors had an unscheduled outage; the lowest annual dose was Bugey 2 with 0.18 man·Sv. The main contributors were 15 short outages, 10 standard outages, 4 ten yearly outages and one Steam Generator Replacement (Tricastin 4). In September 2004, Zinc injection on Bugey Unit 2 was started, planned for 3 fuel campaigns.

EDF 4-loop reactors: The lowest collective dose for a standard outage was Cattenom 4 with 0.38 man·Sv. The lowest collective dose for a short outage was Civaux 1 with 0.09 man·Sv. The highest dose for an outage was Penly 2 with 1.37 man·Sv for a ten yearly outage. In 2004, 7 reactors had no outage and the lowest annual dose was Saint Alban 1 with 0.12 man·Sv. The main dose contributors will be 6 short outages, 9 standard outages and 2 ten yearly outages.

Incidents

At Fessenheim Unit 1, January 24th 2004, following a mistake on a valve, 300 litres of resin were injected in the primary circuit and provoked an unforeseen maintenance outage (around 25 weeks). Only a short outage (20 000 hours, 534 man·mSv) was planned. Around 70 000 working hours in the RCA were needed for reparations (around 0.8 man·Sv):

- to clean all the systems, sometimes cutting the pipe;
- to study the behaviour of the resin (under radiation, under temperature) and chemical impact;
- visual inspection of all components (valves, pumps, fuel elements, seals, control rod drive mechanism, rods,..);
- replace the hydraulic part on a primary coolant pump and a charging pump.

In the field of radiation protection, the resins induced a lot of hot spots, directly in the pipe or after cleaning hot particles from fuel elements. New high radiation areas, over 2mSv/h, were defined in the RCA. During the outage, 2 343 contamination risk analyses were performed and 2 879 provisional dose evaluations, 892 high radiation area access authorisations, and 80 for very high radiation area (over 100 mSv/h). 34 RP technicians coming from 11 EDF NPPs were seconded to Fessenheim unit 1. Fessenheim 1 was reconnected on the grid on July 13, 2004. The total outage dose was 1317 man·mSv.

Future activities

The new targets in the field of collective doses were obtained with a yearly 5% decrease, i.e. 0.79 in 2005 and 0.75 in 2006.

In the field of individual doses, the target is to reduce by 10% the number of workers exceeding 16 mSv over 12 months and to keep the good result of “no worker over 18 mSv”, i.e. less than 30 workers over 16 mSv in 2005 and less than 26 in 2006.

GERMANY

General situation

The general situation regarding collective dose trends and practical Radiation Protection – work in German NPPs is comparable to last year. Since the final shut down of NPP Stade in November 2003, 12 PWR and 6 BWR units are in operation. In 2004 the gross rated power was 21 693 MW with a gross output of 167.1 TWh and an average load factor of 87.4%. The average collective dose was 0.91 Person·Sv per PWR unit and 1.08 Person·Sv per BWR-Unit. For May 2005 the final shutdown of

NPP Obrigheim is planned according to the political agreement between utilities and the present federal government.

The discussion about the introduction of EPDs for the official dose monitoring is still ongoing. In parallel to the successful development of the NPP operators in a pilot project performed in NPP Isar in cooperation with an official monitoring office, the Federal Ministry for Environmental Protection and Reactor Safety has asked GRS as an independent expert organisation to develop a concept for official dose monitoring with EPDs. The GRS- Report on the federal states' authority level has been accepted and will form the basis for a demonstration project for the concept, planned under participation of official institutions and potential users (nuclear facilities, hospitals). VGB has placed a statement paper in order to assure that practical RP aspects and the know-how already existent are sufficiently taken into account.

Following an OSART mission in one German PWR in October 2004, the discussion about standards of ALARA concepts has been restarted among the RP experts of NPPs in order to make sure that practical RP management is optimal.

Special events: unintended and uncontrolled release of radioactivity on non-licensed pathways

According to an event in NPP Neckarwestheim 2 (Konvoi) a principal discussion in the Reactor Safety Commission has been carried out about the possibility of radioactive releases on non-licensed pathways. In any NPP, systems exist where radioactivity can be transported from radioactive contaminated to non-contaminated systems under special conditions. Systems in discussion include:

- Service systems in PWR plants for SG flushing.
- Gas service systems.
- Fire fighting systems.

Under normal conditions, the transmission of radioactivity from one system to the other cannot happen, because of pressure difference and swing check valves. In the case of Neckarwestheim 2, the pressure difference was not in the correct direction and the swing check valve was missing. This caused a non-licensed release via the turbine building sump. By sump cleaning, the radioactivity was released to the environment. However, the amount of radioactivity released was far below the limits.

As a consequence from the event, all NPPs (PWR and BWR) have to check which systems can open a pathway for unintended and uncontrolled releases. In addition, back fitting measures have to be introduced (additional monitoring devices and barriers) and the maintenance inspection concept has to be modified for swing check valves in order to make sure, that the barrier functions are fulfilled.

JAPAN

Collective doses

The dosimetry level in the fiscal year 2004 was 77.86 man·Sv that was down about 18 man·Sv from the previous year for all operating units. The average annual collective doses per unit for all units, BWRs, and PWRs were 1.42 man·Sv, 1.58 man·Sv, and 1.25 man·Sv respectively.

The decrease in dosimetry was mainly due to less modification works under high radiation dose rate during the periodical inspections for BWRs.

Reactor type	Number of units	Total collective dose (man·Sv)	Average collective dose (man·Sv)
PWR	23	28.78	1.25
BWR	31*	49.02	1.58

*Note: includes Higashidori Unit 1, which is pre-operational, date of grid connection was 2005.3.9.

Individual doses

The annual average exposure of radiation workers was 1.2 mSv and this exposure tends to be decreasing from the fiscal year 2003. The highest annual individual exposure per nuclear power station was 19.4 mSv, which was well below the dose limit of 50 mSv/y.

Although annual individual exposure of 1 worker who worked at several nuclear power stations and other nuclear facilities exceeded 20mSv, this exposure was well below the limit as well. The number of workers whose annual individual doses range from 15 mSv to 20 mSv was 776, which was 262 less than the previous year.

Status of outage and periodical inspection

Periodical inspections were completed at 17 BWRs and 18 PWRs. The average duration for periodical inspection was 311 days for BWRs and 84 days for PWRs. The long duration of BWRs was due to the inspections and repairs of the reactor recirculation pipes and shrouds.

For year 2005

In the fiscal year 2005, the modification works, the inspections of the PLR pipes are scheduled, is expected that the dosimetry level in the fiscal year 2005 is as same as the one in the fiscal year 2004.

KOREA, REPUBLIC OF

Summary of national dosimetric trends

For the year of 2004, 19 NPPs were in operation; 15 PWR units and 4 CANDU units. A new PWR, Ulchin Unit 6 (1 000 MWe) had done the test operation in 2004. The average collective dose per unit for the year 2004 was 0.69 man·Sv. As in previous years, the outages of units in 2004 contribute the major part to the collective dose, 79.8% of the collective dose was due to works carried out during the outages. The average annual collective doses of both reactor types for 5 years and average annual collective doses per unit in 2004 are shown in the following tables:

Average annual collective doses per unit for 5 years (man·Sv)

Year	2000	2001	2002	2003	2004
PWR (no. of reactors)	0.77 (12)	0.67 (12)	0.52 (13)	0.51 (14)	0.65 (15)
CANDU (no. of reactors)	0.55 (4)	0.67 (4)	0.63 (4)	0.79 (4)	0.83 (4)

Average annual collective and individual doses for the year of 2004

NPP	Type	Outage duration (days)	Collective doses (man·Sv)	Average individual doses (mSv)
Kori 1	PWR	23	0.73	0.66
Kori 2	PWR	7	0.26	
Kori 3	PWR	48	1.21	1.37
Kori 4	PWR	44	1.12	
Yonggwang 1	PWR	46	0.89	1.24
Yonggwang 2	PWR	37	0.99	
Yonggwang 3	PWR	40	0.61	0.89
Yonggwang 4	PWR	42	0.69	
Yonggwang 5	PWR	119	0.26	0.26
Yonggwang 6	PWR	96	0.15	
Ulchin 1	PWR	34	1.15	1.43
Ulchin 2	PWR	39	0.92	
Ulchin 3	PWR	33	0.45	0.43
Ulchin 4	PWR	-	0.03	
Ulchin 5	PWR	-	0.25	0.17
Ulchin 6	PWR	-	0.0006	
Wolsong 1	CANDU	35	1.19	1.18
Wolsong 2	CANDU	26	0.51	
Wolsong 3	CANDU	22	0.93	1.26
Wolsong 4	CANDU	24	0.70	

There were total 9 867 people involved in radiation works in 19 operating units and one commissioning reactor, and the total collective dose was 13 025 man·mSv. The outage duration was 715 days at 17 reactors which is longer than 575 days at 15 reactors in 2003. One main reason was to confirm safety concerns on thermal sleeves raised by the regulatory body during an outage, and later, this same task was extended to other Korean NPPs except the reactors of all Wolsong and Kori 1&2 sites. As the outage duration is longer than in 2003 the total collective dose is getting higher as well.

One major Korean strategy is to lengthen the NPP’s operational period, which is counted from the end of previous outage to the beginning of following one, and many NPPs have success to extend from 12 month to 18 month. Having this strategy, number of outage reactors is varied from one to the other calendar year as shown in the following table.

Regarding the subject of individual dose, there has been no worker to exceed 20 mSv a year since 1999. More than 76% of radiation workers received radiation dose of less than 1mSv, and only 1% of the workers received more than 15 mSv a year in 2004.

Collective doses and outage duration for recent 3 years

Year	Number of reactors	Collective doses (man·Sv)		Outage duration	
		Total	Average doses per unit	Number of outage reactors	Duration days
2002	17	9.32	0.55	11	438
2003	18	10.29	0.57	15	575
2004	19	13.03	0.69	17	715

LITHUANIA

Summary of national dosimetric trends

In 2004 occupational exposure at the Ignalina NPP had reducing trends: 4.40 man·Sv in 2002, 4.27 man·Sv in 2003, as for 2004 collective dose was 3.41 man·Sv per unit. In 2004, 2 910 INPP workers and 1 482 outside workers worked under the influence of ionising radiation.

Planned annual collective and individual doses for INPP personnel and outside workers in 2004 were estimated on the basis of possible repair works of the 47 unsound weld connections on the pipes of the collectors in the Emergency Core Cooling System at Unit 2 and also they were based on the set of dose reduction measures, planned to be implemented in the workplaces.

Planned annual collective dose for INPP personnel was 8.594 man·Sv, and for outside workers 3.708 man·Sv. But in fact there was no need to perform planned repair works of the unsound weld connections in all planned volume, therefore collective dose for INPP personnel was 4.472 man·Sv, and for outside workers 2.353 man·Sv. Overall collective dose for INPP personnel and outside workers was 6.825 man·Sv.

The average effective individual dose for INPP staff was 1.53 mSv, for INPP staff and outside workers was 1.55 mSv. The maximum individual effective dose for INPP staff was 19.2 mSv, and for outside workers 29.4 mSv. The individual doses of 43 outside workers exceeded 20 mSv, but average individual doses for the last 5 years period (2000-2004) did not exceed 20 mSv.

Events influencing the dosimetric trends

The principal events which have contributed to the collective dose during 2004 at Ignalina NPP are presented in Table below:

Main works	Collective dose (man·mSv)	
	Unit 1	Unit 2
1. Reactor Vessel:		
Maintenance, repairs, inspection of the reactor fuel channels	73.3	
Maintenance, repairs, replacement of the reactor fuel channels, installation of the Secondary Diverse Shutdown System		585.9

2. Main Circulation Circuit:		
Preparing for the inspection of the Primary System Pipes (d=300mm, d=800mm)	11.0	75.8
Inspection of the Primary System Pipes (d=300mm, d=800mm)	33.7	97.5
Repairing of the Primary System Pipes (d=300mm, d=800mm) and pipeline valves	82.5	882.6
Other works	43.5	110.0
3. Repair of the Reactor Equipment and Refuelling:	74.5	206.6
Insulation works	57.7	620.7
Installation of the temporary shielding		98.9
Scaffolding and tents	28.5	63.9
Rooms decontamination	0.9	186.5
Monitoring of radioactive contamination	13.4	147.6
Routine inspections	19.9	72.5
Other works	109.9	474.3
4. Emergency Core Cooling System:		
Preparing for the inspection		117.1
Inspection		125.5
Repairs		84.6

For Unit 1, the overall dose after implementation of these works during the outage period was 548.8 man·mSv, or 8% of the INPP annual occupational collective effective dose. For Unit 2, the overall dose after implementation of these works during the outage period was 3950.0 man·mSv, or 58% of the INPP annual occupational collective effective dose.

Number and duration of outages

In 2004 the outage of Unit 1 was 32 days, outage of Unit 2 took 83 days. The collective dose was distributed as following: normal operation – 15% of annual collective dose, outage of Unit 1 – 10% of annual collective dose, outage of Unit 2 – 75 % of annual collective dose.

New plants on line/plants shut down

After Government decision, Unit 1 of INPP was shutdown on 31 December 2004.

Major evolutions

In 2004 the measures foreseen in the Plan of Implementation of the Decommissioning Programme for the Unit 1 at the INPP were further implemented.

Goals for 2005

- Safe decommissioning of Unit 1.
- Safe operation of Unit 2 for production of electricity and thermal energy.
- Evaluation and upgrading the level of Safety culture.
- Extension and support to the effectiveness of the quality implementation system.

- Permanent evaluation of the INPP safety and work effectiveness considering WANO operation indicators which characterise work effectiveness to improve operational performance of Unit 2.
- Maximum individual dose shall be below 20 mSv.
- Collective dose shall not to exceed 5268 man·mSv, that is determined by the dose plan.
- Further implementation of ALARA principle.

Component or system replacements

In 2004 the installation of the Secondary Diverse Shutdown System at Unit 2 was finished. Ten casks for storage of spent nuclear fuel were delivered to the spent nuclear fuel interim dry storage facility.

Organisational evolutions

During preparation for decommissioning of INPP, the changes in INPP structural departments are proceeding. The growing part of works conducted at INPP will fall to the outside workers and also to the Decommissioning Project Management Unit of the INPP.

Regulatory work in 2004 and plans in the coming year

Exercising the radiation protection state supervision and control at Ignalina NPP (INPP), in 2004 six inspections were carried out at Ignalina NPP units, radioactive waste management facilities and spent nuclear fuel interim dry storage facility. In 2004 the Radiation Protection Centre (RPC) reviewed and approved the INPP Final Decommissioning Plan and the INPP Decommissioning Environmental Impact Assessment Programme, also reviewed other INPP related decommissioning documents. The draft INPP Decommissioning Programme for 2005-2009 was reviewed and comments were submitted. This programme defines technical – environmental and social – economical measures to be taken, in order to successfully implement the second stage of INPP decommissioning – preparation for dismantling of no longer needed equipment. The Plan of RPC Main Activities for Decommissioning Preparation and during Decommissioning of INPP for 2004-2005 was prepared. The plan provides measures and actions that will be taken by the RPC, in order to ensure and to evaluate that the preparation for decommissioning and during the decommissioning will be properly carried out and later the planned dismantling works be safely performed.

MEXICO

Dose information 2004

Laguna Verde NPP (LVNPP): Two units BWR rated 684 MWe each.

Operating Reactors

Reactor Type	Number of reactors	Average annual collective dose per unit and reactor type (Person·Sv)
BWR	2	3.53

Collective Dose Breakdown (Person·Sv)

	Refuelling outages	**Normal operations**	**Total**
Unit 1	2.64	0.95	3.59
Unit 2	2.79	0.68	3.47

Main events influencing dosimetric trends /results

2004 was a year with two refuelling outages and big modifications.

- Plant modifications, mostly redundant interconnections between Residual Heat Removal System (RHR) and Fuel Pool Coolong and Cleanup System (FPCC) for increasing cooling capacity of the spent fuel pools of both Units, consumed around 0.77 Person·Sv.
- In Service Inspection activities [U2-7th RFO]: 0.70 Person-Sv (including 0.15 Person·Sv of thermal insulation removal and replacement for this activity).
- Inspection and repair of internals of five Recirculation System valves [U1-10th RFO]: 0.47 Person·Sv.
- Reactor Water Cleanup System (RWCU) pumps repairs: 0.12 Person·Sv. There were repetitive difficulties with these high radiation pumps in 2004.

Component or system replacements

An interconnection between Residual Heat Removal (RHR) and Spent Fuel Pool Cooling and Cleanup (FPCC) systems in both units was finished. This big modification started in 2003 and has the purpose of giving plant operations more flexibility regarding cooling system resources, mainly during refuelling outages.

Unexpected events

- During U2-7th RFO, it became necessary to open and make corrective maintenance to the loop “A” flow control valve of the reactor Recirculation system (RRC).
- During U1-10th RFO repair of internals of five recirculation valves became necessary.
- During U1 10th RFO unexpected cracking was found in the blades of the low pressure turbines. All the blades of these turbines had to be replaced. This lead to a 74 days outage, originally scheduled for 35 days.

Dose reduction programme:

As in previous year, in 2004 Laguna Verde Units LVNPP continued among the best performers of the BWRs GE fleet, regarding low cobalt concentration in reactor water.

2005 Issues of concern

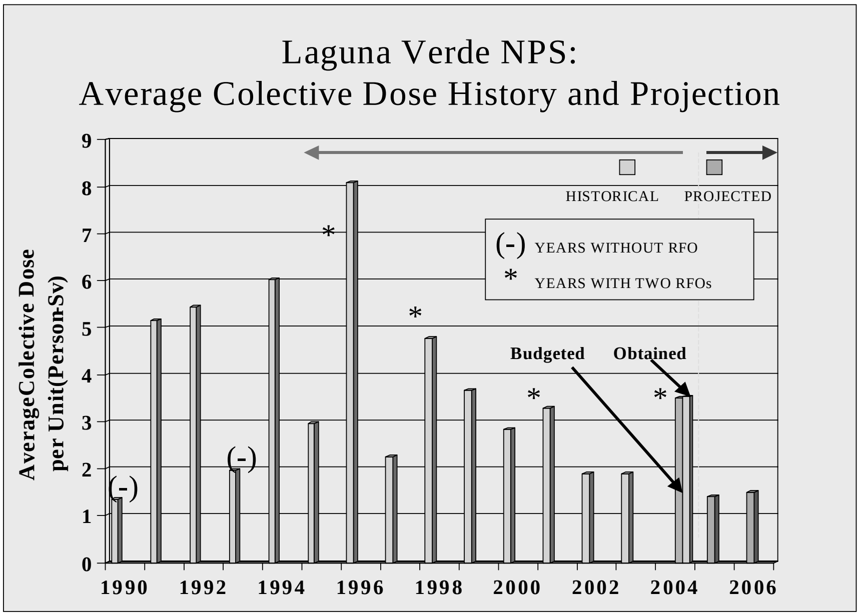
No significant issues of concern are foreseen for 2005

Technical plans for major work

Noble Metal injection starts at Laguna Verde prior to Unit 1 11th RFO: no negative effects observed. Hydrogen injection will also start at the end of the outage by the 2nd week of October 2005.

Trends

2004 was conceived as a "High dose – refurbishing year". This means that, besides the two refueling outages, several high-dose activities were planned for that year. In contrast, 2005 is expected to be a moderate collective dose year: around 1.4 Person·Sv average per unit are expected, the lowest historical record for Laguna Verde NPS.



NETHERLANDS

Dose information

Operating reactors

Reactor type	Number of reactors	Average annual collective dose per unit and reactor type (man·Sv)
PWR	1	0.793

Reactors in cold shutdown or in decommissioning

Reactor type	Number of reactors	Average annual collective dose per unit and reactor type (man·Sv)
BWR	1	0.097

The Netherlands has two nuclear power plants: Dodewaard and Borssele. The Dodewaard BWR (57 MWe), operated by GKN, was shut down in March 1997 for political and economical reasons. Transports of fuel to the BNFL reprocessing plant have been completed by April 2003. The plant is the process of modification into a 40-year "safe enclosure" status, before full decommissioning and return to green field conditions. A number of buildings have been demolished and several decommissioning activities have been carried out in 2004. New systems were built for ventilation and water treatment. The systems for monitoring of emissions were also renewed. The activities for creating the safe enclosure will be finished in 2005. The annual dose was 0.097 man·Sv.

The Borssele plant (450 MWe), operated by NV EPZ, is a baseload unit. Up to this year it has enjoyed 31 years of commercial operation. Major backfittings were completed in the plant in 1997. The unit capability factor in 2004 was 91.4%. The annual outage in October lasted 26 days, 4 days longer than planned. In this outage both steam generators were chemically cleaned and than tube lancing was carried out. After this all the steam generator tubes were inspected over the full length. Six tubes in one steam generator were plugged. The collective dose in the outage was 0.707 man·Sv. The annual collective dose amounted to 0.793 man·Sv.

In 2004 the average individual dose was 0.61 mSv for plant, 1.21 mSv for contractor personnel. The highest yearly individual dose was 6.35 mSv for plant and 8.34 mSv for contractor personnel.

ROMANIA

SNN CNE-PROD Cernavoda operates a single unit nuclear power plant CANDU-600 type. 2004 was the eighth full operation year. In 2004 the collective dose was 656.71 man·mSv, less than 2003 value.

Summary of CNE-PROD dosimetric trends

Occupational exposure at Cernavoda NPP: February 1996 - December 2004

	Internal effective dose (man·mSv)	**External effective dose (man·mSv)**	**Total effective dose (man·mSv)**
1996	0.6	31.7	32.3
1997	3.81	244.48	248.28
1998	54.37	203.25	257.62
1999	85.42	371.11	469.89
2000	110.81	355.39	466.2
2001	141.42	433.44	574.86
2002	206.43	344.04	550.48
2003	298.02	520.27	818.28
2004	398.26	258.45	656.71

Events influencing dosimetric trends

In 2004 the planned outage had a 47% contribution to the collective dose, less than previous years. The contribution of internal dose due to tritium intake was 57% for the planned outage period and 61% for the entire year 2004.

Number and duration of outages

During 2004 there were 1) one 4 days unplanned outage between 28-31 March, without any special radiological impact; 2) one 31 days planned outage, between 28 August and 29 September.

Major evolutions

In 2004 CNCAN continued to issue new regulations:

- Ord. 2/2004 "Regulation about taxes and tariffs for the authorisation and control of nuclear activities".
- Ord. 56/2004 "Fundamentals for safe management of radioactive waste".
- Ord. 62/2004 "Regulations for exemption of materials resulting from nuclear authorised practices".
- Ord. 64/2004 "Radiation safety regulations for radiotherapy".
- Ord. 144/2004 "Radiation safety regulations for measuring systems using ionising radiation".
- Ord. 171/2004 "Radiation safety regulation – Authorisation procedures for mining and milling of uranium and thorium, processing of nuclear raw material and fabrication of nuclear fuel".
- Ord. 274/2004 "Designation of nuclear notified organisms".
- Ord. 280/2004 for modification of "Radiation safety regulation for operational radiation protection in mining and milling of uranium and thorium".
- Ord. 281/2004 for modification of "Radiation safety regulations for decommissioning of mining and milling of uranium and thorium installations – Criteria for exemption of buildings, materials, installations, dump and contaminated fields for other purposes".
- Ord. 286/2004 for modification of "Regulations for generic requirements for quality management systems in constructing, operating and decommissioning of nuclear installations".
- Ord. 287/2004 for modification of "Regulations for specific requirements for quality management systems in goods producing and services supplying for nuclear installations"
- Ord. 289/2004 for modification of "Regulations for operational radiation protection for non-destructive examinations activities with ionising radiation".
- Ord. 291/2004 for modification of "Radiation safety regulations for diagnosis radiology and radiotherapy.
- Ord. 292/2004 for modification of "Individual dosimetry regulations".
- Ord. 293/2004 for modification and completion of "Radiation safety regulations for radiotherapy".
- Ord. 294/2004 for modification and completion of "Radiation safety regulations for measuring systems using ionising radiation"
- Ord. 358/2004 "Radiation safety regulations for nuclear medicine".
- Ord. 360/2004 "Regulations for calculating dispersion of radioactive effluents evacuated in the environment from nuclear installations".
- Ord. 361/2004 "Regulations for meteorologic and hydrologic measurement for nuclear power plants".

2004 continued the implementation of the latest CNCAN regulations related to personnel dosimetry, radioactive waste, calculating dispersion of radioactive effluents, meteorologic and hydrologic measurement, non-destructive examination, designation of nuclear notified organisms.

Component or system replacements

- 3 vertical neutron flux detectors;
- 2 neutrons absorbent rods.

Safety related issues

- Teledosimetry system WRM2 was commissioned during 2004. This is a sub-system of DMC2000S personal alarm dosimeters from MGP Instruments. The teledosimetry system consists of: 5 PAM-TRX transmitters, 1 local station WRM2 type, 1 laptop with TELEVIEW software. The system displays information on-line from personal alarm dosimeters, portable instruments and air monitors (MGP instruments);
- proper and prompt identification, location and removal of an activated small object in a pipe from Liquid Injection Shutdown System, generating high gamma dose rates in one accessible area of the reactor building;
- successful replacement of 3 vertical neutron flux detectors: individual and collective doses were kept very low;
- successful replacement of 2 neutrons absorbent rods.

2005 Issues of concern

Due to the increase of tritium dose rate in the Reactor Building (boiler room and accessible areas) for the second consecutive year, individual and collective internal doses became a major concern. In order to lower these doses respiratory protection became mandatory for tritium dose rates higher than 0.03 mSv/h, instead of 0.05 mSv/h and the access in the reactor Building for routine maintenance activities is more restricted. Also, semi-portable tritium monitors will be installed for early detection of tritiated heavy water leaks in access controlled areas.

Technical plans for major work in 2005

The major activities planned for 2005 outage having a potential impact on the collective dose are: "eddy current" inspection of 3 boilers, replacement of hydro-cyclones from moderator system pump, activities included in preventive/corrective maintenance programme, replacement of 11 VFDs assemblies.

Regulatory plans for major work in 2005

CNE-PROD ALARA committee will be established during 2005.

RUSSIAN FEDERATION

Dose information

Operating reactors

Reactor type	No. of reactors	Average annual collective dose per unit and reactor type [man·Sv]
PWR (VVER)	15	1.004*

* Calculated using 14 VVERs. Kalinin NPP Unit 3 started commercial operations on 16 December 2004.

Reactors in cold shutdown or in decommissioning

Reactor type	No. of reactors	Average annual collective dose per unit and reactor type [man·Sv]
PWR (VVER)	2	0.178

Summary of national dosimetric trends

Collective doses for all operating VVERs

Nuclear Power Plant		Normal operation (man·Sv/unit)	Planned outages (man·Sv/unit)	Total (man·Sv/unit)
Balakovo	Unit 1, VVER-1000	0.220	0.521	0.741
	Unit 2, VVER-1000	0.230	0.347	0.577
	Unit 3, VVER-1000	0.250	0.361	0.611
	Unit 4, VVER-1000	0.254	0.253	0.507
Kalinin	Unit 1, VVER-1000	0.060	0.936	1.028**
	Unit 2, VVER-1000	0.060	0.698	0.758
Kola	Unit 1, VVER-440	0.081	1.015	1.096
	Unit 2, VVER-440	0.330	1.494	1.824
	Unit 3, VVER-440	0.070	0.533	0.603
	Unit 4, VVER-440	0.023	0.210	0.233
Novovoronezh	Unit 3, VVER-440	0.404	1.435	1.839
	Unit 4, VVER-440	0.434	1.231	1.665
	Unit 5, VVER-1000	0.149	2.279	2.428
Volgodonsk	Unit 1, VVER-1000	0.006	0.138	0.144

** There was an unplanned repairing outage at Kalinin 1 from 9-16 October 2004. The outage collective dose was 0.032 man·Sv.

In comparison with 2003, the total annual collective dose (personnel and contractors) of all Russian operational VVER type reactors decreased at 2.533 man·Sv and was 14.054 man·Sv in 2004. This value corresponds to 85 % of the total annual collective dose in 2003. The main contribution to collective dose reduction was determined at Novovoronezh 3 and 4 (3.242 man·Sv in sum).

Individual doses

In 2004, the annual effective individual doses received by 6 workers of Novovoronezh NPP exceeded the control level of 20 mSv. This control level was fixed by concern Rosenergoatom – operating organisation of all Russian NPPs – as operational dose constraint. In this specific case, control level exceeding has been preliminary planned and met ALARA requirements, aimed at collective dose reduction. The main dose limit – individual effective dose of 20 mSv/year, averaged over defined periods of 5 years with the further provision that it should not exceed 50 mSv in any single year – was not violated in this situation. All these doses were gradually received at various operating Novovoronezh units during 2004. Main part of 6 workers' exposure related to repairing activity at Novovoronezh 5 reactor pressure vessel head with replacement of control rod nozzles. The maximum recorded individual effective dose was 26.8 mSv.

There were no events exceeding 20 mSv of annual individual dose at other plants with VVER type reactors. The highest annual effective individual doses were:

- Balakovo – 14.0 mSv;
- Kalinin – 18.0 mSv;
- Kola – 19.7 mSv;
- Volgodonsk – 2.2 mSv.

All these workers are from the plant central repair department and doses were caused by maintenance and repairing activities of the primary circuit equipment. Doses were gradually received during 2004.

Number and duration of outages

Name of reactor unit	Since	Duration, days
Balakovo 1	05.03.04	79
Balakovo 2	15.05.04	48
Balakovo 3	29.08.04	50
Balakovo 4	23.06.04	51
Kalinin 1	13.06.04	60
Kalinin 2	03.04.04	47
Kola 1	13.03.04	60
Kola 2	21.06.04	87
Kola 3	26.07.04	38
Kola 4	12.05.04	38
Novovoronezh 3	01.06.04	50
Novovoronezh 4	16.09.04	44
Novovoronezh 5	23.06.04	Outage was not finished in 2004
Volgodonsk 1	30.04.04	43

New dose-reduction programmes in 2004

- Programme of activities for NPP radiation control departments' accreditation was elaborated and put into action.
- Contest for "The best health physicist of NPPs" was organised.
- Manual on "Basic arrangements of radiation control at NPP", aimed at improvement of workers knowledge in the area of radiation protection, was prepared and published.
- Implementation of electronic personnel dosimeters.

Issues of concern for 2005

- Provision of the control that the individual effective doses of NPP staff should not exceed 100 mSv in the first 5 years period (2001-2005).
- Evaluation and practical application of radiation exposure goals (annual collective dose per unit) for NPPs of concern Rosenergoatom.
- Continuation of the centralised delivery of electronic personnel dosimeters at NPPs.
- Commercial operation start-up of personnel dosimetric control computer based system.

SLOVAK REPUBLIC

Principal events

The average annual collective dose per unit and reactor type PWR–VVER in Slovak Republic for 2004 is 278.484 man mSv.

Bohunice Nuclear Power Plant (4 units)

The total annual effective dose in Bohunice NPP in 2004 calculated from legal film dosimeters was 1 219.244 man·mSv (employees 702.604 man·mSv, outside workers 516.640 man·mSv). The maximum individual dose was 10.720 mSv (contractor).

Events influencing dosimetric trends

The main contributors to the total collective dose at Bohunice NPP were the outages. Outages at all four units contributed with the approximately same value to the total collective exposure (except for Unit 3, where the exposure was about 100 man·mSv less than at other units) even if the duration of outages at Unit 3 and 4 was at least two times longer than those at Units 1 and 2. The reason is the better radiation situation at Unit 3 and 4. All activities performed in radiation-controlled zones had been optimised.

Number and duration of outages

Unit 1 – 36 days standard maintenance outage. Total collective dose was 329.75 man·mSv.
Unit 2 – 33 days standard maintenance outage. Total collective dose was 312.78 man·mSv.
Unit 3 – 64 days standard maintenance outage. Total collective dose was 206.36 man·mSv.
Unit 4 – 83 days major maintenance outage. Total collective dose was 369.11 man·mSv.

Note: all data in this paragraph came from electronic operational dosimetry.

Component and system replacement

Several important modernisations of old radiation protection instrumentation were performed:

- finalising of the improving of contamination measurement at all exit points from RCA for women;
- finishing of the modernisation of the main radiation control room at Unit 3 and 4;
- installation of new tritium and carbon monitors in gas discharge system.

Organisational evolutions

The company organisational structure has been changed during the year touching also the radiation protection dept. All the QA documentation had to be transformed to fulfil the new organisation requirements.

Plans for major works in 2005

Unit 1 – 71 days major maintenance outage.
Unit 2 – 35 days standard maintenance outage.

Unit 3 –78 days major maintenance outage combined with the modernisation works.
Unit 4 – 53 days standard maintenance outage combined with the modernisation works.

Technical issues of concern from radiation protection point of view

Following events in the field of modernisation of radiation instrumentation are expected:

- finishing of installation of accident monitors on live steam pipelines from steam generators at Units 3 and 4;
- installation of accident gas discharge monitor in ventilation stack.

Due to the privatisation process Bohunice NPP will be divided into two separate plants – Units 1+2 and Units 3+4. That will again have an influence not only to organisational changes but also to technical aspects at the site.

Mochovce Nuclear Power Plant (2 units)

Total collective effective dose (CED) for the two units was 451.661 man·mSv (CED was evaluated from legal film badge and TLD neutron personal dosimeters), maximum individual effective dose was 5.642 mSv (supplier).

Events influencing dosimetric trends

The main contributors to the total CED at Mochovce NPP were planned outages at Units 1 and 2. The total CED for both units from normal operation was 92.401 man·mSv and CED from outages was 387.593 man·mSv (CED was evaluated on a base of results of operational electronic personal dosimeters).

Number and duration of outages

Unit 1 – 41 days long planned standard outage. Total CED was 260.798 man mSv (plant personnel 122.316 man·mSv, contractors 138.482 man·mSv).

Unit 2 – 44 days long planned standard outage. Total CED was 126.795 man·mSv (plant personnel 70.067 man·mSv, contractors 56.728 man·mSv).

Note: Collective effective doses during outages were evaluated by electronic operational dosimetry.

Component and system replacement

- installation of two tool monitors at the exit from the RCA.

Expected principal events for the year 2005

Plans for major works in the coming year

Unit 1 – 70 days major maintenance outage.
Unit 2 – 38 days standard maintenance outage.

Technical issues of concern from radiation protection point of view

- Clearance of radioactive material to the environment according Slovak legislation in order to decrease amount of radioactive waste.

Regulatory plans for major work in the coming year

- Implementation of EC legislation.
- Assessment of upgrading of both units of NPP V2 in Bohunice.
- Inspections of outages in all operated units.

SLOVENIA

Radiological performance indicators of Krško nuclear power plant (PWR) for the year 2004 were: Collective radiation exposure was 0.69 man·Sv (0.13 man·mSv per GWh electrical output). Maximum individual dose was 13.8 mSv, average dose per person was 0.84 mSv.

Planned outage (4.9.03-3.10.04), 30 days: Refuelling outage collective dose was 0.61 man·Sv. Main additional activities were inspections of reactor vessel head, under-vessel inspections and welds of the vessel and reactor coolant piping.

Other

In this year the plant has started 18 months fuel cycles (last one was 15 months as transition from 12 months). No fuel defects were detected in the beginning of the 21st fuel cycle.

Major evolution

The plant activities relate to replacement of both low pressure turbines in outage 2006.

SOUTH AFRICA

Summary of national dosimetric trends

The dosimetry trend for Koeberg Nuclear Power Station is downwards. The WANO three-year average dose per unit was reduced at Koeberg Nuclear Power Station from 990 mSv in December 2003 to 750 mSv in December 2004. The number of occupationally exposed persons was 1 826 and the annual average dose to occupationally exposed persons was 0.4714 mSv. The highest annual individual dose was 7.747 mSv.

Number and duration of outages

Koeberg Nuclear Power Station had one refuelling outage on Unit 1 with duration of 49 days.

New/experimental dose-reduction programmes

Koeberg Nuclear Power Station has implemented a training simulator for radiation workers. This practice improved has improved compliance to the radiation protection rules and processes. The radiation protection group has also developed and implemented ALARA dose targets for different departments, workgroups and specific tasks. This practice has improved and increased the worker's focus on the application of good ALARA practices. The General Manager (Nuclear Cluster) has issued a challenge to all Koeberg Nuclear Power Station personnel to reduce dose. This practice has motivated all workers to support and compliment dose reduction initiatives.

Issues of concern

During initial inspections, traces of rust and fine, hairline cracks were detected on some of the piping inside radiological controlled zones at Koeberg Nuclear Power Station.

Technical plans for major work in the coming year

Plans are in place to inspect large quantities of piping for rust and cracks inside radiological controlled zones during 2005 and two re-fuelling outages are scheduled at Koeberg Nuclear Power Station for 2005. Technical plans are developed to perform large quantities of (CP1) modifications at Koeberg Nuclear Power Station during 2005.

Regulatory plans for major work in the coming year

Pursue the application of a process-based licensing concept for radiation protection at Koeberg Nuclear Power Station.

SPAIN

In the year 2004 the average dose per outage has been 0.409 man·Sv for PWR (4 units). Per plant, the annual collective doses and the outage collective doses are shown in the following table:

NPP	Type	Outage coll. doses (man·Sv)	No. days	Annual coll. doses (man·Sv)	Comments
J. Cabrera	PWR	—	—	0.188	No outage
Almaraz I	PWR	—	—	0.042	No outage
Almaraz II	PWR	0.381	25	0.423	
Ascó I	PWR	0.448	32	0.494	
Ascó II	PWR	0.614	27	0.716	
Vandellos II	PWR	—	—	0.052	No outage
Trillo	PWR	0.192	23	0.209	
S.M Garoña	BWR	—	—	0.227	No outage
Cofrentes	BWR	—	—	0.700	No outage

Regarding the annual collective dose in PWRs, the average for this year is 0.30 man·Sv and the 3 year rolling average is 0.43 man·Sv. This last value indicates that the downward trend continues (decreasing from 0.48 to 0.43), with values in line with those of the previous years. Regarding the annual collective dose in BWRs, the total collective dose average for this year is 0.463 man·Sv and the three-year rolling average is 1.39 man·Sv, decreasing from 1.55 to 1.39 principally due to the lack of outages this last year.

Cofrentes NPP had a forced outage during 10 days of May (from 2/05/2004 to the 11/05/2004) in order to change two damaged fuel elements, performing a sipping in core of the reactor core, excepting the peripheral elements. The collective dose received during this forced outage was 238 man·mSv.

Regarding the dose rate values in the drywell during this forced outage, they were a 12% lower than the high dose rates values registered in the last refueling outage in October 2003 (14^{th} outage), where the dose rates were 300% higher than usual. This reduction in the dose rate values shows that the corrective action plan developed until next outage in May 2005 is being effective. During this next outage it has been programmed a chemical decontamination of the Recirculation System, Reactor Water Clean-up and partially of the Residual Heat Removal system inside the drywell.

Almaraz II has had a special refueling outages, due to its 20 years operating. This implies a higher number of inspections and other tasks with the consequent increase of the collective dose compared with other standard outages.

Ascó I has had problems with contamination in the containment area with I-131 during its last refueling outage (September 2004). It has produced the internal contamination of several workers, all of them with doses below the registration level (1 mSv).

This year Ascó II has had a higher annual collective dose than usual due to the following facts:

- During the refuelling outage, they replaced the vessel head, which produced a collective dose of 71 man·mSv.
- Several Design modifications have been carried out, with a total dose of 103 man·mSv.
- The transport of the old vessel head from the reactor building to its new place, the temporary store of the steam generators, with a dose of 33 man·mSv.

Regarding Vandellós I, the dismantling tasks have already concluded. The Dormancy License was expected at the end of 2004 and was issued by the Industry Ministry in January 2005.

In 2000, a jointly working group between the Spanish Regulatory Body (CSN) and the Spanish utilities was set up to identify guidelines for the enhancement of the nuclear regulatory effectiveness in Spain. The group recommended to perform some tasks, one of them was the analysis in depth of the NRC Reactor Oversight Process (ROP) in order to study its usefulness and adaptability in Spain. As a conclusion of this analysis this year has started the development of the SISC Project, the Spanish adaptation of ROP, with the following main tasks: development of the Process Indicators, definition of the Significance Determination Process and development of the CSN Inspection Procedures.

An interdisciplinary working group on decommissioning and dismantling of Jose Cabrera NPPP has been created with the objective of proposing a licensing and control strategy guarantying safety during all operations and incorporating up-to-date worldwide learnt lessons. The alternative chosen for this plant is the total immediate decommissioning, with the following milestones:

- Definitive shutdown and start of the pre-decommissioning activities in April 2006.
- Licensee transfer from Union Fenosa Generation to the Waste National Company (ENRESA) and beginning of the dismantling in April 2009.

- License termination in year 2015.

A sectorial dosimetric study by CSN showed higher doses in transport activities (mainly radiopharmaceuticals) than in other sectors, with an average individual dose of 4 mSv/year. For this reason, in 2004 CSN planned to issue a safety instruction on guidelines to implement in order to get ALARA doses in transport.

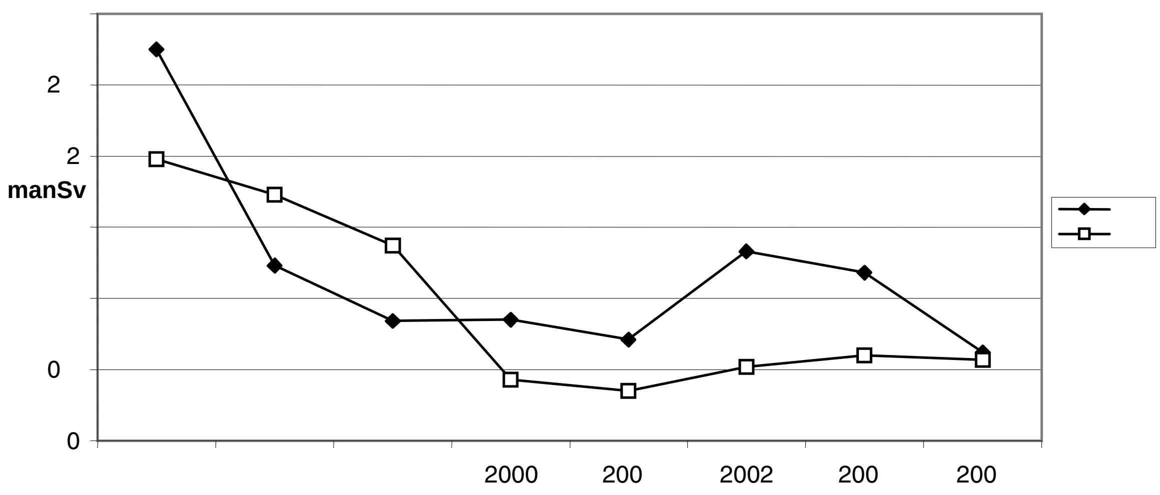
SWEDEN

Collective dose and dosimetric trends

The total collective dose for the Swedish NPPs 2004 was 6.4 man·Sv. The collective dose is showing a nice down going trend after modernisations of several reactors are finished.

Collective dose per reactor type and unit has a positive downward trend during the last years.

Annual collective dose per reactor type and unit



The average dose was 1.1 mSv and the highest individual dose was 19.5 mSv. Four contractors had a dose in the interval of 15-20 mSv per year. There were 2 internal contaminations resulting in an effective dose greater than 0.25 mSv. The average collective dose per PWR unit (3 units) was 0.58 man·Sv and the average collective dose per BWR unit (8 units) was 0.57 man·Sv.

Number and duration of outages

Collective dose and duration of the outages 2004.

Plant	Type of Reactor	Outage Length (days)	Collective Dose (man·Sv)	Comments
Barsebäck 2	BWR	13	0.17	
Forsmark 1	BWR	8	0.16	
Forsmark 2	BWR	10	0.22	
Forsmark 3	BWR	37	0.61	Replacement of the low pressure turbines.
Oskarshamn 1	BWR	38	0.97	
Oskarshamn 2	BWR	33	0.35	
Oskarshamn 3	BWR	21	0.25	
Ringhals 1	BWR	31	1.01	
Ringhals 2	PWR	26	0.70	Replacement of pressure relief pipes of the pressuriser.
Ringhals 3	PWR	16	0.14	
Ringhals 4	PWR	24	0.67	Replacement of the reactor vessel head.

Dose rate trends and source term reductions

At Ringhals 1 there were increasing dose rates by 20-30 % at the main recirculation loops. The reason is so far not known but will be investigated. However the global source term/dose rate situation is noticeably stable during the period of 2000 to 2005. At Forsmark 1 there were increasing dose rates by 25-30% at the reactor and turbine systems. This was probably due to high moisture content in the steam. At Forsmark 3 the recontamination of the reactor water clean up system was only 30% of the level before the system decontamination in 2001. Zinc injection was started at Oskarshamn 1 in 2003. The dose rates in 2004 were the same as last year, but it is too early to estimate the effect of the zinc injection. At Barsebäck 2 the zinc injection was started in 2001. The dose rates are now 20% lower in average. The recontamination of the decontaminated systems at Oskarshamn 2 in 2003 is 10-12%. Zinc injection was started in 2003. An increase of 40% was expected in 2004.

The Swedish Radiation Protection Authority

The Swedish Radiation Protection Authority (SSI) has performed inspections according to the regulations concerning free release of material and planning for decommissioning. During 2005 several regulations will be revised. SSI will also prepare for the licensing of the coming power up rates. SSI stresses the need for available resources to guarantee that the good RP conditions will be maintained and further developed.

ISOE activities

A training course was performed in Uppsala in May 2004 in order to facilitate and encourage the use of the ISOE database. During 2004 eight new ISOE 3 reports were registered in the database.

There were some software problems with the ISOE system in 2004 resulting in late and partial reporting of doses to the ISOE 1.

Future issues

There was a political proposal to finally close down Barsebäck 2 in 2005. In 2005 the reactor vessel head of Ringhals 3 will be replaced. There will be a partial replacement of the isolation of the reactor pressure vessel and replacement of the high-pressure turbines at Ringhals 1. The low-pressure turbines at Forsmark 1 and 2 will be replaced.

There are on going plans to up rate the power at Forsmark 1-3, Ringhals 1 and 3 and Oskarshamn 2 and 3 during the next coming years. The electrical output will be raised between 13-25% of each reactor. The source terms and dose rates will rise in proportion to the up rating.

SWITZERLAND

Summary of national dosimetric trends (TL-Dosimeters)

Facility	Number of monitored workers 2004	Years' collective dose (man m·Sv)		
		2004	2003	2002
NPP Beznau I + II (PWR)	873	617	454	595
NPP Gösgen (PWR)	921	823	555	931
NPP Mühleberg (BWR)	930	1048	1180	944
NPP Leibstadt (BWR)	1644	1746	862	428

Events influencing dosimetric trends

NPP Beznau I + II: Normal in-service inspections and maintenance works in unit 1 resulting in 443 man·mSv during standard outage. In unit 2 a short outage causes 81 man·mSv. No significant changes in dose rates as well as no fuel rod cladding leakage were investigated.

NPP Gösgen: The outage 2004 was longer as the standard outages last years in order to bring several jobs forward which were normally done during outage 2005. No significant changes in dose rates as well as no fuel rod cladding leakage were investigated.

NPP Leibstadt: Because of relevant material defects found inside the recirculation pump A (around 1 kg metal removal) welding works had to be done. An inspection of pump B showed the same defect resulting in an additional repairing work. The recirculation system and further support systems (reactor water cleaning system) were successfully decontaminated chemically with the CORD UV technique reducing the collective dose by several hundred man mSv.

NPP Mühleberg: The standard outage resulted in a lower collective dose then the year before, because of a little reduction of dose rates inside the Drywell. No fuel rod cladding leakage was investigated.

Number and duration of outages

- NPP Beznau I: 1 outage, 42 days (last year 10 days)
- NPP Beznau II: 1 outage, 10 days (last year 27 days)
- NPP Gösgen: 1 outage, 20 days (last year 20 days)
- NPP Leibstadt: 1 outage, 45 days (last year 22 days)
- NPP Mühleberg: 1 outage, 20 days (last year 30 days)

Safety-related issues

Corrosion found on the steel nappe of the containment in NPP Beznau unit 1 was investigated. A leakage test resulted in leakage rates well below specified limits.

Unexpected events with radiological effects

None event occurred in connection with occupational external and internal exposure above 1 mSv individual dose. Nobody was contaminated with radioactivity that could not be removed immediately.

New/experimental dose-reduction programmes

In KKB 1 the draining valve of the regenerative heat exchanger was moved outside of the exchanger room. Thus the emptying of the system causes a noticeable smaller occupational dose.

Technical plans for major work in the coming year 2005

In KKG the spray valves and needles of the pressuriser have to be changed, which will result in a job dose of about 750 Person-mSv.

Regulatory plans for major work in the coming year 2005

A new law and ordnance about nuclear energy is being prepared this year. The enactment is planned for early 2005.

Plans for major work in the coming years (2006 …)

The plan from KKL to start with hydrogen water chemistry (HWC) in 2005 was prolonged to 2007. HWC will result in a higher dose rate due to higher Co-60 in the primary loops and N-16 in the secondary loops. First construction jobs preparing additional shielding have been planned in 2004-05.

UKRAINE

The average collective doses for operational reactors in 2004 are as follows:

Reactor type	Number of units	Collective dose/unit (man·mSv)
VVER	15*	1180**

* In 2004 were put into operation two units: Khmelnytsky 2 (08.2004) and Rovno 4 (10.2004).

** Collective dose per unit calculated subject to 15 units in fourth quarter 2004.

Summary of national dosimetric trends

In 2004 the collective occupational exposure dose of NNEGC "EnergoAtom" NPP personnel was 15.84 man·Sv, that is 2.94 man·Sv less in comparison with 2003.

NPP	Total collective dose (man·Sv); Total collective dose per unit (man·Sv/unit)	Individual annual dose: plant personnel (man·mSv)	Individual annual dose: outside personnel (man·mSv)	Outside personnel dose contribution to NPP annual collective dose (%)
Zaporizhzhe NPP	5.76 (0.96)	1.12	0.28	4%
Rivno NPP	3.36 (0.99***)	0.94	0.62	8%
South Ukraine NPP	4.43 (1.48)	1.53	1.47	21%
Khmelnitsky NPP	2.29 (2.22***)	0.71	0.274	16%

*** Collective dose per unit calculated subject to new unit.

The greatest contribution into the collective dose by outside personnel was recorded at SU NPP due to works carried out during steam generator replacement and on the primary circuit.

For the year of annual report (2004) overwhelming majority (85.63%) of personnel obtained individual annual doses less than 2 mSv. Within 15-20 mSv only 66 workers were registered, that is 0.5% from the total number of personnel.

Number and duration of outages

Planned unit outages took place at all NPP units in 2004.

NPP	Duration of the outage per unit (days)	Annual collective dose (man·Sv)
Zaporizhzhe NPP	53	0.82
Rivno NPP	37	0.80
South Ukraine NPP	45	0.79
Khmelnitsky NPP	63	1.73

In 2004 average duration of outage was 48.2 days that is 18.3 days less that in 2003; average collective dose per unit was 0.88 mSv, that is less by 0.07mSv (9%) in comparison with 2003.

New plants on line/plants shut down

In 2004 were put into operation two units: Khmelnytsky 2–(08.2004) and Rovno 4 (10.2004). It is WWER 1000/B320 type.

Following the ALARA principles the utility organisation NNEGC “Energoatom” for 6 years has been carrying out systematic work in the area of radiation protection and radiation safety: ALARA groups were created at all Ukrainian NPPs.

New/experimental dose-reduction programmes

Organisational evolutions

According with ALARA methodology at Ukraine NPPs were developed the planned indices for 2004 year. Collective doses have been calculated on the basis of the previous experience.

In 2004 *at Zaporozhzhe NPP* was developed standard act “Statement on dose exposure management of Zaporozhzhe NPP staff to ALARA principles”. These one and “The Programme on Decreasing the NPP Staff Exposure” are define concretely of radiation protection division activity in the part of deepening international principles of occupational doses management. They have provided a list of measures during 2003-2005 years with purpose to further decreasing collective and individual dose NPP staff exposure and perfection of radiation protection at Zaporozhzhe NPP. During 2004 implemented eight points out of nine.

At Rovno NPP annually developed the “Programme on occupation exposure optimisation (ALARA Programme)”. In 2004 it developed and commissioning of software net “Radiation monitoring Rovno NPP units”, it works online. Due to net it possible to make analysis of units radiation parameters under automatise and systematise condition.

At South-Ukraine NPP Council of ALARA is functioning, NPP’s Chief engineer is the head of Council. In 2004 within the framework of ALARA Programme with purpose to discover and remove of discrepancy in radiation protection division activity. Programme on staff self-assessment were developed and according to them self assessment were carried out.

At Khmelnitsky NPP within the framework of ALARA Programme seven measures were planned and implemented in 2004. Some of them are: NPP staff training of ALARA methodology, daily individual dose control of maintenance staff carried out by means of electronic dosimeters.

UNITED KINGDOM

Summary of plant operation

Sizewell B NPP, the UK’s sole PWR, is the only utility member of the ISOE programme. Other than Sizewell B, at the end of 2004 there were eleven operating nuclear power plants in UK; seven based upon twin Advanced Gas Cooled Reactors (AGRs), operated by British Energy and four with twin Magnox Reactors, operated by British Nuclear Group, part of BNFL. A number of other Magnox

Reactors, owned by British Nuclear Group, are at various stages of decommissioning. During 2004 Chapelcross, a 240 MW (e) Magnox NPP, was shut down for decommissioning.

Dose trends for British Energy

The Table below summarises the collective doses for the eight NPPs operated by British Energy including Sizewell B. The collective dose for 2004 was the lowest ever recorded, principally because a number of plants did not have outages.

Summary of collective doses for British Energy Nuclear Power Plants (man·Sv.

Worker category	Year				
	2000	**2001**	**2002**	**2003**	**2004**
NPP Staff	0.73	0.55	0.53	0.42	0.27
Contractors	1.15	0.28	1.23	0.97	0.12
Total	**1.88**	**0.83**	**1.76**	**1.39**	**0.39**

Dose trends for Sizewell B

Sizewell B operates with an 18-month operating cycle. The plant did not have a refuelling outage during 2004 consequently the collective radiation exposure was very low. For 2004 the collective dose was approximately 0.03 man·Sv with a maximum individual dose of 1.3 mSv. At the end of 2004 the three year rolling collective radiation exposure for Sizewell B was 0.23 man·Sv, down from the previous year.

ISOE benchmarking study

During September 2004 a joint team from ISOE ETC and EdF carried out a benchmarking study of Sizewell B NPP. The visit reviewed the organisation and management of radiological protection at the plant and made comparisons with other plants within the peer group.

UNITED STATES

Summary of USA occupational dose trends

The USA PWR and BWR occupational dose averages for 2004 continued a downward trend for the 104 commercial reactors:

Reactor type	Number of units	Total collective dose (person Sv)	Avg dose per reactor (person Sv/unit)
PWR	69	49 169.15	0.71
BWR	35	54 509.82	1.55

The total collective dose for the 104 reactors in 2004 was 10 367 person Sv, a decrease of 13% from the 2003 total. The resulting average collective dose per reactor for USA LWR was 0.997 person Sv/unit: among the lowest average collective dose ever recorded for US light water reactors.

The total collective dose for US PWRs in 2004 was 49 169 person Sv for 69 operating PWR units. The 2004 average collective dose per reactor was 0.71 person Sv/ PWR unit. The average 2004 PWR dose represents a 23% decrease from the 2003 value: the sixth time since the first commercial reactor commenced operations in 1969 that the average PWR annual dose has been under 1.00 person Sv/unit.

The total collective dose for US BWRs in 2004 was 54 509 person Sv for 35 operating BWR units. The 2004 average collective dose per reactor was 1.55 person Sv/BWR unit. The average 2004 BWR dose represents a 3% decrease from the 2003 value. The BWR average collective dose for 2004 is the fourth lowest recorded average dose per unit for US BWRs since 1969.

NRC regulatory issues

All commercial nuclear power reactors operating in the United States must be licensed and monitored by the Nuclear Regulatory Commission (NRC). There are as of June 2004, 104 commercial nuclear power reactors licensed to operate in 31 States. The 104 reactors licensed to operate during 2004 have accumulated 2 460 reactor-years of experience. An additional 385 reactor-years of experience have been accumulated by permanently shutdown reactors.

A. Strategic plan

The NRC’s FY 2004-2009 Strategic Plan focuses on five general goals: safety, security, openness, effectiveness, and excellence in agency management. These goals support NRC’s ability to maintain the public health, safety, and trust. Under each goal, strategic outcomes provide general barometer whether the goals are being achieved.

B. U.S. electricity generated by commercial nuclear power

In 2004, net nuclear-based electric generation in the United States produced a total of 789 billion kilowatt-hours. Since 1993, the average capacity factor has increased 19.6 percent (capacity factor is the ratio of electricity generated to the amount of energy that could have been generated).

C. NRC reactor oversight

The NRC does not operate nuclear power plants. Rather, it regulates the operation of the nation’s 104 nuclear power plants by establishing regulatory requirements for the design, construction and operation of such plants. To ensure that the plants are operated safely within these requirements, the NRC licenses the plants to operate, licenses the plant operators, and establishes technical specifications for the operation of each plant.

The NRC provides continuous oversight of plants through its reactor oversight process (ROP) to verify that they are being operated in accordance with NRC rules and regulations. The NRC has full authority to take whatever action is necessary to protect public health and safety and may demand immediate license actions, up to and including a plant shutdown.

The ROP is described on the NRC's Web site and in NUREG-1649, Revision 3, "Reactor Oversight Process." In general terms, the ROP uses both inspection findings and performance indicators (PIs) to assess the performance of each plant within a regulatory framework of seven corner stones of safety. The ROP recognises that issues of very low safety significance inevitably occur, and plants are expected to effectively address these issues.

The ROP is risk-informed, objective, predictable, understandable, and focused on the areas of greatest safety significance. Key features of the ROP are a risk-informed regulatory framework, risk informed inspections, a Significance Determination Process to evaluate inspection findings, performance indicators, a streamlined assessment process, and more clearly defined actions the NRC takes for plants based on their performance. The NRC began implementation of the ROP in April 2000 and continues to refine the ROP as experience is gained.

D. International activities

NRC has statutory responsibility for licensing the exports and imports of nuclear facilities, major components, materials, and related commodities. NRC is enhancing its controls on the export and import of high risk radioactive sources as part of the Commission's comprehensive review of nuclear material security requirements. These enhancements will reduce the likelihood the high risk radioactive sources will be used in a "dirty bomb."

E. Industry performance indicators

In addition to evaluating the performance of each individual plant, the NRC compiles data on overall performance using various industry-level performance indicator. The indicators can provide additional data for assessing trends in industry performance.

3. ISOE PROGRAMME OF WORK

ACHIEVEMENTS OF THE ISOE PROGRAMME IN 2004

Data collection and management

Collection of ISOE 1 data

ISOE participants provided their 2003 data using the ISOE Software under Microsoft ACCESS. ETC integrated all data received into the ISOE database.

Collection of ISOE 2 data

New ISOE 2 data continued to be collected during 2003, as well as updates on existing data.

Collection of ISOE 3 reports

The ISOEDAT database contained 202 ISOE 3 reports, including historical ISOE 3 (NEA 3) reports at the end of 2004.

Data release

The first release of the ISOEDAT database with data from 1969 to 2003 was made available to the European Utilities and to the Technical Centres for distribution on password protected ETC FTP server in July. Since then, several updates have been performed. The database and the ISOE Software were provided on CD-ROM to all participants after the annual ISOE Steering Group meeting (November 2004).

Use of the ISOE 3 reporting system

The use of the ISOE 3 reporting system has been very low, even after the agreement during the 2003 Steering Group meeting to further promote the system's use. The ISOE Bureau met, in conjunction with the International ALARA Symposium in Lyon, and also discussed this issue. At that time, the ISOE Technical Centres all agreed to take initiatives to have the power plants reporting through them create new ISOE 3 reports.

Documents and reports (under the auspices of the ISOE Working Group on Data Analysis)

***ISOE Annual Report 2003* –** The report was published and distributed in 2005.

***Information sheets* –** During 2004 several new information sheets were issued. A complete list of information sheets can be found in Annex 1- List of Publications.

Promotion of ISOE use

Several approaches to the effective promotion of the use of ISOE were identified by the in-depth analysis that was presented and discussed during the 2003 Steering Group meeting.

- It was agreed that the ISOE Chair would send a promotion letter to high level management in utilities and regulatory authorities, accompanied by a short document explaining the benefits of the ISOE system.
- National Co-ordinators have encouraged utilities to introduce procedures in nuclear power plants requesting the exchange of information with the ISOE system.
- The ISOE Technical Centres were asked to promote new products.
- The ISOE Past-Chair, Borut Breznik, developed the ISOE News, a short news letter summarising interesting and relevant information from within the ISOE family.

Meetings of ISOE utilities and ISOE regulators

During the 2003 Steering Group meeting it was suggested that utilities and regulatory authorities could usefully discuss technical issues separately. Topical sessions for utilities and regulators were first arranged during the ISOE International ALARA Symposium in Lyon, France, in March 2004. These useful sessions developed a number of technical issues and exchanges, summarised below, that were very much appreciated by all participants. Given the success of these meetings, it was agreed that they should be continued.

As part of the in-depth review of ISOE, it was agreed that each Steering Group meeting should be separated into administrative and technical sessions. Initially, it was felt that this would be an appropriate occasion to hold separate utility and regulator discussions. However, discussions within the ISOE Bureau suggested that the annual International ALARA Symposium would be a more appropriate venue for these separate discussions. The rationale for this suggestion is that the ISOE programme itself was designed to foster open discussions between utilities and regulators. Also, in that the participation at the Steering Group meeting is restricted, a more open meeting with larger participation, such as the International ALARA Symposium, is a much better setting to have meaningful, separate discussions.

Summaries of the utilities and regulators forums from the March 2004 ALARA Symposium in Lyon are provided below.

Utilities forum

The first ISOE Radiation Protection Managers' meeting, held at EdF premises, identified the following issues to be considered by the ISOE Steering Group in order to promote the mutual understanding and support between operators and regulators:

- How to develop a concept to share the 20 mSv dose budget between specialised workers in a market with decreasing manpower? International (electronic) passbook?
- How to develop and maintain high qualification through education and training in a deregulated market with economic pressure, increasing globalisation of manpower resources and increasing demand for young manpower?
- How to create a strategy for the surveillance of a potential transfer of contamination between nuclear power plants? Administrative and technical guidance? How to install an event reporting system based on a "no blame" principle?

- Necessity of independent radiation protection advisors? Qualification criteria and definition of duties.

Regulators forum

The first meeting of the regulatory bodies participating in ISOE, held at Lyon, was attended by representatives from ten countries from both Europe and Asia, as well as the EC, IAEA and NEA. The morning session was devoted to discussions on the use of the ISOE system by regulatory bodies as a tool for improving radiation protection regulatory control in their country, including making analyses for internal regulatory reports or public information, preparing inspections using ISOE data, and favouring benchmarking of NPPs. The afternoon was devoted to discussing outside worker problems. There was a consensus for requesting harmonisation of regulations, and in particular the setting up an international dosimetry passport. All participants agreed on the usefulness of the forum, and want the experience to be renewed and extended to more countries.

Software maintenance

Madras on line – As requested during the 2003 ISOE Steering Group meeting, the ETC has been developing a web-based access to the ISOE databases. The ETC presented the progress that had been made to the WGDA and ISOE Steering Group in November 2004.

ISOE Discussion Forum – The ETC, as requested, established a preliminary on-line discussion forum in July 2004, and submitted this for testing by ISOE Bureau Members. The ETC demonstrated this forum during the November 2004 ISOE Steering Group meeting, and put it into full operation as per the decisions taken by the ISOE Steering Group.

Contact with EPRI

Mr. David Miller reported to the mid-year ISOE Bureau meeting that the US Electric Power Research Institute (EPRI) would like to be affiliated with ISOE. The ISOE Bureau agreed to consider to offer EPRI the status of an observer. The North American Technical Centre will inform EPRI that they have to send an official letter to the ISOE Joint Secretariat – the NEA and the IAEA – requesting the status of an ISOE Observer. The final decision will be with the ISOE Steering Group at its next meeting in November 2004.

PROPOSED PROGRAMME OF WORK FOR 2005

Implement the improvements agreed to from the in-depth evaluation of the ISOE System

- Reinforce the role of the National Co-ordinators;
  - Prepare a more descriptive understanding of the role and responsibilities of the national co-ordinators.
  - Present the activities of the national co-ordinators at each Steering Group meeting.
  - Encourage utilities to introduce procedures at their nuclear power plants encouraging the use of the ISOE system as a work-planning resource, and as an important information storage and exchange mechanism.
- General promotion of the ISOE System:
  - ISOE Chair will send a promotion letter to high level management in utilities and regulatory authorities. National co-ordinators will send the co-ordinates of appropriate addressees via the Technical Centres to the Secretariat.

- ISOE Bureau and the Secretariat will prepare a short document explaining the benefits of the ISOE system. This document will be sent together with the above mentioned promotion letter.

- Promotion of the ISOE 3 reporting system:
  - Encourage further commitment from National co-ordinators to organise the preparation and inclusion of at least a few ISOE 3 reports into the system.
  - Encourage a more active role of Technical Centres in the development of ISOE 3 reports.
  - Recognise the top five ISOE 3 reports with a special presentation at the annual meeting of the ISOE utilities.
- Evaluate the new ISOE Steering Group meeting structure (administrative session, technical session) and improve its efficiency and usefulness for the 2006 Steering Group meeting.
- Promote new products by the Technical Centres (for example the organisation of topical meetings for radiation protection managers).
- Develop and implement an ISOE web page (see also Software Maintenance).
- Develop additional predefined analyses of the ISOE data (see also Software Management).

Data collection and management (performed through the ISOE Technical Centres)

- Collect ISOE 1 and ISOE 2 (dynamic) data for the year 2004.
- Collect ISOE 2 static data.
- Organise national training courses on the use of the ISOE system, especially with a view to use the ISOE 3 reporting system (Commitment from national co-ordinators).
- Issue several updates of the ISOEDAT database on the ETC server, and distribute these on a CD-ROM in December 2005.

Data analysis (under the auspices of the ISOE Working Group on Data Analysis)

- Review ISOE 2 data, discuss and propose useful analyses;
- Perform further analyses to clarify and enhance data from nuclear power plants which are in shut-down or some stage of decommissioning.

Documents and Reports (under the auspices of the ISOE Working Group on Data Analysis)

- ***ISOE Annual Report 2004 –*** Objective to publish the report in September 2005.
- ***ISOE News –*** Continue to issue news and current information of interest.
- ***Information Sheets –*** Planned for 2005:

	Yearly analyses	**Technical centre**
1	Japanese dosimetric results: FY2005 data and trends	ATC
2	Japanese occupational exposure during periodic inspection at PWRs and BWRs ended in FY 2005	ATC

International ISOE Workshop on occupational exposure in nuclear power plants

- Organisation and follow-up of the 2005 International ALARA Symposium, which will be held 9-12 January 2005, in Fort Lauderdale, Florida, United States.
- Preparation of the 2006 International ALARA Symposium, scheduled to take place in the Spring of 2006, in Essen, Germany.

Interaction with the international organisations

European Commission

- Establish close links to the European Commission occupational exposure programme; harmonise occupational exposure data collection programme.

INPO/EPRI

- Intensify the co-operation between INPO and the ISOE System especially in the domain of ISOE 3 reporting system.
- Explore areas where mutual co-operation between EPRI and ISOE could be beneficial.

Software maintenance (under the auspices of the Working Group on Data Analysis)

- To further enhance the usefulness of the ISOE system, it was decided to offer an ISOE web page for easy data analysis and ISOE 3 reports retrieval. In 2004, the Working Group on Data Analysis will prepare an action plan for the development of an ISOE web page.
- Establish a discussion forum on the web by ETC.
- To further improve the usefulness of the ISOEDAT software package, the following maintenance will be performed:
  - Develop additional predefined, easy-to-use analyses of ISOE data through MADRAS.
  - Publish a hard copy of the User's Manual for the management of ISOE 1 data, ISOE 2 data and ISOE 3 reports using the ISOE Software.
- Translate the ISOE software and the ISOE User's Manual in various languages.
- Organise software training sessions to meet the user's needs (organised by ETC on request).

Possible further topics of interest

- How to develop a concept to share the 20 mSv budget between specialised workers in a market with decreasing manpower? International (electronic) passbook?
- How to develop and maintain high qualification through education and training in a deregulated market with economic pressure, increasing globalisation of manpower resources and increasing demand for young manpower?
- How to create a strategy for the surveillance of a potential transfer of contamination between nuclear power plants? Administrative and technical guidance.
- How to install an event reporting system based on a "no blame" principle?
- Necessity of independent radiation protection advisors? Qualification criteria and definition of duties.
- RP issues and aspects of Decommissioning
- Emerging Challenges: What will happen if LNT is found to not be valid? Discussion of current research and possible practical implications
- Implementation of new ICRP recommendations: The practical use of Dose Constraints.

Appendix 1

LIST OF ISOE PUBLICATIONS

Reports

1. *Occupational Exposures at Nuclear Power Plants: Thirteenth Annual Report of the ISOE Programme, 2003,* OECD, 2005.
2. *Optimisation in Operational Radiation Protection,* OECD, 2005.
3. *Occupational Exposures at Nuclear Power Plants: Twelfth Annual Report of the ISOE Programme, 2002*, OECD, 2004.
4. *Occupational Exposure Management at Nuclear Power Plants: Third ISOE European Workshop, Portoroz, Slovenia, 17-19 April 2002,* OECD 2003.
5. *ISOE – Information Leaflet,* OECD 2003.
6. *Occupational Exposures at Nuclear Power Plants: Eleventh Annual Report of the ISOE Programme, 2001*, OECD, 2002.
7. *ISOE – Information System on Occupational Exposure, Ten Years of Experience, OECD, 2002.*
8. *Occupational Exposures at Nuclear Power Plants: Tenth Annual Report of the ISOE Programme, 2000*, OECD, 2001.
9. *Occupational Exposures at Nuclear Power Plants: Ninth Annual Report of the ISOE Programme, 1999*, OECD, 2000.
10. *Occupational Exposures at Nuclear Power Plants: Eighth Annual Report of the ISOE Programme, 1998*, OECD, 1999.
11. *Occupational Exposures at Nuclear Power Plants: Seventh Annual Report of the ISOE Programme, 1997*, OECD, 1999.
12. *Work Management in the Nuclear Power Industry*, OECD, 1997 (also available in Chinese, German, Russian and Spanish).
13. *ISOE – Sixth Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1996,* OECD, 1998.
14. *ISOE – Fifth Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1995*, OECD, 1997.
15. *ISOE – Fourth Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1994,* OECD, 1996.
16. ISOE – *Third Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1993,* OECD, 1995.
17. *ISOE – Nuclear Power Plant Occupational Exposures in OECD Countries: 1969-1992*, OECD, 1994.
18. ISOE – Nuclear Power Plant Occupational Exposures in OECD Countries: 1969-1991, OECD, 1993.

ISOE news

No. 1, December 2003	No. 5, April 2005
No. 2, March 2004	No. 6, June 2005
No. 3, July 2004	No. 7, October 2005
No. 4, December 2004	No. 8, December 2005

ISOE information sheets

Asian technical centre	
No. 1, October 1995	Japanese Dosimetric Results: FY 1994 data
No. 2, October 1995	Japanese Occupational Exposure during Periodical Inspection at LWRs ended in FY 1994
No. 3, July 1996	Japanese Dosimetric Results: FY 1995 data
No. 4, July 1996	Japanese Occupational Exposure during Periodical Inspection at LWRs ended in FY 1995
No. 5, September 1997	Japanese Dosimetric Results: FY 1996 data
No. 6, September 1997	Japanese Occupational Exposure during Periodical Inspection at LWRs ended in FY 1996
No. 7, October 1998	Japanese Dosimetric Results: FY 1997 data
No. 8, October 1998	Japanese Occupational Exposure During Periodical Inspection at LWRs Ended in FY 1997
No. 9, October 1999	Replacement of Reactor Internals and Full System Decontamination at a Japanese BWR
No. 10, November 1999	Experience of 1st Annual Inspection Outage in an ABWR
No. 11, October 1999	Japanese Dosimetric Results: FY 1998 Data and Trends
No. 12, October 1999	Japanese Occupational Exposure During Periodical Inspection at LWRs Ended in FY 1998
No. 13, September 2000	Japanese Dosimetric Results: FY 1999 Data and Trends
No. 14, September 2000	Japanese Occupational Exposure During Periodical Inspection at LWRs Ended in FY 1999
No. 15, October 2001	Japanese Dosimetric results: FY 2000 data and trends
No. 16, October 2001	Japanese occupational exposure during periodical inspection at PWRs and BWRs ended in FY 2000
No. 17, October 2002	Japanese dosimetric results: FY2001 data and trends
No. 18, October 2002	Japanese occupational exposure during periodic inspection at PWRs and BWRs ended in FY 2001
No. 19, October 2002	Korea, Republic of; Summary of national dosimetric trends
No. 20, October 2003	Japanese dosimetric results: FY2002 data and trends
No. 21, October 2003	Japanese occupational exposure during periodic inspection at PWRs and BWRs ended in FY 2002
No. 22, October 2003	Korea, Republic of; Summary of national dosimetric trends
No. 23, October 2003	Japanese Occupational Exposure of Steam Generator Replacements
No. 24, October 2003	Japanese Occupational Exposure of Shroud Replacements
No. 25, November 2004	Japanese dosimetric results: FY2003 data and trends

No. 26, November 2004	Japanese occupational exposure during periodic inspection at PWRs and BWRs ended in FY 2003
No. 27, November 2004	Achievements and Issues in Radiation Protection in the Republic of Korea
No. 28, November 2005	Japanese Dosimetric Results : FY 2004 Data and Trends
European technical centre	
No. 1, April 1994	Occupational Exposure and Steam Generator Replacement
No. 2, May 1994	The influence of reactor age and installed power on collective dose: 1992 data
No. 3, June 1994	First European Dosimetric Results: 1993 data
No. 4, June 1995	Preliminary European Dosimetric Results for 1994
No. 6, April 1996	Overview of the first three Full System Decontamination
No. 7, June 1996	Preliminary European Dosimetric Results for 1995
No. 9, December 1996	Reactor Vessel Closure Head Replacement
No. 10, June 1997	Preliminary European Dosimetric Results for 1996
No. 11, September 1997	Annual individual doses distributions: data available and statistical biases
No. 12, September 1997	Occupational exposure and reactor vessel annealing
No. 14, July 1998	PWR collective dose per job 1994-1995-1996 data (restricted distribution)
No. 15, September 1998	PWR collective dose per job 1994-1995-1996 data (general distribution)
No. 16, July 1998	Preliminary European Dosimetric Results for 1997 (general distribution)
No. 17, December 1998	Occupational Exposure and Steam Generator Replacements, update (general distribution)
No. 18, September 1998	The Use of the man-Sievert monetary value in 1997 (general distribution)
No. 19, October 1998	ISOE 3 data base – New ISOE 3 Questionnaires received (since September 1998) (restricted distribution)
No. 20, April 1999	Preliminary European Dosimetric Results 1998
No. 21, May 2000	Investigation on access and dosimetric follow-up rules in NPPs for foreign workers
No. 22, May 2000	Analysis of the evolution of collective dose related to insulation jobs in some European PWRs
No. 23, June 2000	Preliminary European Dosimetric Results 1999
No. 24, June 2000	List of BWR and CANDU sister unit groups
No. 25, June 2000	Conclusions and recommendations from the 2nd EC/ISOE workshop on occupational exposure management at nuclear power plants
No. 26, July 2001	Preliminary European Dosimetric Results for the year 2000
No. 27, October 2001	Annual outage duration and doses in European reactors
No. 28, December 2001	Trends in collective doses per job from 1995 to 2000
No. 29, April 2002	Implementation of Basic Safety Standards in the regulations of European countries
No. 30, April 2002	Occupational exposure and steam generator replacements - update
No. 31, July 2002	Preliminary European Dosimetric Results for the year 2001
No. 32, November 2002	Conclusions and Recommendations from the 3rd European ISOE Workshop on Occupational Exposure Management at Nuclear Power

	Plants
No. 33, March 2003	Update of the annual outage duration and doses in European reactors (1993-2001)
No. 34, July 2003	Man-Sievert monetary value survey (2002 update)
No. 35, July 2003	Preliminary European dosimetric results for 2002
No. 36, October 2003	Update of the annual outage duration and doses in European reactors (1993-2002)
No. 37, July 2004	Conclusions and recommendations from the 4th European ISOE workshop on occupational exposure management at NPPs
No. 38, November 2004	Update of the annual outage duration and doses in European reactors (1993-2003)
No. 39, 2005	Preliminary European dosimetric results for 2004
No. 40, 2005	Workers internal contamination practices survey
No. 41, 2005	Update of the annual outage duration and doses in European reactors (1994-2004)
No. 42, November 2005	Self-employed Workers in Europe
IAEA technical centre	
No. 1, October 1995	ISOE Expert meeting
No. 2, April 1999	IAEA Publications on occupational radiation protection
No. 3, April 1999	IAEA technical co-operation projects on improving occupational radiation protection in nuclear power plants
No. 4, April 1999	IAEA Workshop on implementation and management of the ALARA principle in nuclear power plant operations, Vienna 22-23 April 1998
No. 5, September 2000	Preliminary dosimetric results for 1999
No. 6, June 2001	Preliminary dosimetric results for 2000
No. 7, October 2002	Information on exposure data collected for the year 2001
No.8, November 2002	Conclusions and Recommendations from the 3rd European ISOE Workshop on Occupational Exposure Management at Nuclear Power Plants
No. 9, August 2003	Preliminary dosimetric results for 2002
North American technical centre	
No. 1, July 1996	Swedish Approaches to Radiation Protection at Nuclear Power Plants: NATC site visit report by Peter Knapp
No. 2, 1998	Monetary Value of person-REM Avoided 1997
No. 3, 2001	3-year rolling average annual dose comparisons US PWR, 1998 – 2000
No. 4, 2001	3-year rolling average annual dose comparisons US BWR, 1998 – 2000
No. 5, 2001	3-year rolling average annual dose comparisons CANDU, 1998 – 2000
No. 6, 2001	U.S. PWR 2000 Occupational Dose Benchmarking Charts
No. 7, 2001	U.S. BWR 2000 Occupational Dose Benchmarking Charts
No. 8, 2001	Monetary Value of person-REM Avoided: 2000
No. 02-1, Nov 2002	3-year rolling average annual dose comparisons US PWR, 1999 – 2001
No. 02-2, July 2002	3-year rolling average annual dose comparisons US BWR, 1999 – 2001
No. 02-4, July 2002	US PWR 2001 Occupational Dose Benchmarking Chart
No. 02-5, July 2002	US BWR 2001 Occupational Dose Benchmarking Chart
No. 02-6, 2002	Monetary value of person-rem avoided

ISOE topical session reports

First ISOE Topical Session: Dec 1994	• Fuel Failure • - Steam Generator Replacement
Second ISOE Topical Session: Nov 1995	• Electronic Dosimetry • - Chemical Decontamination
Third ISOE Topical Session: Nov 1996	• Primary Water Chemistry and its Affect on Dosimetry • - ALARA Training and Tools

ISOE international workshop proceedings

Asian technical centre	
November 2005, Hamaoka, Japan	First Asian ALARA Symposium
European technical c.entre	
September 1998, Malmö, Sweden	First EC/ISOE Workshop on Occupational Exposure Management at Nuclear Power Plants
April 2000, Tarragona, Spain	Second EC/ISOE Workshop on Occupational Exposure Management at Nuclear Power Plants
April 2002, Portoroz, Slovenia	Third ISOE European Workshop on Occupational Exposure Management at Nuclear Power Plants
March 2004, Lyon, France	Fourth ISOE European Workshop on Occupational Exposure Management at Nuclear Power Plants
North American technical centre	
March 1997, Orlando, FL, USA	First International ALARA Symposium
January 1999, Orlando, FL, USA	Second International ALARA Symposium
January 2000, Orlando, FL, USA	North-American National ALARA Symposium
February 2001, Anaheim, CA, USA	2001 International ALARA Symposium
February 2002, Orlando, FL, USA	North-American National ALARA Symposium
January 2003, Orlando, FL, USA	2003 International ALARA Symposium
January 2004, Ft. Lauderdale, FL, USA	2004 North American ALARA Symposium
January 2005, Ft. Lauderdale, FL, USA	2005 International ALARA Symposium

Appendix 2

ISOE PARTICIPATION AS OF DECEMBER 2004

Officially participating utilities: detailed information on operating reactors

Country	Utility	Plant name
Armenia	Armenian (Medzamor) NPP	Armenia 2
Belgium	Electrabel	Doel 1, 2, 3, 4 Tihange 1, 2, 3
Brazil	Electronuclear A/S	Angra 1, 2
Bulgaria	Nuclear Power Plant Kozloduy	Kozloduy 3, 4, 5, 6
Canada	Bruce Power	Bruce A1*, A2*, A3, A4 Bruce B5, B6, B7, B8
	Ontario Power Generation	Pickering A1*, A2*, A3*, A4 Pickering B5, B6, B7, B8 Darlington 1, 2, 3, 4
	Hydro Quebec	Gentilly 2
	New Brunswick Power	Point Lepreau
		(laid-up)*
China	Guangdong Nuclear Power Joint Venture Co., Ltd	Guangdong 1, 2
	Qin Shan Nuclear Power Co.	Qin Shan 1
	Lingao Nuclear Power Co. Ltd	Lingao 1, 2
Czech Republic	CEZ	Dukovany 1, 2, 3, 4 Temelin 1, 2
Finland	Fortum Power and Heat Oy	Loviisa 1, 2
	Teollisuuden Voima Oy	Olkiluoto 1, 2
France France	Électricité de France	Belleville 1, 2 Blayais 1, 2, 3, 4 Bugey 2, 3, 4, 5 Cattenom 1, 2, 3, 4 Chinon B1, B2, B3, B4 Chooz B1, B2 Civaux 1, 2 Cruas 1, 2, 3, 4 Dampierre 1, 2, 3, 4 Fessenheim 1, 2 Flamanville 1, 2 Golfech 1, 2 Gravelines 1, 2, 3, 4, 5, 6 Nogent 1, 2

		Paluel 1, 2, 3, 4 Penly 1, 2 Saint-Alban 1, 2 Saint Laurent B1, B2 Tricastin 1, 2, 3, 4
Germany	Energie-Versorgung BadenWürttemberg (EnBW)	Obrigheim Philippsburg 1, 2
	E.ON	Grafenrheinfeld Isar 1, 2 Brokdorf Grohnde Stade Unterweser
	Neckarwerke AG, TWS Stuttgart	Gemeinschafts – Kernkraftwerk Neckar, Neckarwestheim (GKN) 1, 2
	Vattenfall Europe/Hamburgische Elektrizitäts-Werke AG (HEW)	Brunsbüttel
	Vattenfall Europe/HEW and E.ON	Krümmel
	RWE Power	Biblis A, B Gundremmingen B, C Emsland
Hungary	Magyar Vilamos Muvek Rt	Paks 1, 2, 3, 4
Japan	Hokkaido Electric Power Co.	Tomari 1, 2
	Tohoku Electric Power Co.	Onagawa 1, 2, 3 Higashidori 1
	Tokyo Electric Power Co.	Fukushima Daiichi 1, 2, 3, 4, 5, 6 Fukushima Daini 1, 2, 3, 4 Kashiwazaki Kariwa 1, 2, 3, 4, 5, 6, 7
	Chubu Electric Power Co.	Hamaoka 1, 2, 3, 4, 5
	Hokuriku Electric Power Co.	Shika
	Kansai Electric Power Co.	Mihama 1, 2, 3 Takahama 1, 2, 3, 4 Ohi 1, 2, 3, 4
	Chugoku Electric Power Co.	Shimane 1, 2
	Shikoku Electric Power Co.	Ikata 1, 2, 3
	Kyushu Electric Power Co.	Genkai 1, 2, 3, 4 Sendai 1, 2
Japan	Japan Atomic Power Co.	Tokai 2 Tsuruga 1, 2
Korea	Korean Hydro and Nuclear Power	Wolsong 1, 2, 3, 4 Kori 1, 2, 3, 4 Ulchin 1, 2, 3, 4, 5 Yonggwang 1, 2, 3, 4, 5

Lithuania	Ignalina Nuclear Power Plant	Ignalina 1, 2
Mexico	Comisiòn Federal de Electricidad	Laguna Verde 1, 2
Netherlands	N.V. EPZ	Borssele
Pakistan	Pakistan Atomic Energy Commission	Chasnupp 1 Kanupp
Romania	Societatea Nationala Nuclearelectrica	Cernavoda 1
Russian Federation	Rosenergoatom	Balakovo 1, 2, 3, 4 Beloyarsky 3 Kalinin 1, 2, 3 Kola 1, 2, 3, 4 Novovoronezh 3, 4, 5 Volgodonsk 1
Slovak Republic	Slovenske Electrarne	Bohunice 1, 2, 3, 4 Mochovce 1, 2
Slovenia	Krsko Nuclear Power Plant	Krsko 1
South Africa	ESKOM	Koeberg 1, 2
Spain	UNESA	Almaraz 1, 2 Asco 1, 2 Cofrentes Santa Maria de Garona Trillo Vandellos 2 Jose Cabrera
Sweden	Barsebäck Kraft AB	Barsebäck 2
	Forsmarks Kraftgrupp AB	Forsmark 1, 2, 3
	OKG AB	Oskarshamn 1, 2, 3
	Ringhals AB	Ringhals 1, 2, 3, 4
Switzerland	Kernkraftwerk Leibstadt AG (KKL)	Leibstadt
	Forces Motrices Bernoises (FMB)	Mühleberg
	Nordostschweizerische Kraftwerke AG (NOK)	Beznau 1, 2
	Kernkraftwerk Gosgen-Daniken (KGD)	Gosgen
Ukraine	Ministry of Fuel and Energy of Ukraine	Khmelnitski 1, 2 Rovno1, 2, 3, 4 South Ukraine 1, 2, 3 Zaporozhe 1, 2, 3, 4, 5, 6
United Kingdom	Nuclear Electric	Sizewell B
United States	Amergen Energy Company	Clinton 1 Oyster Creek 1 TMI 1
United States	American Electric Power	D.C. Cook 1, 2 South Texas 1, 2
	Arizona Public Service Co.	Palo Verde 1, 2, 3
	Calvert Cliffs Nuclear Power Plant Inc.	Calvert Cliffs 1, 2

	Carolina Power and Light Co.	H. B. Robinson 2
	Entergy Nuclear NE	Indian Point 2, 3 Pilgrim 1
	Exelon	Braidwood 1, 2 Byron 1, 2 Dresden 2, 3 LaSalle County 1, 2 Limerick 1, 2 Peach Bottom 2, 3 Quad Cities 1, 2
	First Energy Corporation	Beaver Valley 1,2 Davis Besse 1 Perry 1
	Nuclear Management Company	Duane Arnold 1 Kewaunee 1 Monticello 1 Palisades 1 Point Beach 1, 2 Prairie Island 1,2
	Pacific Gas and Electric Company	Diablo Canyon 1, 2
	PPPL Susquehanna LLC	Susquehanna 1, 2
	South Carolina Electric Co.	Virgil C. Summer 1
	Southern California Edison Co.	San Onofre 2, 3
	TXU Electric	Comanche Peak 1, 2

Officially participating utilities: Detailed information on definitively shutdown reactors

Country	Utility	Plant Name
Bulgaria	Nuclear Power Plant Kozlody	Kozlody 1, 2
Canada	Ontario Power Generation Hyrdo Quebec	NPD Gentilly 1
France	Électricité de France	Bugey 1 Chinon A1, A2, A3 Chooz A St. Laurent A1, A2
Germany	E.ON Arbeitsgemeinschaft Versuchsreaktor AVR RWE Power	Würgassen Stade Jülich Mülheim-Kärlich
Italy	SOGIN	Caorso Garigliano Latina (GCR) Trino
Japan	Japan Atomic Power Co.	Tokai 1
Netherlands	NCGKN	Dodewaard
Russian Federation	Rosenergoatom	Beloyarsky 1, 2 Novovoronezh 1, 2
Spain	UNESA	Vandellos 1

Sweden	Barsebäck Kraft AB	Barsebäck 1
Ukraine	Ministry of Energy of Ukraine	Chernobyl 1, 2, 3
United States	Amergen Energy Company Nuclear Management Company Exelon Pacific Gas and Electric Company Southern California Edison Co.	TMI 2 Big Rock Point 1 Dresden 1 Peach Bottom 1 Zion 1, 2 Humboldt Bay 3 San Onofre 1

Participating regulatory authorities

Country	Authority
Armenia	Armenian Nuclear Regulatory Authority (ANRA)
Belgium	Federal Agency for Nuclear Control
Bulgaria	Bulgarian Nuclear Regulatory Agency
Canada	Canadian Nuclear Safety Commission
China	China National Nuclear Corporation (CNNC)
Czech Republic	State Office for Nuclear Safety
Finland	Säteilyturvakeskus (STUK)
France	Ministère du travail et des affaires sociales, represented by l'*Institut de Radioprotection et de Sûreté Nucléaire* (IRSN)
Germany	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit
Italy	Agenzia Nazionale per la Protezione dell'Ambiente (ANPA)
Japan	Ministry of Economy, Trade and Industry (METI)
Korea	Ministry of Science and Technology (MOST) Korea Institute of Nuclear Safety (KINS)
Lithuania	Radiation Protection Centre
Mexico	Commision Nacional de Seguridad Nuclear y Salvaguardias
Netherlands	Ministerie van Sociale Zaken en Werkgelegenheld
Pakistan	Pakistan Atomic Energy Commission
Romania	National Commission for Nuclear Activities Control
Slovak Republic	State Health Institute of the Slovak Republic
Slovenia	Slovenian Nuclear Safety Administration (SNSA)
South Africa	Council for Nuclear Safety
Spain	Consejo de Seguridad Nuclear
Sweden	Statens strålskyddsinstitut (SSI)
Switzerland	Office Fédéral de l'Énergie, Division principale de la Sécurité des Installations Nucléaires, DSN
United Kingdom	Nuclear Installations Inspectorate
United States	U.S. Nuclear Regulatory Commission (US NRC)

Country – technical centre affiliations

Country	Technical Centre*	Country	Technical Centre
Armenia	IAEATC	Mexico	NATC
Belgium	ETC	Netherlands	ETC
Brazil	IAEATC	Pakistan	IAEATC
Bulgaria	IAEATC	Romania	IAEATC
Canada	NATC	Russian Federation	IAEATC
China	IAEATC	Slovak Republic	ETC
Czech Republic	ETC	Slovenia	IAEATC
Finland	ETC	South Africa	IAEATC
France	ETC	Spain	ETC
Germany	ETC	Sweden	ETC
Hungary	ETC	Switzerland	ETC
Italy	ETC	Ukraine	IAEATC
Japan	ATC	United Kingdom	ETC
Korea	ATC	United States	NATC
Lithuania	IAEATC		

* Note: ETC: European Technical Centre ATC: Asian Technical Centre
IAEATC: IAEA Technical Centre NATC: North American Technical Centre

ISOE technical centres and web pages

ISOE network web portal	
ISOE Homepage	www.isoe-network.net
ISOE technical centres	
European Region (ETC)	*Centre d'étude sur l'évaluation de la protection dans le domaine nucléaire* (CEPN), Fontenay-aux-Roses, France
	isoe.cepn.asso.fr
Asian Region (ATC)	Japan Nuclear Energy Safety Organisation(JNES), Tokyo, Japan
	www.jnes.go.jp/isoe/
IAEA Region (IAEATC)	International Atomic Energy Agency (IAEA), Vienna, Austria *Agence Internationale de l'Energie Atomique* (AIEA), Vienne, Autriche
	www-ns.iaea.org/tech-areas/rw-ppss/isoe-iaea-tech-centre.htm
North American Region (NATC)	University of Illinois, Champagne-Urbana, Illinois, U.S.A.
	www.natcisoe.org
Joint Secretariat	
NEA (Paris)	www.nea.fr/html/jointproj/isoe.html
IAEA (Vienna)	www-ns.iaea.org/tech-areas/rw-ppss/isoe.htm

International cooperation

- European Commission (EC)
- World Association of Nuclear Operators, Paris Centre (WANO PC)

Appendix 3

ISOE BUREAU, WORKING GROUPS AND NATIONAL COORDINATORS

Bureau of the ISOE Steering Group

Mr. Jean-Yves Gagnon (Chair)	*Centrale Nucléaire Gentilly-2*, CANADA
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Dr. Seong Ho Na (Vice-Chair, 2003-05)	Korea Institute of Nuclear Safety REPUBLIC OF KOREA
Mr. Veli Riihiluoma (Vice-Chair, 2006-08)	Finnish Centre for Radiation and Nuclear Safety (STUK) FINLAND

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ISOE WORKING GROUPS

ISOE Newsletter Editor

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ISOE Working Group on Strategic Planning (WGSP)

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KOREA (REPUBLIC OF) NA, Seong Ho	 Korea Institute of Nuclear Safety
LITHUANIA KLEVINSKAS, Gintautas	 Radiation Protection Centre
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SLOVENIA BREZNIK, Borut JANZEKOVIC, Helena	 Krsko NPP Slovenian Nuclear Safety Administration
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Joint Secretariat AHIER, Brian ERGUN, Tuncay NAGEL, Pierre DEBOODT, Pascal MRABIT, Khammar	 OECD/NEA OECD/NEA OECD/NEA IAEA IAEA

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The Fourteenth Annual Report of the ISOE Programme summarises achievements made during 2004 and compares annual occupational exposure data. Principal developments in ISOE participating countries are also described.

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