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Occupational Exposures at Nuclear Power Plants

Seventeenth Annual Report of the ISOE Programme, 2007

AEN NEA

ISOE

INFORMATION SYSTEM ON OCCUPATIONAL EXPOSURE

IAEA

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NEA

NUCLEAR ENERGY AGENCY

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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 steadily decreased since the early 1990s. Regulatory pressures, technological advances, improved plant designs and operational procedures, ALARA culture and experience exchange have contributed to this downward trend. However, with the continued ageing and possible life extensions of nuclear power plants worldwide, ongoing economic pressures, regulatory, social and political evolutions, and the potential of new nuclear build, the task of ensuring that occupational exposures are as low as reasonably achievable (ALARA), taking into account operational costs and social factors, continues to present challenges to radiological protection professionals.

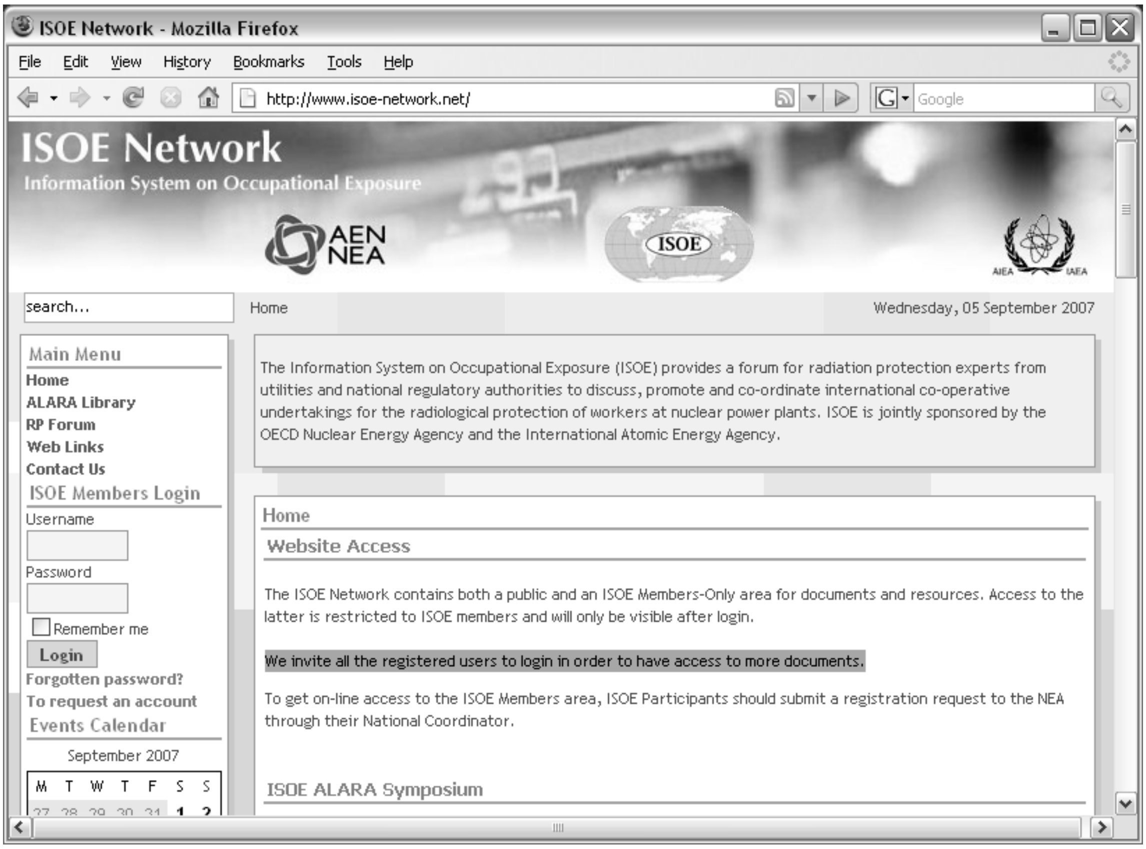
Since 1992, the Information System on Occupational Exposure (ISOE), jointly sponsored by the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA), has provided a forum for radiological protection professionals from nuclear power utilities and national regulatory authorities worldwide to discuss, promote and co-ordinate international co-operative undertakings for the radiological protection of workers at nuclear power plants. The objective of ISOE is to improve the management of occupational exposures at nuclear power plants by exchanging broad and regularly updated information, data and experience on methods to optimise occupational radiological protection.

As a technical exchange initiative, the ISOE Programme includes a global occupational exposure data collection and analysis programme, culminating in the world's largest occupational exposure database for nuclear power plants, and an information network for sharing dose reduction information and experience. Since its launch, ISOE participants have used this 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 radiological protection programmes.

This Seventeenth Annual Report of the ISOE Programme presents the programme's status for the year 2007.

"... the exchange and analysis of information and data on ALARA experience, dose-reduction techniques, and individual and collective radiation doses to the personnel of nuclear installations and to the employees of contractors are essential to implement effective dose management programmes and to apply the ALARA principle." (ISOE Terms and Conditions, 2008-2011).

ISOE Network Information Exchange Website (www.isoe-network.net)



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EXECUTIVE SUMMARY

Since 1992, the Information System on Occupational Exposure (ISOE) has supported the optimisation of worker radiological protection in nuclear power plants through a worldwide information and experience exchange network for radiation protection professionals at nuclear power plants and national regulatory authorities, and through the publication of relevant technical resources for ALARA management. This 17th Annual Report of the ISOE Programme (2007) presents the status of the ISOE programme for the calendar year 2007.

ISOE is jointly sponsored by the OECD/NEA and IAEA, and its membership is open to nuclear electricity utilities and radiation protection regulatory authorities worldwide who accept the programme's Terms and Conditions. In November 2007, the ISOE Management Board (formerly referred to as the Steering Group) approved the renewal of the new ISOE Terms and Conditions for the period 2008-2011. At the end of 2007, the ISOE programme included 71 Participating Utilities in 29 countries (334 operating units; 45 shutdown units), as well as the regulatory authorities of 25 countries. The ISOE occupational exposure database itself included information on occupational exposure levels and trends at 395 operating reactors in 29 countries, covering about 91% of the world's operating commercial power reactors. Four ISOE Technical Centres (Europe, North America, Asia and IAEA) manage the programme's day-to-day technical operations.

Based on the occupational exposure data supplied by ISOE members for operating power reactors, the 2007 average annual collective doses per reactor and 3-year rolling averages per reactor (2005-2007) were:

	2007 average annual collective dose (man·Sv/reactor)	**3-year rolling average for 2005-2007 (man·Sv/reactor)**
Pressurised water reactors (PWR/VVER)	0.74	0.75
Boiling water reactors (BWR)	1.50	1.43
Pressurised heavy water reactors (PHWR/CANDU)	0.87	1.04
All reactors, including gas cooled (GCR) and light water graphite reactors (LWGR)	0.93	0.89

In addition to information from operating reactors, the ISOE database contains dose data from 76 reactors which are shutdown or in some stage of decommissioning. As these reactor units are generally of different type and size, and at different phases of their decommissioning programmes, it is difficult to identify clear dose trends. However, work was undertaken in 2007 to improve the data collection for such reactors in order to facilitate better benchmarking. Details on occupational dose trends for operating reactors, and reactors undergoing decommissioning are provided in Section 2 of the report.

While ISOE is well known for its occupational exposure data and analyses, the programme's strength comes from its objective to share such information broadly amongst its participants. In 2007, the ISOE Network website (www.isoe-network.net) continued to provide the ISOE membership with a comprehensive web-based information and experience exchange portal on dose reduction and ISOE ALARA resources. The development of data input modules for the on-line submission of members' occupational exposure data continued during 2007.

The annual ISOE International ALARA Symposia on occupational exposure management at nuclear power plants continued to provide an important forum for ISOE participants and for vendors to exchange practical information and experience on occupational exposure issues. The 2007 ISOE International ALARA Symposium, organised by the North American Technical Centre, was held in Fort Lauderdale, United States. The technical centres also continued to host regional symposia, which in 2007 included the ISOE Asian Regional ALARA Symposium, organised by the Asian Technical Centre in Seoul, Korea. These symposia provide a global forum to promote the exchange of ideas and management approaches for maintaining occupational radiation exposures as low as reasonably achievable.

Of importance is the support that the technical centres supply in response to special requests for rapid technical feedback and in the organisation of voluntary site benchmarking visits for dose reduction information exchange between ISOE regions. The combination of ISOE symposia and technical visits provides a means for radiation protection professionals to meet, share information and build links between ISOE regions to develop a global approach to occupational exposure management.

The ISOE Working Group on Data Analysis (WGDA) continued its activities in support of the technical analysis of the ISOE data and experience, focussing largely on the integrity and consistency of the ISOE database. Under the WGDA, the Expert Group on Work Management was established to develop an update to the 1997 ISOE report on "Work Management in the Nuclear Power Industry", taking into account new experience and technology in occupational radiation protection and 15 years of information exchange under the ISOE programme.

Principal events in ISOE participating countries are summarised in Section 6 of this report. Details of ISOE participation and programme of work for 2008 are provided in the Annexes.

SYNTHÈSE DU RAPPORT

Depuis 1992, le programme ISOE (système d'information sur les expositions professionnelles) facilite la mise en œuvre de l'optimisation de la radioprotection des travailleurs dans les centrales nucléaires par le biais d'un réseau d'échange d'information et d'expériences entre les responsables de la radioprotection des centrales nucléaires et les représentants des autorités réglementaires du monde entier ainsi que par la publication de produits techniques spécifiques pour la mise en œuvre d'ALARA. Ce dix-septième rapport annuel du système ISOE (2007) fait le point sur le programme ISOE à la fin de l'année 2007.

ISOE est conjointement sponsorisé par l'AEN de l'OCDE et l'AIEA, et est ouvert à l'adhésion d'exploitants des centrales nucléaires de production d'électricité et des autorités réglementaires de radioprotection qui acceptent les conditions de mise en œuvre du programme. En Novembre 2007, le conseil d'administration ISOE (anciennement dénommé groupe de pilotage) a approuvé le renouvellement des nouvelles conditions de mise en œuvre d'ISOE pour la période 2008-2011. À la fin de 2007, 71 exploitants de 29 pays participaient au programme ISOE (334 réacteurs nucléaires en fonctionnement; 45 réacteurs arrêtés) ainsi que les autorités réglementaires de 25 pays. La base de données ISOE contient des informations sur les expositions professionnelles et leurs tendances pour 395 réacteurs en exploitation dans 29 pays, représentant ainsi près de 91% de l'ensemble des réacteurs de puissance en fonctionnement dans le monde. Quatre centres techniques ISOE (Europe, Amérique du Nord, Asie et AIEA) gèrent au jour le jour les opérations techniques du programme.

Sur la base des données sur les expositions professionnelles fournies par les membres ISOE, la dose collective moyenne par réacteur annuelle pour 2007 et la dose collective par réacteur moyennée sur trois ans (2005-2007) des réacteurs en fonctionnement étaient de :

	Dose collective moyenne annuelle 2007 (Homme·Sv/réacteur)	**Dose collective moyennée 3 ans pour 2005-2007 (Homme·Sv/réacteur)**
Réacteurs à eau pressurisée (REP/VVER)	0,74	0,75
Réacteurs à eau bouillante (REB)	1,50	1,43
Réacteurs à eau lourde pressurisée (PHWR/CANDU)	0,87	1,04
Tous les réacteurs, y compris les graphite gaz (GCR) et les réacteurs à eau graphite (RBMK)	0,93	0,89

La base de données ISOE contient également des données concernant les doses collectives de 76 réacteurs en arrêt à froid ou en phase de démantèlement. Etant donné que les réacteurs présents dans la base de données sont de type et de taille différents, et qu'ils sont généralement à des phases différentes de leurs programmes de démantèlement, il est difficile de mettre en évidence des tendances sur l'évolution des expositions. Toutefois, un travail a été entrepris en 2007 pour améliorer la collecte de données pour ces réacteurs en vue de faciliter les comparaisons. Des détails sur l'évolution de la dose des réacteurs en exploitation, et des réacteurs en cours de démantèlement sont fournis à la section 2 de ce rapport.

Bien qu'ISOE soit connu pour ses données et ses analyses des expositions professionnelles, la force du système provient de son objectif de partager largement ces informations parmi ses participants. En 2007, le site internet du Réseau ISOE (www.isoe-network.net) a continué de fournir aux membres ISOE une information complète ainsi qu'un portail d'échange d'expérience sur la réduction des doses et sur les documents ALARA. Le développement du module de saisie des données pour la soumission sur le Web des données d'exposition professionnelle des participants a continué en 2007.

Les symposiums ISOE ALARA annuels internationaux sur la gestion des expositions professionnelles dans les centrales nucléaires constituent des rendez-vous importants permettant aux participants ISOE et aux entreprises exposantes d'échanger des informations et des bonnes pratiques sur les expositions professionnelles dans les centrales nucléaires. Le symposium international ISOE ALARA de 2007, organisé par le centre technique ISOE d'Amérique du Nord, s'est tenu à Fort Lauderdale, aux États-Unis. Les centres techniques continuent également à organiser des symposiums régionaux : en 2007 un symposium a été organisé par le centre technique ISOE asiatique à Séoul en Corée du Sud. Ces symposiums perpétuent la tradition de fournir un large forum pour promouvoir les échanges d'idées et d'expériences de gestion en vue de maintenir les expositions professionnelles aussi basses que raisonnablement possibles.

L'appui offert par les centres techniques en réponse aux demandes spéciales de retour d'expérience technique, et pour l'organisation de visites de type benchmarking afin d'échanger entre les régions ISOE des informations sur les réductions des doses revêt une importance croissante. L'organisation conjointe de symposiums ISOE avec des visites techniques fournit aux professionnels de la radioprotection un intéressant forum pour se rencontrer, discuter et partager des informations, construisant ainsi des liens et des synergies entre les régions ISOE pour développer une approche globale de l'organisation du travail.

Le groupe de travail ISOE sur l'analyse des données (WGDA) a poursuivi ses activités d'appui pour l'analyse technique des données et de l'expérience, en se focalisant principalement sur l'intégrité et la cohérence de la base de données ISOE. Dans le cadre du WGDA, le groupe d'experts sur la gestion du travail a été créé pour rédiger une mise à jour du rapport ISOE sur la « Gestion du travail dans l'industrie nucléaire » de 1997, en tenant compte des nouvelles technologies et des nouvelles expériences en radioprotection professionnelle et des 15 ans d'échange d'informations dans le cadre du programme ISOE.

Les principaux événements qui ont eu lieu dans les pays participants à ISOE sont résumés dans la section 6 de ce rapport. Les détails concernant la participation et le programme de travail d'ISOE pour 2008 sont fournis dans les annexes.

ZUSAMMENFASSUNG

Seit 1992 fördert ISOE die Optimierung des Strahlenschutzes in Kernkraftwerken durch weltweiten Informations- und Erfahrungsaustausch für beruflich strahlenexponierte Personen und nationale Aufsichtsbehörden und die Veröffentlichung von wichtigen technischen Erkenntnissen das ALARA –Management. Dieser 17. Jahresbericht (2007) stellt den Status des ISOE-Progamms für das Kalenderjahr 2007 vor.

ISOE wird gemeinsam durch OECD/NEA und IAEA unterstützt, eine Mitgliedschaft ist für alle Kernkraftwerksbetreiber und Strahlenschutzaufsichtsbehörden unter Beachtung und Anerkennung der ISOE- Geschäftsordnung weltweit offen. Im November 2007 hat das ISOE Management Board (früher als Steering Group bezeichnet) die Erneuerung der ISOE Ziele und Geschäftsordnung für die Zeit 2008 bis 2011 bestätigt. Am Ende des Jahres 2007 waren 71 Betreiber aus 29 Ländern (334 in Betrieb befindliche KKW, 45 im Rückbau befindliche Anlagen) sowie Aufsichtsbehörden aus 25 Ländern im ISOE Programm eingebunden. Die ISOE-Datenbank zur beruflichen Strahlenexposition enthält Informationen zu Dosisdaten und Dosistrends von 395 in Betrieb befindlichen Reaktoren in 29 Ländern, die etwa 91% der weltweit kommerziell genutzten Leistungsreaktoren darstellen. Vier ISOE Zentren (Europa, Nordamerika, Asien und IAEA) sind für die technisch-organisatorische Umsetzung des ISOE Programms zuständig.

Basierend auf den von den ISOE- Mitgliedern gelieferten Daten zeigt die nachfolgende Tabelle die durchschnittliche jährliche Kollektivdosis und die gleitenden 3-Jahres Mittelwerte für in Betrieb befindliche Leistungsreaktoren pro Block:

	2007 mittlere Jahreskollektivdosis (man·Sv/Block)	**3-Jahresmittelwerte 2005-2007 (man·Sv/Block)**
Druckwasserreaktoren (DWR/WWER)	0.74	0.75
Siedewasserreaktoren (SWR)	1.50	1.43
Schwerwasserreaktoren (PHWR/CANDU)	0.87	1.04
Alle Reaktoren, inkl. gasgekühlte (GCR) und Leichtwasser Graphitreaktoren (LWGR)	0.93	0.89

In Ergänzung zu Informationen über in Betrieb befindliche Reaktoren enthält die Datenbank auch Dosisangaben von endgültig abgeschalteten oder im Rückbau befindlichen Anlagen. Da diese Reaktoren sich weitestgehend in Typ und Größe unterscheiden und sich in unterschiedlichen Stadien der Stilllegung befinden, ist es schwierig, eindeutige Dosistrends zu bestimmen. Allerdings wurden in 2007 Arbeiten durchgeführt, um die Datenbasis für solche Anlagen zu verbessern, mit dem Ziel, ein Benchmarking zu ermöglichen. Einzelheiten zu Dosistrends für in Betrieb befindliche und im Rückbau befindliche Anlagen werden in Sektion 2 dieses Berichts dokumentiert.

Neben den ISOE- Daten zur beruflichen Strahlenexposition und zugehörigen Datenanalysen, liegt die Stärke des ISOE- Programms im breit angelegten Informationsaustausch unter den Mitgliedern.

Auf der ISOE Netzwerk – Webseite wurde in 2007 die Unterstützung der ISOE Mitglieder weiter mit einer umfangreichen internetgestützten Information und einem Portal für Erfahrungsaustausch zur Strahlenschutzoptimierung und Nutzung von ALARA- Methoden fortgeführt. Die Module zur Online-Datenerfassung von Strahlenexpositionsdaten wurden in 2007 weiterentwickelt.

Das jährliche internationale ALARA Symposium zum Management der beruflichen Strahlenexposition in Kernkraftwerken stellte erneut ein wichtiges Forum für die ISOE Teilnehmer und für Hersteller dar, um Informationen und Erfahrungen aus der Strahlenschutzpraxis auszutauschen. Das durch das Nordamerikanische Technische Zentrum organisierte internationale ISOE ALARA Symposium 2007 fand in Fort Lauderdale, USA, statt. Die Technischen Zentren richteten weitere regionale Symposien aus, zu dem in 2007 das regionale asiatische ISOE ALARA Symposium gehörte, organisiert durch das asiatische Technische Zentrum in Seoul, Korea. Diese Symposien bilden ein globales Forum, um den Austausch von Ideen und Methoden des Managements im Sinne von ALARA zu fördern.

Von besonderer Bedeutung ist die Unterstützung durch die Technischen Zentren, wenn es um spezielle Fragestellungen von Mitgliedern und deren schnelle Beantwortung geht. Außerdem organisieren und unterstützen die Zentren Anlagenbesuche zu Benschmarkzwecken auf freiwilliger Basis. Die Kombination von ISOE Symposien und technischen Besuchen stellt für Strahlenschutzexperten ein gutes Hilfsmittel zur überregionalen Zusammenarbeit dar. Die ISOE - Arbeitsgruppe, die sich mit Datenanalysen (WGDA) befasst, führte ihre Aktivitäten bei der Unterstützung der technischen Analyse von ISOE- Daten und Erfahrungen fort, mit dem Focus auf Integrität und Konsistenz der ISOE Datenbank. Unter der WGDA wurde eine Expertengruppe für „Work Management“ gegründet, um nach 15- jährigem Bestehen des ISOE-Programms den ISOE-Bericht „Work Management in der Kernkraftwerksindustrie“ von 1997 unter Berücksichtigung neuer Erfahrungen und Technologien zu überarbeiten.

Wesentliche Informationen aus den in ISOE beteiligten Ländern sind in Sektion 6 dieses Berichtes zusammengefasst. Einzelheiten zur ISOE- Teilnahme und zum Arbeitsprogramm 2008 sind in den Anhängen dokumentiert.

正文摘要

自 1992 年以来，“职业照射信息系统”一直通过世界各地核电厂和国家监管当局辐射防护专业人员信息和经验交流网络以及通过发表关于“合理可行尽量低”管理的相关技术资源，支持开展核电厂工作人员放射性防护优化工作。《职业照射信息系统计划第 17 期年度报告》（2007 年）介绍了该计划在 2007 年的状况。

“职业照射信息系统”由经济合作与发展组织核能机构和国际原子能机构联合主办，接受该计划“条款和条件”的核电公司和辐射防护监管当局均可申请参加。2007 年 11 月，“职业照射信息系统”管理委员会（以前称“指导小组”）核准了对 2008－2011 年期间新的“职业照射信息系统”的“条款和条件”的更新。截至 2007 年底，“职业照射信息系统”计划包括 29 个国家的 71 个参加电力公司（334 台在运机组；45 台关闭机组）以及 25 个国家的监管当局。“职业照射信息系统”的职业照射数据库本身载有关于 29 个国家 399 座在运反应堆职业照射水平和趋势的资料，涵盖世界上 91% 的在运商业动力堆。该系统的四个技术中心（欧洲、北美洲、亚洲和原子能机构）管理着该计划的日常技术工作。

根据“职业照射信息系统”成员提供的在运动力堆的职业照射数据，每座堆的 2007 年度平均集体剂量和每座堆的三年（2005－2007 年）滚动平均数据如下：

	2007 年平均集体剂量（人·希/堆）	**2005－2007 年三年滚动平均数据（人·希/堆）**
压水堆（压水堆/水水堆）	0.74	0.75
沸水堆	1.50	1.43
加压重水堆（加压重水堆/坎杜堆）	0.87	1.04
包括气冷和轻水石墨反应堆在内的所有反应堆	0.93	0.89

除来自在运反应堆的资料外，“职业照射信息系统”数据库还载有 83 座已关闭或处于某一退役阶段的反应堆的剂量数据。由于这些反应堆机组通常类型不同，规模各异，而且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。但 2007 年开展了旨在改进此类反应堆数据收集的工作，以促进更准确地确定基准。本报告第二部分提供了在运反应堆和正在退役的反应堆职业剂量趋势的详细资料。

虽然“职业照射信息系统”以其职业照射数据和分析著称，但该计划的强项在于其促进各参与方广泛共享此类信息的目标。2007 年，“职业照射信息系统”网站（www.isoe-network.net）继续为“职业性照射信息系统”成员提供有关剂量减少情况和该系统“合理可行尽量低”资源的“一站式”网基信息和经验交流门户。2007 年继续开发供成员在线提交职业照射数据的数据输入模块。

核电厂职业照射管理问题年度职业照射信息系统“合理可行尽量低原则”国际专题讨论会继续为该系统各参加者和制造商提供交流职业照射问题实用信息和经验的重要论坛。由北美洲技术中心组织的 2007 年度职业照射信息系统“合理可行尽量低原则国际专题讨论会在美国劳德代尔堡举行。各技术中心还继续主办了几次地区专题讨论会，包括亚洲技术中心在韩国首尔组织的 2007 年度职业照射信息系统“合理可行尽量低原则”亚洲地区专题讨论会。这些专题讨论会继续坚持为促进交流思想和管理方案提供全球论坛的传统，以保持职业辐射照射实现“合理可行尽量低”原则。

各技术中心为响应对快速技术反馈的特别请求以及通过为“职业照射信息系统”各地区之间进行减少剂量信息交流而自愿组织的现场基准访问所提供的支助非常重要“职业照射信息系统”专题讨论会与技术访问两者的结合，为辐射防护专业人员汇聚一堂共享信息以及建立“职业照射信息系统”各地区之间的联系以制订全球职业照射管理方案提供了手段。

“职业照射信息系统”数据分析工作组继续开展支持该系统数据和经验技术分析的活动，并主要侧重于“职业照射信息系统”数据库的完整性和一致性。在数据分析工作组下设立了工作管理专家组，以编写 1997 年“职业照射信息系统”报告“核电工业工作管理”的更新本，同时考虑职业照射防护领域的新经验和新技术以及 15 年来在“职业照射信息系统”计划下开展的信息交流情况。

本报告第六部分概述“职业照射信息系统”参加国的主要活动。附件提供有关“职业照射信息系统”取得的成就、参加情况和 2008 年工作计划的详细资料。

概 略

1992 年以来、ISOE（職業被ばく情報システム）は、原子力発電所の放射線防護専門家と規制当局による世界規模での情報と経験交換ネットワーク、及び関連した ALARA 管理の技術的な資源の公表を通じて、原子力発電所作業員の放射線防護の最適化を支援している。この ISOE プログラムの第 17 年次報告書(2007)は、2007 年の ISOE プログラムの状況を示したものである。

ISOE は OECD/NEA と IAEA が共同出資をしており、ISOE メンバーの資格はプログラムの規約を承認した電気事業者と規制当局に開かれている。2007 年 11 月、ISOE 運営委員会は ISOE の 2008-2011 年に適用される新規約を承認した。2007 年末では、ISOE プログラムには 29 ヵ国の 71 加盟電気事業者（334 炉は運転中； 45 炉は操業停止）並びに 25 ヵ国の規制当局が参加している。ISOE 職業被ばくデータベース自体には 29 ヵ国の 395 炉の運転中原子炉の職業被ばくレベル及び傾向に関する情報が含まれおり、全世界の商用運転中の動力炉の約 91%が扱われている。 4 つの技術センター（欧州、北米、アジア、IAEA）はプログラムの技術的な運営を日々管理している。

ISOE メンバーから提供された職業被ばくデータによれば、運転中動力炉における 2007 年の一炉あたりの平均集団線量及び一炉あたりの 3 年平均年間集団線量(2005-2007 年)は以下の通りである。

	2007 年 平均集団線量 (man·Sv/炉)	**2005-2007 年 3 年平均 (man·Sv/炉)**
加圧水型原子炉 (PWR/VVER)	0.74	0.75
沸騰水型原子炉 (BWR)	1.50	1.43
加圧重水型原子炉 (PHWR/CANDU)	0.87	1.04
ガス冷却炉 (GCR)と軽水黒鉛炉(LWGR)を含む全ての原子炉	0.93	0.89

運転中の原子炉からの情報に加え、ISOE データベースには、操業停止または廃止措置段階にある 76 炉の原子炉からの線量データが含まれている。 データベースに含まれる原子炉は型や規模が異なっており、また、通常それらの廃止措置計画の段階が異なっているので、明確な線量傾向を特定するのは難しい。しかし効果的なベンチマーキングの促進のための操業停止と廃止措置の原子炉のデータ収集改善を 2007 年に取り組んだ。運転中原子炉及び廃止措置段階の原子炉の職業被ばく傾向の詳細は報告書の第 2 章に記載されている。

ISOE はその職業被ばくデータと分析においてよく知られているが、システムの強みは加盟者の間でこのような情報を広く共有するという目的によるものである。2007 年においてISOE ネットワーク・ウェブサイト（www.isoe-network.net）は、線量低減と ALARA 資源に関する包括的なウェブベースの情報と経験交換の窓口を ISOE メンバーに提供することが継続されている。メンバーの職業被ばくデータのオンライン提出のためのデータ入力モジュールの開発が 2007 年も引き続き行なわれた。

原子力発電所での職業被ばく管理に関する年次 ISOE 国際 ALARA シンポジウムは、職業被ばく問題に関する実用的な情報と経験を交換するために ISOE メンバーとベンダーに重要なフォーラムの提供を続けている。 北米技術センターによる 2007 年 ISOE 国際 ALARA シンポジウムが米国のフォート・ローダーデールで開催された。 また、技術センターは、地域シンポジウム開催を継続しており、2007 年には韓国のソウルにおいてアジア技術センターによる 2007 年 ISOE アジア地域 ALARA シンポジウムが開催された。これら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維持するための考え及び管理方法の交換を促進するために世界的規模のフォーラムを提供している。

迅速かつ技術的なフィードバックを求める特別なリクエストに対する回答、そしてISOE 地域間の線量低減情報交換のための自主的なサイト・ベンチマーキング訪問の実施において、技術センターが提供する支援は重要である。シンポジウムと技術的な訪問を組み合わせることによって、放射線防護専門家が集まり、情報を共有し、ISOE 地域間の連結を築くことができ、作業管理のための世界的規模のアプローチの開発手段が提供されている。

ISOE データ分析ワーキンググループ（WGDA）は、ISOE データベースの完全性及び一貫性に主に焦点を合わせ、ISOE データ及び経験の技術分析のサポート活動を継続した。WGDA の下、作業管理に関する専門家グループが設立され、ISOE プログラムの下での 15 年間の情報交換及び放射線防護における新しい経験、技術を考慮に入れて、1997 年の ISOE 報告書「原子力産業における作業管理」が改訂された。

本報告書の第 6 章で ISOE 加盟国の主な出来事について要約する。ISOE の成果の詳細、参加者及び 2008 年の作業計画を附属書に提示する。

ОСНОВНЫЕ ИТОГИ

С 1992 года Информационная система по профессиональному облучению (ИСПО) поддерживает оптимизацию радиационной защиты работников АЭС посредством использования всемирной сети по обмену информацией и опытом между специалистами по радиационной защите на АЭС и в национальных регулирующих органах, а также путем публикации соответствующих технических материалов по управлению принципом ALARA. Настоящий 17-й ежегодный доклад программы ИСПО (2007 год) отражает положение дел с осуществлением программы ИСПО в 2007 календарном году.

ИСПО финансируется совместно ОЭСР/АЯЭ и МАГАТЭ, и членство в ней открыто для ядерных энергопредприятий и регулирующих органов, ведающих вопросами радиационной защиты, которые принимают Положения и условия этой программы. В ноябре 2007 года Совет по управлению ИСПО (ранее именовавшийся Руководящей группой) одобрил возобновление новых Положений и условий ИСПО на период 2008-2011 годов. По состоянию на конец 2007 года, в программе ИСПО участвовали 71 энергопредприятие в 29 странах (334 блока, находящихся в эксплуатации; 45 остановленных блоков), а также регулирующие органы 25 стран. База данных по профессиональному облучению ИСПО включала информацию об уровнях и тенденциях профессионального облучения на 399 находящихся в эксплуатации реакторах в 29 странах, охватывая приблизительно 91% находящихся в эксплуатации промышленных энергетических реакторов мира. Управление повседневной технической деятельностью по программе обеспечивается четырьмя техническими центрами ИСПО (Европа, Северная Америка, Азия и МАГАТЭ).

На основе данных о профессиональном облучении, полученных от членов ИСПО, в 2007 году значения средней годовой коллективной дозы на реактор и скользящей средней дозы на реактор за трехлетний период (2005-2007 годы) в отношении находящихся в эксплуатации энергетических реакторов составляли:

	Средняя годовая коллективная доза за 2007 год (чел·Зв/реактор)	**Скользящая средняя доза за трехлетний период, 2005-2007 годы (чел·Зв/реактор)**
Реакторы с водой под давлением (PWR/ВВЭР)	0,74	0,75
Кипящие водяные реакторы (BWR)	1,50	1,43
Корпусные тяжеловодные реакторы (PHWR/CANDU)	0,87	1,04
Все реакторы, включая газоохлаждаемые (GCR) и легководные реакторы с графитовым замедлителем (LWGR)	0,93	0,89

В дополнение к информации по находящимся в эксплуатации реакторам база данных ИСПО содержит также данные о дозах по 83 реакторам, которые находятся в состоянии останова или на некоторой стадии снятия с эксплуатации. Поскольку эти реакторные блоки, как правило, относятся к различным типам и имеют различные мощности и находятся на различных стадиях снятия с эксплуатации, четкие тенденции изменения дозы определить трудно. Однако в 2007 году была проведена работа по улучшению сбора данных по таким реакторам с целью содействия усовершенствованию оценок контрольных показателей. Подробная информация о тенденциях дозы профессионального облучения применительно к реакторам, находящимся в эксплуатации, и реакторам, находящимся в процессе снятия с эксплуатации, содержится в разделе 2 этого доклада.

В то время как ИСПО хорошо известна в связи с ее данными и анализами профессионального облучения, сильная сторона этой программы состоит в ее цели - широко распространять такую информацию среди своих участников. В 2007 году на веб-сайте сети ИСПО (www.isoe-network.net) членам ИСПО продолжал предоставляться универсальный Интернет-портал для обмена информацией и опытом по методам снижения дозы и ресурсам ИСПО ALARA. В течение 2007 года продолжалась разработка модулей ввода данных для он-лайнового представления членами данных о профессиональном облучении.

Ежегодно проводимые ИСПО международные симпозиумы ALARA по управлению профессиональным облучением на АЭС продолжали обеспечивать важный форум для участников ИСПО и для поставщиков, с тем чтобы они могли обменяться практической информацией и опытом по вопросам профессионального облучения. В Форт-Лодердейле, Соединенные Штаты Америки, был проведен Международный симпозиум ИСПО ALARA 2007 года, организованный Североамериканским техническим центром. В технических центрах продолжалось также проведение региональных симпозиумов, которые в 2007 году включали Азиатский региональный симпозиум ИСПО ALARA, организованный Азиатским техническим центром в Сеуле, Корея. Эти симпозиумы продолжили традицию обеспечения глобального форума для содействия обмену идеями и данными об управленческих подходах к поддержанию профессионального радиационного облучения "на разумно достижимом низком уровне".

Представляется важной поддержка, которую технические центры предоставляют в ответ на специальные запросы для осуществления быстрой технической обратной связи, а также посредством организации добровольных контрольных посещений для обмена информацией между регионами ИСПО по вопросам снижения дозы. Сочетание симпозиумов и технических посещений ИСПО предоставляет специалистам по радиационной защите возможность встретиться, обменяться информацией и установить связи между регионами ИСПО для выработки глобального подхода к управлению профессиональным облучением.

Рабочая группа ИСПО по анализу данных (РГАД) продолжала свою деятельность в поддержку технического анализа данных и опыта ИСПО, уделяя основное внимание обеспечению целостности и согласованности базы данных ИСПО. Под эгидой РГАД была создана Группа экспертов по управлению работами с целью подготовки обновленного варианта доклада ИСПО 1997 года “Управление работами в ядерной энергетике”, в котором бы учитывался накопленный опыт и новые технологии в области радиационной защиты персонала, а также результаты 15-летнего обмена информацией в рамках программы ИСПО.

Важнейшие события, произошедшие в участвующих в ИСПО странах, кратко излагаются в разделе 6 настоящего доклада. Подробные сведения о достижениях в рамках ИСПО, об участии в ней и о программе работы на 2008 год содержатся в приложениях.

RESUMEN EJECUTIVO

Desde 1992, el Sistema de Información sobre Exposición Ocupacional (Information System on Occupational Exposure, ISOE), ha apoyado la optimización de la protección radiológica de los trabajadores de las centrales nucleares a través de una red de intercambio de experiencia e información a escala mundial para los profesionales de protección radiológica de centrales y las autoridades reguladoras, y mediante la publicación de informes técnicos relevantes sobre gestión ALARA. Este 17º Informe Anual del Programa ISOE (2007) presenta el estado del programa para el año 2007.

La participación en el programa ISOE, co-patrocinado conjuntamente por la OCDE/NEA y el OIEA, está abierta a compañías eléctricas y autoridades reguladoras de todo el mundo que acepten los Términos y Condiciones del Programa. En Noviembre de 2007, el Comité de Dirección del ISOE (referido anteriormente como Grupo de Dirección) aprobó la renovación de los nuevos Términos y Condiciones para el periodo 2008-2011. A finales de 2007, el programa ISOE contaba con la participación de 71 compañías eléctricas de 29 países (334 unidades en operación y 45 paradas), así como de las autoridades reguladoras de 25 países. La base de datos de exposición ocupacional del ISOE incluía información sobre niveles de exposición ocupacional y tendencias en 395 reactores en operación en 29 países, cubriendo el 91% del total de reactores comerciales de potencia en el mundo. Cuatro Centros Técnicos del ISOE (Europa, Norteamérica, Asia y el OIEA) gestionan día a día las funciones técnicas del programa.

En base a los datos de exposición ocupacional aportados por los miembros del programa ISOE y referidos a reactores de potencia en operación, la dosis colectiva media anual por reactor en 2007 y la media trienal (2005-2007) por reactor fueron:

	Dosis colectiva anual media en 2007 (Sv.p/reactor)	**Media de dosis trienal 2005-2007 (Sv.p/reactor)**
Reactores de agua a presión (PWR/VVER)	0.74	0.75
Reactores de agua en ebullición (BWR)	1.50	1.43
Reactores de agua pesada a presión (PHWR/CANDU)	0.87	1.04
Todos los reactores, incluyendo los refrigerados por gas (GCR) y los de agua ligera y grafito (LWGR)	0.93	0.89

Además de la información relativa a los reactores en operación, la base de datos del ISOE contiene datos de dosis de 76 reactores parados o en alguna etapa del proceso de clausura. Dado que estos reactores son de diferentes tipos y tamaños y se encuentran en diferentes fases de sus respectivos programas de clausura, es difícil identificar tendencias dosimétricas claras. No obstante, en 2007 se adoptó una iniciativa para mejorar la recopilación de datos de dichos reactores con el fin de proporcionar una mejor comparativa. La sección 2 de este documento presenta información detallada sobre las tendencias de dosis ocupacionales para reactores en operación y reactores en fase de clausura.

Aunque el programa ISOE es bien conocido por sus datos y análisis de exposición ocupacional, su fuerza radica en el objetivo de compartir ampliamente esta información entre sus participantes. En 2007, la página WEB de la red de ISOE (www.isoe-network.net) continuó poniendo a disposición de los miembros del programa un portal de información amplia y de intercambio de experiencias sobre reducción de dosis y recursos ALARA. El desarrollo de módulos de entrada de datos para la aportación on-line por parte de los miembros de datos de exposición ocupacional continuó durante el año 2007.

Los Simposios anuales internacionales ALARA del ISOE sobre la gestión de la exposición ocupacional en centrales nucleares, continúan siendo foros importantes para participantes del programa ISOE y suministradores para intercambiar información práctica y experiencia en asuntos de exposición ocupacional. El Simposio ALARA Internacional de 2007 del ISOE, organizado por el Centro Técnico Norteamericano, se celebró en Fort Lauderdale, Estados Unidos. Los centros técnicos siguieron albergando Simposios regionales, que en 2007 incluyeron el Simposio Regional Asiático organizado por el Centro Técnico Asiático en Seúl, Corea. Estos simposios proporcionan un foro global para la promoción del intercambio de ideas y planteamientos de gestión para mantener los niveles de exposición ocupacional tan bajos como sea razonablemente posible.

Es importante el apoyo que brindan los centros técnicos en respuesta a los requerimientos específicos de realimentación técnica, así como la organización de visitas voluntarias para el intercambio de información sobre reducción de dosis entre regiones del programa ISOE. La combinación de Simposios del ISOE y visitas técnicas proporciona un valioso foro de encuentro, intercambio de información y establecimiento de relaciones entre las regiones ISOE para los profesionales de la protección radiológica, con el fin de desarrollar un planteamiento global a la gestión de la exposición ocupacional.

El Grupo de Trabajo para el Análisis de Datos (Working Group on Data Analisis, WGDA) del ISOE continuó sus actividades de apoyo al análisis técnico de los datos y experiencias operativas del ISOE, centrándose en gran medida en la integridad y consistencia de la base de datos de ISOE. Bajo dicho Grupo, se estableció el Grupo de Expertos en Gestión de Trabajos (Expert Group on Work Management) para desarrollar y actualizar el informe ISOE de 1997 sobre "Gestión de Trabajos en la Industria de Producción Eléctrica Nuclear" (Work Management in the Nuclear Power Industry), considerando las nuevas experiencias y tecnologías en el campo de la protección radiológica ocupacional así como los 15 años de intercambio de información bajo el programa ISOE.

Los principales sucesos ocurridos en los países participantes en el programa ISOE se resumen en la Sección 6 del presente informe. En los Anexos se ofrecen detalles de las participaciones en ISOE y el programa de trabajo para 2008.

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

Since 1992, ISOE has supported the optimisation of worker radiological protection in nuclear power plants through a worldwide information and experience exchange network for radiation protection professionals at nuclear power plants and national regulatory authorities, and through the publication of relevant technical resources for ALARA management.

The ISOE programme includes a global occupational exposure data collection and analysis programme, culminating in the world's largest occupational exposure database for nuclear power plants, and an information network for sharing dose reduction information and experience. Since the launch of ISOE, participants have used this 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, and the sharing of experience globally.

Participation in ISOE includes radiation protection professionals from nuclear electricity utilities (public and private), from national regulatory authorities (or institutions representing them) and ISOE Technical Centres who have agreed to set up and participate in the operation of ISOE under its Terms and Conditions (2004-2007; renewed for 2008-2011). Four ISOE Technical Centres (Asia, Europe, North America and IAEA) manage the day-to-day technical operations in support of the membership in the four ISOE regions (see Annex 3 for country-technical centre affiliation). The objective of ISOE is to make available to the Participants:

- broad and regularly updated information on methods to improve the protection of workers and on occupational exposure in nuclear power plants; and
- a mechanism for dissemination of information on these issues, including evaluation and analysis of the data assembled, as a contribution to the optimisation of radiation protection.

At the end of 2007, the ISOE programme included 71[1] Participating Utilities in 29 countries (334 operating units; 45 shutdown units), as well as the regulatory authorities of 25 countries. In addition to the detailed occupational exposure data provided directly by Participating Utilities, Participating Authorities may also contribute official national data in cases where some of their licensees may not yet be ISOE members. The ISOE database thus includes information on occupational exposure levels and trends at 471 reactor units (395 operating; 76 in cold-shutdown or some stage of decommissioning) in 29 countries, covering about 91% of the world's operating commercial power reactors[2]. Occupational exposure data collected annually from participants is made available to all ISOE members, according to their status as a participating utility or authority, through the ISOE database provided to members on the ISOE Network website and on CD-ROM.

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1. Represents the number of lead utilities; in some cases, a plant may be owned/operated by multiple enterprises.
2. The largest blocks of reactors not included in the database are in India and the Russian Federation (LWGRs).

During 2007, the following changes were noted with respect to the status of ISOE participants:

- Utilities officially joining ISOE:
  - USA: Constellation Energy- R.E. Ginna (PWR, 515 MWe); Nine Mile Point 1, 2 (BWR, 640/1164 MWe) (USA)
  - USA: Southern Nuclear Company-Vogtle 1, 2 (PWR, 1160 MWe)
- Units starting commercial operations:
  - Romania: Cernavoda 2 (CANDU, November 2007)
- Units shutdown, decommissioned
  - Bulgaria: Kozloduy 3, 4 (definitive shutdown, December 2006)
  - Slovak Rep: JAVYS 1 (Bohunice 1) (definitive shutdown, December 2006)

Table 1 summarises total participation by country, type of reactor and reactor status. Annex 3 provides a complete list of units, utilities and authorities officially participating in ISOE at the end of 2007.

Table 1: Participation summary (as of December 2007)

Operating reactors participating in ISOE						
Country	**PWR[1]**	**BWR**	**PHWR**	**GCR**	**LWGR**	**Total**
Armenia	1	–	–	–	–	1
Belgium	7	–	–	–	–	7
Brazil	2	–	–	–	–	2
Bulgaria	2	–	–	–	–	2
Canada[2]	–	–	22	–	–	22
China	5	–	–	–	–	5
Czech Republic	6	–	–	–	–	6
Finland	2	2	–	–	–	4
France	58	–	–	–	–	58
Germany	11	6	–	–	–	17
Hungary	4	–	–	–	–	4
Japan	23	32	–	–	–	55
Korea, Republic of	16	–	4	–	–	20
Lithuania	–	–	–	–	1	1
Mexico	–	2	–	–	–	2
The Netherlands	1	–	–	–	–	1
Pakistan	1	–	1	–	–	2
Romania	–	–	2	–	–	2
Russian Federation[3]	15	–	–	–	–	15
Slovak Republic	5	–	–	–	–	5
Slovenia	1	–	–	–	–	1
SouthAfrica, Rep. of	2	–	–	–	–	2
Spain	6	2	–	–	–	8
Sweden	3	7	–	–	–	10
Switzerland	3	2	–	–	–	5
Ukraine	15	–	–	–	–	15
United Kingdom	1	–	–	–	–	1
United States	41	20	–	–	–	61
Total	**231**	**73**	**29**	**–**	**1**	**334**
Operating reactors not participating in ISOE, but included in the ISOE database						
Country	**PWR**	**BWR**	**PHWR**	**GCR**	**LWGR**	**Total**
United Kingdom	–	–	–	18	–	18
United States	28	15	–	–	–	43
Total	**28**	**15**	–	**18**	**–**	**61**
Total number of operating reactors included in the ISOE database						
	PWR	**BWR**	**PHWR**	**GCR**	**LWGR**	**Total**
Total	**259**	**88**	**29**	**18**	**1**	**395**

1. Includes VVER.
2. Includes 2 reactors in laid-up state (long-term shutdown), and 2 undergoing refurbishment.
3. LWGRs from Russian Federation are not ISOE participants.

Definitively shutdown reactors participating in ISOE							
Country	**PWR**	**BWR**	**PHWR**	**GCR**	**LWGR**	**Other**	**Total**
Bulgaria	4	–	–	–	–	–	4
Canada	–	–	2	–	–	–	2
France	1	–	–	6	–	–	7
Germany	3	1	–	1	–	–	5
Italy	1	2	–	1	–	–	4
Japan	–	–	–	1	–	1	2
Lithuania	–	–	–	–	1	–	1
The Netherlands	–	1	–	–	–	–	1
Russian Federation	2	–	–	–	–	–	2
Slovak Republic	1	–	–	–	–	–	1
Spain	1	–	–	1	–	–	2
Sweden	–	2	–	–	–	–	2
Ukraine	–	–	–	–	3	–	3
United States	5	3	–	1	–	–	9
Total	**18**	**9**	**2**	**11**	**4**	**1**	**45**
Definitively shutdown reactors not participating in ISOE but included in the ISOE database							
Country	**PWR**	**BWR**	**PHWR**	**GCR**	**LWGR**	**Other**	**Total**
United Kingdom	–	–	–	22	–	–	22
United States	5	3	–	1	–	–	9
Total	**5**	**3**	–	**23**	–	–	**31**
Total number of definitively shutdown reactors included in the ISOE database							
	PWR	**BWR**	**PHWR**	**GCR**	**LWGR**	**Other**	**Total**
Total	**23**	**12**	**2**	**34**	**4**	**1**	**76**

Total number of reactors included in the ISOE database							
	PWR	**BWR**	**PHWR**	**GCR**	**LWGR**	**Other**	**Total**
Total	**282**	**100**	**31**	**52**	**5**	**1**	**471**

Number of **Participating Countries**	**29**
Number of **Participating Utilities**[1]	**71**
Number of **Participating Authorities**[2]	**27**

1. Represents the number of lead utilities; in some cases, a plant may be owned/operated by multiple enterprises.
2. Two countries participate with two authorities.

2. OCCUPATIONAL DOSE STUDIES, TRENDS AND FEEDBACK

A key element of ISOE is the tracking of occupational exposure trends from nuclear power facilities worldwide for benchmarking, comparative analysis and experience exchange amongst ISOE members. Using the ISOE database, which contains annual occupational exposure data supplied by all Participating Utilities (generally based on operational dosimetry systems), ISOE members can perform various benchmarking and trend analyses by country, by reactor type, or by other criteria such as sister-unit grouping. The summary below provides highlights of the general trends in occupational doses at nuclear power plants.

2.1 Occupational exposure trends: Operating reactors

Figures 1 and 2 show the trends in annual average and 3-year rolling average collective dose per reactor type for 1992-2007. In general, the average collective dose per operating reactor unit has consistently decreased over the time period covered in the ISOE database, with the 2007 averages maintaining the levels reached in last few years. In spite of some yearly variations, the clear downward dose trend in most reactors has continued, with the exception of PHWRs, which have shown a slight increasing trend since the lows achieved in the 1996-1998 time period.

With respect to 2007, a summary of average annual collective doses by reactor type is provided in Table 2. Exposure trends over the past three years for participating countries and by technical centre regional groupings, expressed as average annual and 3-year rolling average annual collective doses per reactor are shown in Tables 3 and 4 respectively. These results are based primarily on data reported and recorded in the ISOE database during 2007, supplemented by the individual country reports (Section 6) as required. Figures 3 to 6 provide a detailed breakdown of the 2007 data in bar-chart format, ranked from highest to lowest average dose. In all figures, the "number of units" refers to the number of reactor units for which data has been reported for the year in question.

Table 2: Summary of average collective doses for operating reactors, 2007

	2007 average annual collective dose (man·Sv/reactor)	3-year rolling average for 2005-2007 (man·Sv/reactor)
Pressurised water reactors (PWR/VVER)	0.74	0.75
Boiling water reactors (BWR)	1.50	1.43
Pressurised heavy water reactors (PHWR/CANDU)	0.87	1.04
All reactors, including gas cooled (GCR) and light water graphite reactors (LWGR)	0.93	0.89

The following discussion provides a brief overview of the results and trends observed in the four ISOE regions. However, it is noted that due to the the various power plant designs and the complex parameters influencing collective doses, these analyses 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 individual countries can be found in Section 6 of this report.

European Region

In the European region, the 2007 average collective dose for PWRs and VVERs was around 0.57 man·Sv/reactor, with most countries showing a stable or decreasing trend over the last three years. The average collective dose for European BWRs was around 1.33 man·Sv/reactor.

The trends over time of the 3-year rolling average annual collective dose per reactor, which provides a better representation of the general trend in dose, shows a light continuity of the decrease for PWRs and VVERs, going from 0.70 man·Sv/reactor for 2003-2005 to 0.62 man·Sv/reactor for 2005-2007. The average collective dose per reactor for BWRs shows an increasing trend, with 1.05 man·Sv/reactor for 2003-2005 and 1.18 man·Sv/reactor for 2005-2007, mainly due to the Spanish plants. Except for this country, the 3-year rolling average annual collective doses per reactor for BWRs are quite similar in all European countries, the minimum being Finland with 0.94 man·Sv/reactor, and the maximum being Sweden with 1.08 man·Sv/reactor. For Spain, the 3-year rolling average collective dose per reactor for BWRs is twice as high, with 2.29 man·Sv/reactor for 2005-2007.

For European PWRs, the data from individual countries shows that with respect to the 3-year rolling average annual collective dose for 2005-2007, three main groups can be distinguished:

- Belgium, The Netherlands, United Kingdom: 0.3-0.4 man·Sv/reactor.
- Spain, Sweden, Switzerland around 0.4-0.5 man·Sv/reactor.
- France, Germany: around 0.7-1.1 man·Sv/reactor.

Regarding VVERs, the Czech Republic showed the lowest 3-year rolling average annual collective dose per reactor in 2005-2007 at 0.17 man·Sv/reactor, followed by the Slovak Republic (0.30 man·Sv/reactor), Hungary (0.43 man·Sv/reactor) and Finland (0.53 man·Sv/reactor).

Asian Region

In the Asian region, the 2007 average collective dose per reactor increased for all type of reactors. However, the trends over time of the 3-year rolling average annual collective dose shows a stable or decreasing trend for all types.

The 2007 average collective dose per reactor for Japanese PWRs was 1.35 man·Sv/reactor. Though this was the highest value over the last ten years, the trend of the 3-year rolling average annual collective dose was stable with 1.10 man·Sv/reactor for 2003-2005 and 1.13 man·Sv/reactor for 2005-2007. For Korean PWRs, the 2007 average collective dose per reactor was 0.67 man·Sv/reactor, which was half of the value for Japanese PWRs.

For Japanese BWRs, the 2007 average collective dose per reactor increased to 1.47 man·Sv/reactor from 1.33 man·Sv/reactor for 2006 which was the lowest recorded value. However, the 3-year rolling average annual collective dose shows a decreasing trend with 1.78 man·Sv/reactor for 2003-2005 and 1.40 man·Sv/reactor for 2005-2007.

For Korean PHWRs, the 2007 average collective dose was 0.80 man·Sv/reactor, and the 3-year rolling average annual collective dose was 0.71 man·Sv/reactor, which shows a slight decreasing trend.

North American Region

In the US, the total collective dose for all light water reactors (LWR) was 101.18 man·Sv (10 118 person-rem) which is 8% lower than the 2006 total collective dose of 110.21 man·Sv (11 021 person-rem). The US average collective dose in 2007 for LWRs was 0.97 man·Sv (97 person-rem) per reactor, which is a slight decrease from 2006 (106 person-rem). This dose is reduced by almost half from the LWR dose recorded ten years ago (in 1995) and is only about one-eighth of the maximum LWR average dose per reactor of 7.90 man·Sv (790 person-rem) recorded in 1980. The total collective dose was 101.18 man·Sv (10 118 person-rem) which is 8% lower than the 2006 total collective dose of 110.21 man·Sv (11 021 person-rem).

In 2007, the total collective dose for US PWRs was 47.30 man·Sv (4 730 person-rem) for 69 reactors. The resulting average collective dose per reactor for PWRs in 2007 was 0.69 man·Sv (69 person-rem)/reactor. This average represents a 21% decrease from the 2006 value of 0.87 man·Sv (87 person-rem)/reactor, and is the lowest average annual dose per reactor recorded to date for US PWRs (in 2004, 0.71 man·Sv (71 person-rem)/reactor was recorded). This is the ninth year that the average annual PWR dose has been less than 1.0 man·Sv (100 person-rem)/reactor.

The total collective dose for US BWRs in 2007 was 53.88 man·Sv (5 388 person-rem) for 35 reactors. The resulting average collective dose per reactor was 1.54 man·Sv (154 person-rem)/reactor, which is the third lowest recorded annual average dose per unit. The lowest average BWR dose of 1.38 man·Sv (138 person-rem)/reactor was recorded in 2001.

One of the noted differences between the collective doses recorded in 2007 and those recorded in 2006 was the number of plants having collective doses equal to or less than 0.10 man·Sv (10 person-rem) for the year. In 2006, five LWRs had annual collective doses equal to or less than 0.10 man·Sv (10 person-rem), while in 2007, nine LWRs had annual collective doses in this range. Doses in this range usually indicate that the plant operated the entire year without any outages.

Non-OECD Countries (participating through the IAEA)

The information provided by the non-OECD countries lead to the following conclusions. There is a global decrease of the collective dose for the year 2007 in the majority of plants. For some, the rate of reduction is quite significant, in particular concerning the impact of intake of tritium for CANDU reactors. Extension of the fuel cycle duration up to 18 months seems also to be beneficial in terms of collective doses reduction. Some plants have undertaken planned operations such as refuelling outages or extended maintenance programmes; local increases of the collective dose are mainly due to these operations.

The maximum individual dose results still show some very high values, some of them being close to the annual limit of 20 mSv for occupationally exposed workers. Without any doubt, efforts will have to be maintained in order to reduce these remaining "hot spots". In some plants, actions have already been discussed for this purpose and further actions are planned for 2008. The impact of these efforts should partially be seen in 2008 as high exposure risk operations, such as replacement of the steam generator or of the reactor pressure vessel head, are planned for 2008.

Lack of data does not allow any conclusion for the year 2007 concerning the breakdown between utilities employees and contractors doses.

Preparatory works for the decommissioning of plants have been initiated in 2007 and are expected to be completed in 2008.

Table 3: Average annual collective dose per reactor, by country and reactor type, 2005-2007 (man·Sv/reactor)

	PWR, VVER			BWR			PHWR		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
Armenia	0.84	0.86	0.75						
Belgium	0.41	0.39	0.35						
Brazil	0.62	0.56	1.05						
Bulgaria	0.78	0.40	0.41						
Canada[1]							1.30	0.98	0.92
China	0.66	0.49	0.66						
Czech Republic	0.18	0.15	0.17						
Finland	0.38	0.83	0.36	1.14	1.10	0.59			
France	0.78	0.69	0.63						
Germany	1.32	0.84	1.04	1.01	1.14	0.99			
Hungary	0.47	0.35	0.45						
Japan[2]	0.97	1.09	1.35	1.39	1.33	1.47			
Korea, Republic of	0.56	0.54	0.67				0.75	0.58	0.80
Mexico				1.68	1.48	2.74			
The Netherlands	0.20	0.62	0.23						
Pakistan	0.42	0.02	n/a				1.43	4.48	n/a
Romania							0.73	0.56	0.27
Russian Federation	1.00	0.70	0.91						
Slovak Republic	0.40	0.28	0.24						
Slovenia	0.07	0.86	0.89						
South Africa[2], Rep. of	1.13	0.80	0.74						
Spain	0.42	0.38	0.50	2.32	0.41	4.15			
Sweden	0.63	0.51	0.41	1.06	1.09	1.10			
Switzerland	0.66	0.35	0.37	0.99	0.97	1.10			
Ukraine	1.01	0.95	1.17						
United Kingdom	0.36	0.52	0.05						
United States[2]	0.78	0.87	0.69	1.70	1.46	1.54			
Average	**0.77**	**0.73**	**0.74**	**1.47**	**1.32**	**1.50**	**1.19**	**1.04**	**0.87**
By Region[3]									
Europe	0.70	0.59	0.57	1.18	1.02	1.33			
Asia	0.80	0.86	1.07	1.39	1.33	1.47	0.75	0.58	0.80
North America	0.78	0.87	0.69	1.70	1.46	1.60	1.30	0.98	0.92
IAEA	0.90	0.72	0.94				1.08	2.52	0.27

	GCR			LWGR		
Lithuania				2.11	3.06	2.37
United Kingdom	0.06	0.12	0.04			

	2005	2006	2007
Global Average	**0.91**	**0.85**	**0.93**

1. Dose (Canada) is calculated for 18 reactors.
2. Data provided directly from country, rather than calculated from the ISOE database: Japan (2005, 2006, 2007: BWR); South Africa (2007: PWR); USA (2006, 2007: PWR/BWR).
3. See Annex 3 for country composition of the four ISOE regions.

Table 4: 3-year rolling average annual collective dose per reactor, by country and reactor type, 2003-2005 to 2005-2007 (man·Sv/reactor)

	PWR, VVER			BWR			PHWR		
	/03-/05	**/04-/06**	**/05-/07**	**/03-/05**	**/04-/06**	**/05-/07**	**/03-/05**	**/04-/06**	**/05-/07**
Armenia	0.96	0.96	0.82						
Belgium	0.40	0.40	0.39						
Brazil	0.74	0.55	0.74						
Bulgaria	0.85	0.74	0.56						
Canada							1.05	1.03	1.07
China	0.68	0.57	0.60						
Czech Republic	0.18	0.17	0.17						
Finland	0.70	0.82	0.53	0.81	0.99	0.94			
France	0.82	0.75	0.70						
Germany	1.08	1.02	1.06	1.00	1.07	1.05			
Hungary	0.54	0.40	0.43						
Japan	1.10	1.10	1.13	1.78	1.43	1.40			
Korea, Republic of	0.57	0.58	0.59				0.82	0.72	0.71
Mexico				2.37	2.23	1.97			
The Netherlands	0.42	0.54	0.35						
Pakistan	0.34	0.34	n/a				2.28	2.50	n/a
Romania							0.74	0.65	0.52
Russian Federation	1.06	0.90	0.87						
Slovak Republic	0.33	0.32	0.32						
Slovenia	0.52	0.54	0.61						
South Africa, Rep. of	0.86	0.79	0.89						
Spain	0.39	0.37	0.43	1.65	1.06	2.29			
Sweden	0.58	0.57	0.52	0.97	0.91	1.08			
Switzerland	0.49	0.50	0.46	1.16	1.14	1.02			
Ukraine	1.21	1.04	1.04						
United Kingdom	0.25	0.31	0.31						
United States	0.81	0.79	0.78	1.62	1.57	1.57			
Average	**0.81**	**0.76**	**0.75**	**1.56**	**1.41**	**1.43**	**1.05**	**1.03**	**1.04**
By Region:									
Europe	0.70	0.65	0.62	1.05	1.01	1.18			
Asia	0.89	0.89	0.91	1.78	1.43	1.40	0.82	0.72	0.71
North America	0.81	0.79	0.78	1.66	1.61	1.59	1.05	0.98	1.07
IAEA	0.99	0.85	0.85				1.51	1.58	1.49

	GCR			LWGR		
Lithuania				3.49	3.00	2.51
United Kingdom	0.06	0.07	0.08			

	/03-/05	**/04-/06**	**/05-/07**
Global Average	**0.95**	**0.88**	**0.89**

Figure 1: Average collective dose per reactor for all operating reactors included in ISOE by reactor type, 1992-2007 (man·Sv/reactor)

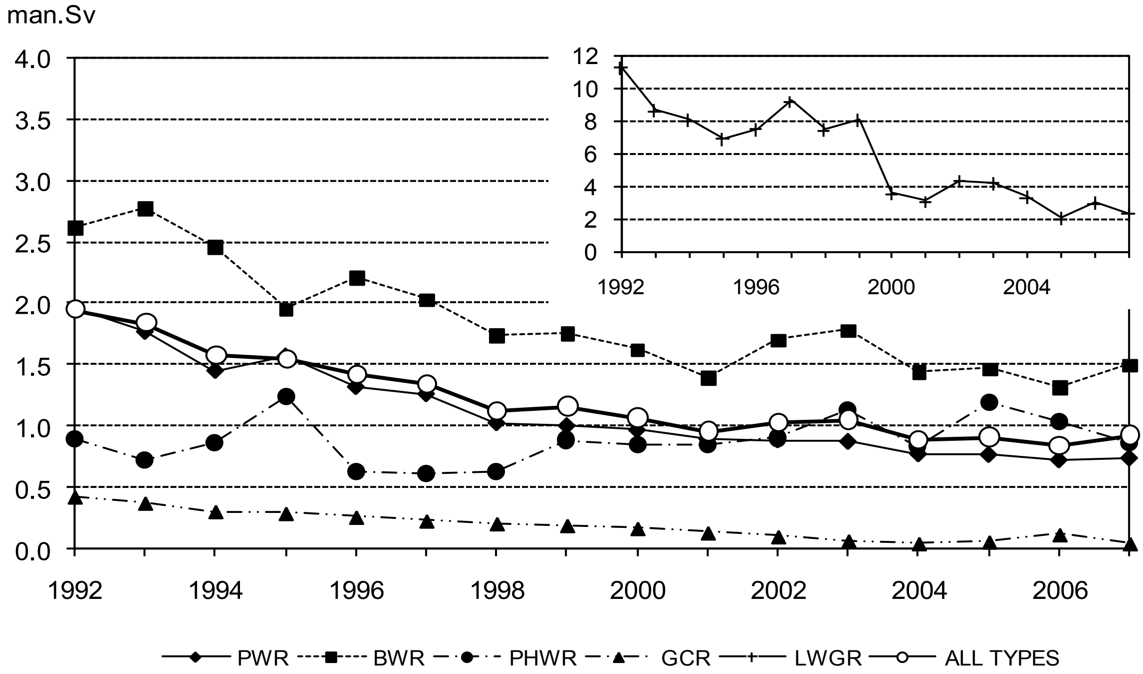
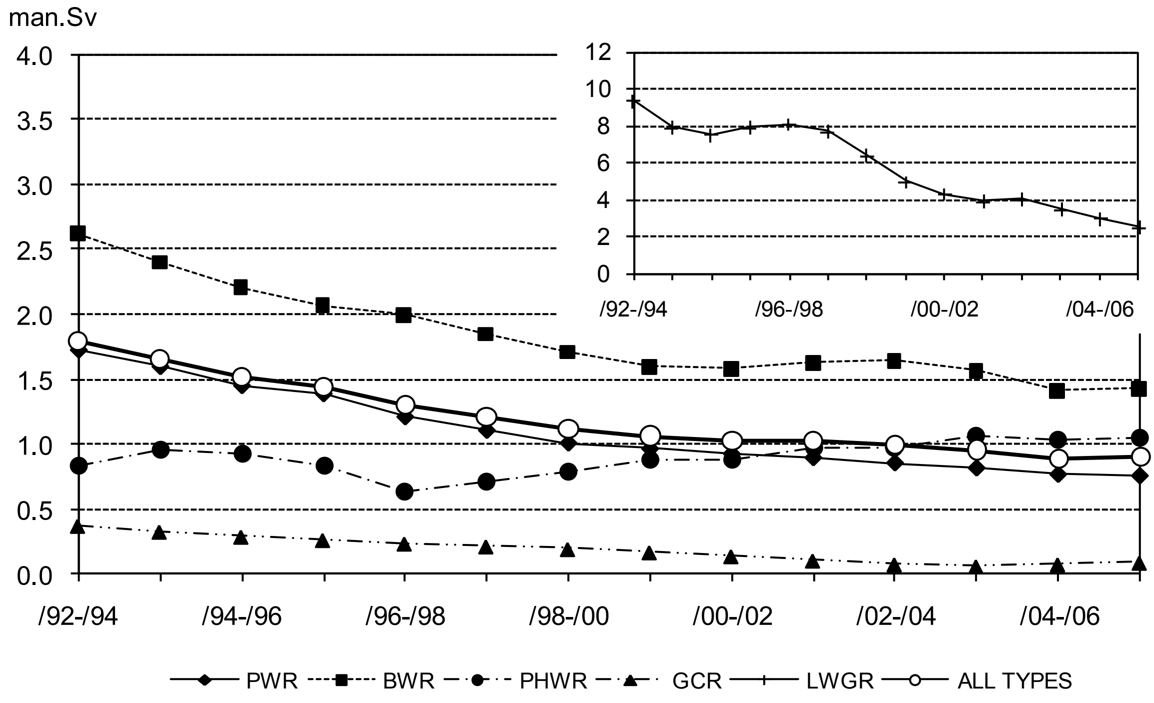


Figure 2: 3-year rolling average per reactor for all operating reactors included in ISOE by reactor type 1992-2007 (man·Sv/reactor)



Note: Inset charts shows average collective dose for LWGRs.

Figure 3: 2007 PWR/VVER average collective dose per reactor by country (man·Sv/reactor)

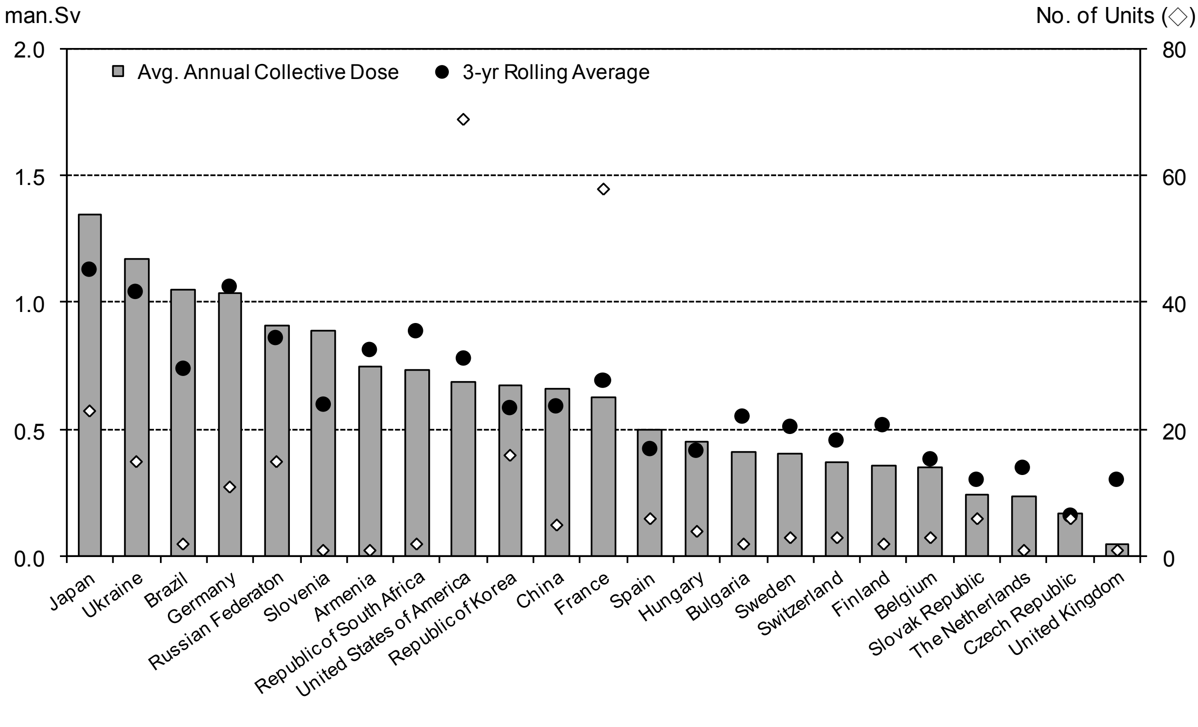


Figure 4: 2007 BWR average collective dose per reactor by country (man·Sv/reactor)

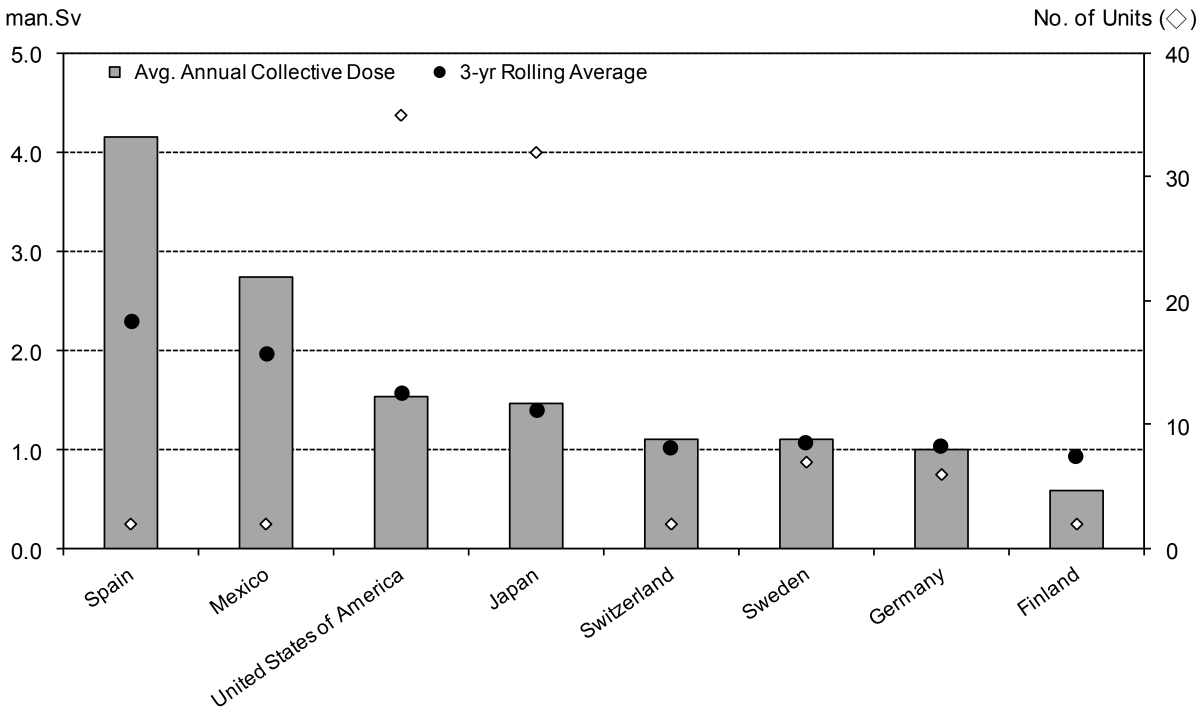


Figure 5: 2007 PHWR average collective dose per reactor by country (man·Sv/reactor)

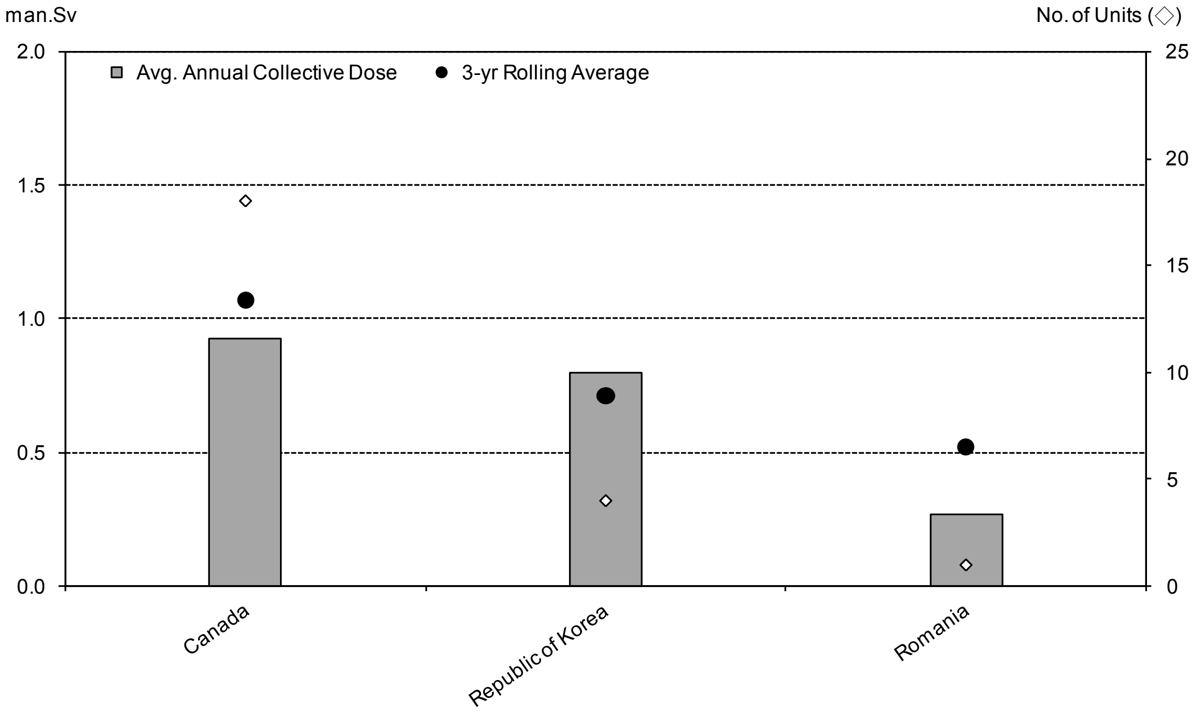
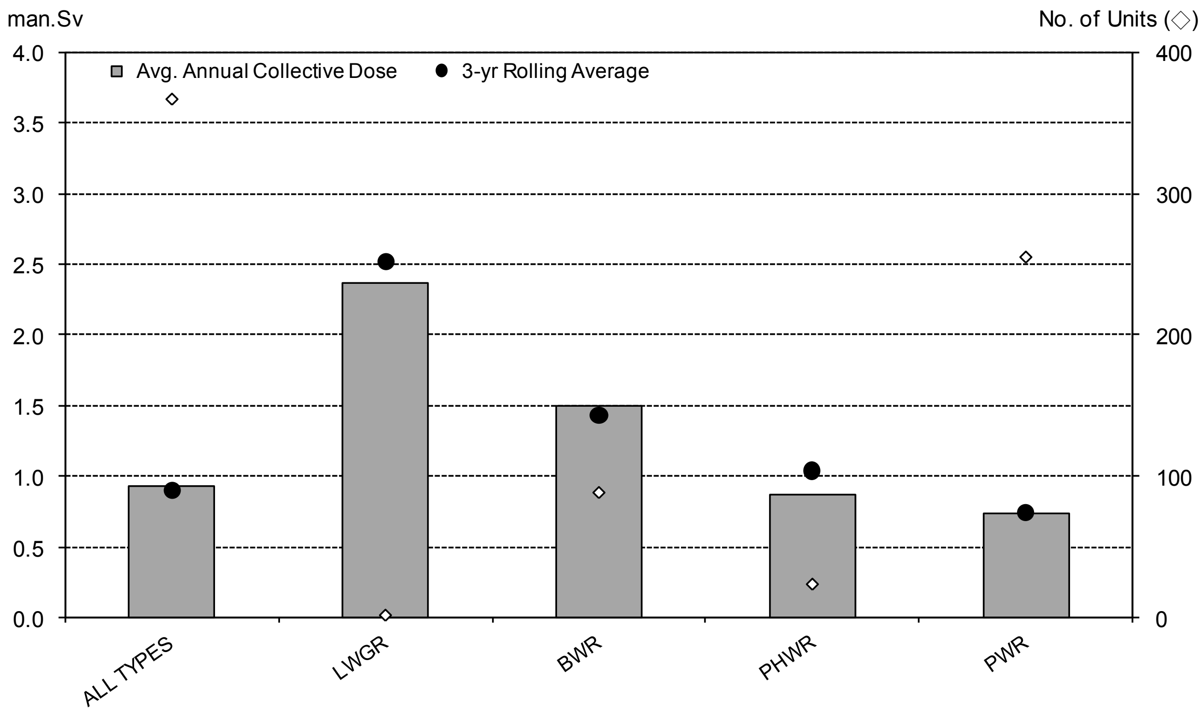


Figure 6: 2007 average collective dose per reactor type (man·Sv/reactor)



2.2 Occupational exposure trends: Definitely shutdown reactors

In addition to information from operating reactors, the ISOE database contains dose data from 76 reactors which are shut-down or in some stage of decommissioning. This section provides a summary of the dose trends for those reactors reporting during the 2005-2007 period. These reactor units are generally of different type and size, at different phases of their decommissioning programmes, and supply data at various levels of detail. For these reasons, and because these figures are based on a limited number of shutdown reactors, definitive conclusions cannot be drawn. Under the ISOE Working Group on Data Analysis, work was undertaken in 2007 aimed at improving data collection for shut-down and decommissioned reactors in order to facilitate better benchmarking.

Table 5 provides average annual collective doses per unit for definitely shutdown reactors by country and reactor type for 2005-2007, based on data recorded in the ISOE database, supplemented by the individual country reports (Section 6) as required. Figures 7-10 present the average collective dose per reactor for shutdown reactors for 1992-2007 by reactor type (PWR, BWR and GCR). In all figures, the "number of units" refers to the number of units for which data has been reported for the year in question.

Table 5: Number of units and average annual dose per unit by country and reactor type for definitely shutdown reactors, 2005-2007 (man·mSv/reactor)

		2005		2006		2007	
		No.	**Dose**	**No.**	**Dose**	**No.**	**Dose**
PWR	France	1	5.6	1	5.5	1	10.4
	Germany	3	175.2	3	174.2	2	172.9
	Italy	1	31.0	1	10.0	1	0.5
	Spain					1	292.9
	United States	8	123.6	8	95.0	6	26.5
VVER	Bulgaria	2	26.7	2	23.5	4	60.4
	Germany[1]	5	37.0				
	Russian Federation	2	232.1	2	126.1	2	100.6
BWR	Germany	1	272.4	1	483.1	1	405.1
	Italy	2	5.0	2	12.4	2	6.5
	The Netherlands	1	3.0	1	0.3	1	0.4
	Sweden	2	63.0	2	51.8	2	141.0
	United States	5	159.6	5	70.0	4	180.7
GCR	France	6	8.8	6	6.3	6	2.2
	Germany[1]	2	19.0				
	Italy	1	0.0	1	0.4	1	0.5
	Japan	1	100	1	30	1	30
	United Kingdom	14	55.6	14	60.0	18	44.1
LWGR	Lithuania	1	364.1	1	352.3	1	215.8
LWCHWR	Japan	1	159.7	1	195.6	1	85.7

1. German data for 2005 provided directly from country, and not derived from the ISOEDAT database.

Figure 7: Average collective dose per shutdown reactor: PWR/VVERs (man·mSv/reactor)

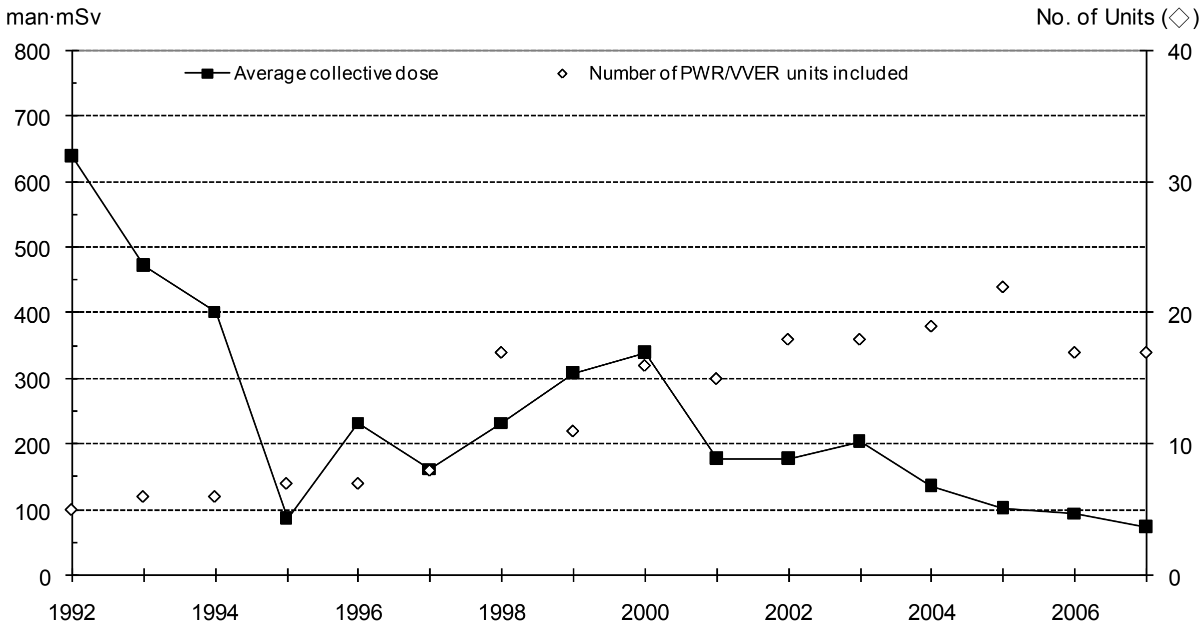


Figure 8: Average collective dose per shutdown reactor: BWRs (man·mSv/reactor)

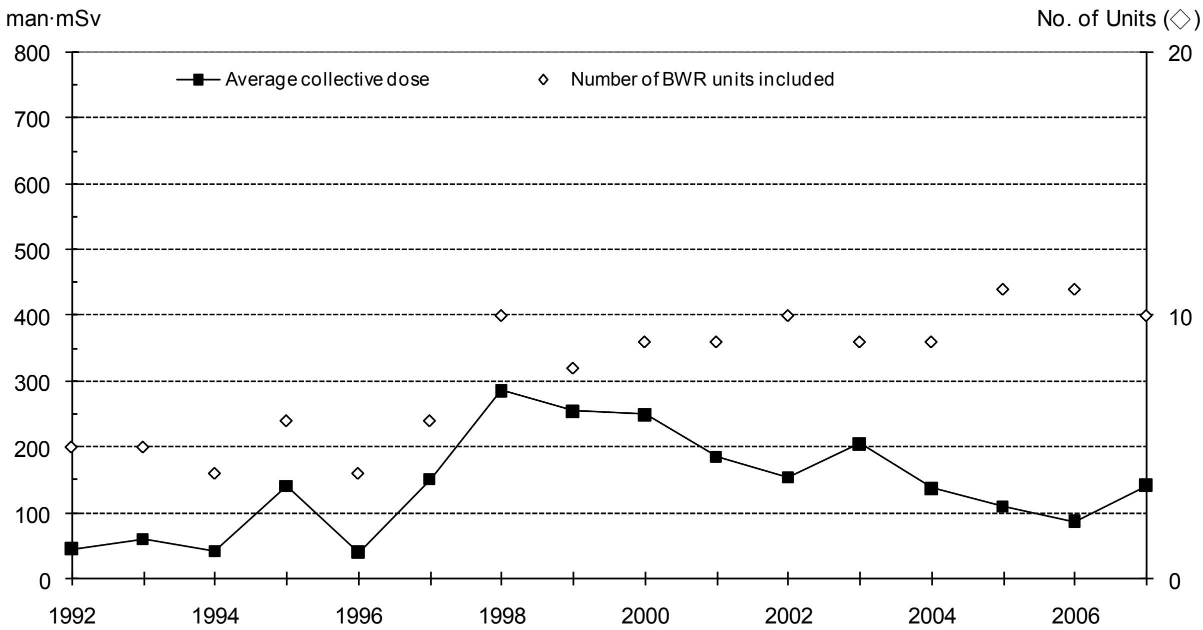


Figure 9: Average collective dose per shutdown reactor: GCRs (man·mSv/reactor)

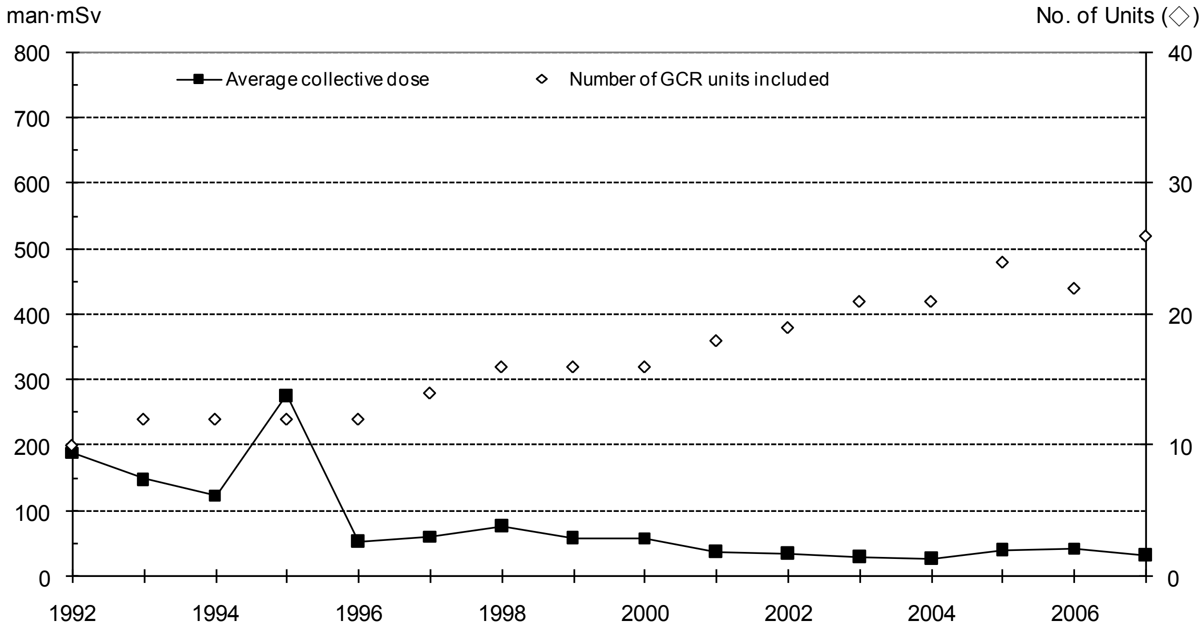
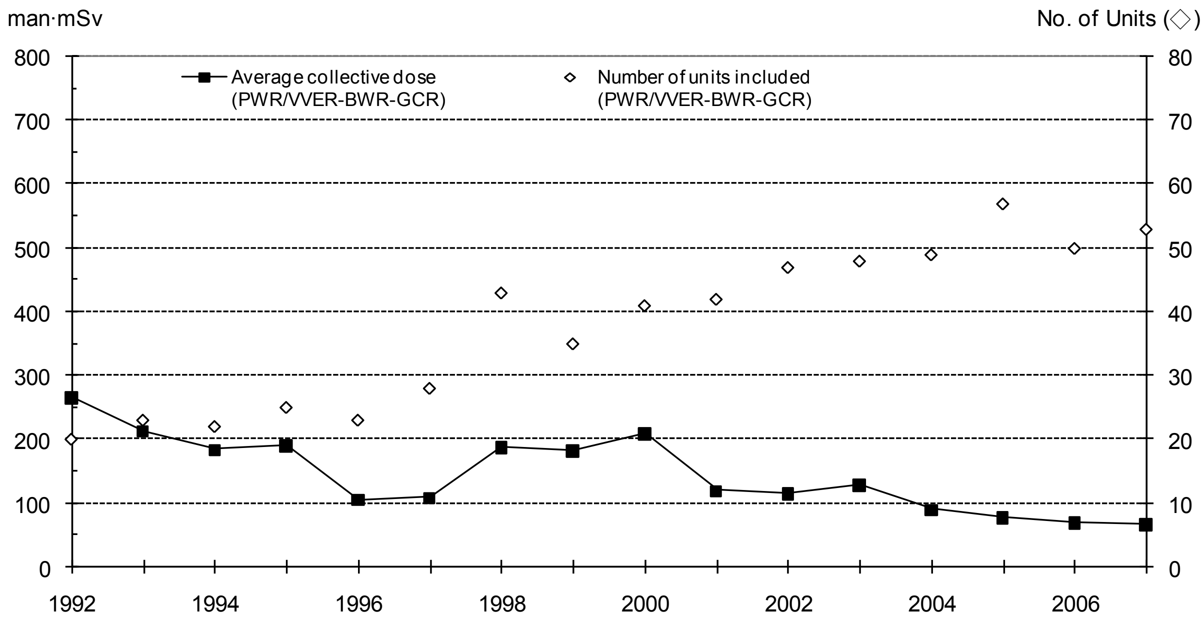


Figure 10: Average collective dose per shutdown reactor: PWR/VVER, BWR, GCR (man·mSv/reactor)



2.3 Average outage durations and collective doses per reactor type for 1996-2006

The following section provides an analysis of average outage durations and collective doses per reactor type for BWR, PWR and VVER operational reactors over the 10 year period from 1996-2006. The analysis includes only those reactors with complete historical outage information in terms of dose and duration over the time period considered, leading to the exclusion of reactors which started commercial operations or which were shutdown during this period. Additionally, in order to consider only maintenance refuelling outages in the analysis, reactors with outage durations greater than 250 days (i.e about 8 months) were not taken into account, as it was assumed that outage durations greater than 8 months were due not only to normal maintenance but also to other types of work. In the same line, outages with duration less than 4 days have also been removed. Finally, the differences of design, ages or type of outages between the reactors have not been taken into account either.

The following table gives the number of reactors taken into account during the period 1996-2006 for these analyses.

Years	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
BWR	57	48	53	47	51	51	38	40	40	46	44
PWR	126	119	111	142	122	134	133	123	126	127	122
VVER	18	19	18	18	19	18	19	19	19	19	19
Total	201	186	182	207	192	203	190	182	185	192	185

For each reactor type, two indicators have been calculated:

- The 3-year rolling average outage collective dose per unit (man·Sv/reactor).
- The 3-year rolling average outage duration per unit (number of days).

BWR Evolution

Figure 11 shows the trends in BWR outage collective dose and outage duration, which are quite similar. After a regular decrease between 1996-2002, a slight increase of both outage collective dose and outage duration are seen. The decrease of the average outage collective dose as well as the average outage duration are both on the order of 30% for the first period: from 1.9 man·Sv/reactor in 1996-1998 to 1.4 man·Sv/reactor in 2000-2002 for the dose; from 68 days in 1996-1998 to 50 days in 2000-2002 for the duration.

The increase of the average outage collective dose since 2001-2003 from 1.4 man·Sv/reactor to 1.5 man·Sv/reactor in 2004-2006 is on the order of 15%, with a peak at 1.6 man·Sv/reactor in 2003-2005. In terms of average outage duration, the increase was irregular over this period. However, the global trend follows that of the average outage collective dose, with an increase of about 10% between 2000-2002 (50 days) and 2004-2006 (54 days).

Regarding outage duration, if the data per country are analysed, it appears that the general trend of the graph is influenced mainly by the Japanese data. The number of Japanese reactors represents about 40% of the total BWR reactors taken into account in this study, and the average outage duration of Japanese plants is usually 55% higher than the outage duration of the other countries for BWR (usually more than 100 outage days in Japan). Two elements contribute to evolution of the average outage duration in the period 2002-2006: i) the number of Japanese reactors taken into account between 2002-2004 was slightly lower than the other periods, and ii) the average outage duration of

Japanese reactors increased significantly since 2003, reaching 133 days on an average on the period 2004 to 2006.

The distributions of the average outage duration and average outage doses by country for the periods 1996-1998 and 2004-2006 are given in Figures 12 and 13.

During the period 1996-1998, the strict correlation between outage duration and outage collective dose is difficult to establish, however, the following observations are noted:

- Finnish, Swiss and German plants having an average outage duration of 18-50 days present an average outage dose around 1 man·Sv/reactor;
- On the other hand, Swedish, US, Spanish and Japanese plants having an average collective dose around 2 man·Sv/reactor present an average outage duration from 34 to 104 days;
- Mexican plants, with a 57 days outage duration, have the highest average outage collective doses (around 4 man·Sv/reactor).

For the period 2004-2006, again a strict correlation between outage duration and outage collective dose is difficult to establish, although it is noted that:

- US, Mexican and Spanish plants having average outage durations of 30-60 days present an average outage collective dose around 2 man·Sv/reactor. This dose is in the same order of magnitude as that of Japanese plants, which however, present outage durations of more than 130 days on average;
- German, Swedish, Finnish and Swiss plants with outage durations between 15 and 30 days present an average outage collective dose around 0.8 man·Sv/reactor.

From these figures, and excluding the specific case of Japan, it can be seen that most plants with outage durations below 30 days present an average outage collective dose two times lower than plants with outage durations between 30 and 60 days.

Nevertheless, the comparison between the 1996-1998 and 2004-2006 data for the average outage duration shows, except for Spain and Japan, a decrease (about 50% decrease for Sweden). Moreover, with the exception of Japan and Finland, the average outage dose decreased during the period considered (50% lower for Mexican and Swedish plants).

Figure 11: Average outage dose (man·Sv/reactor) and average outage duration for BWR

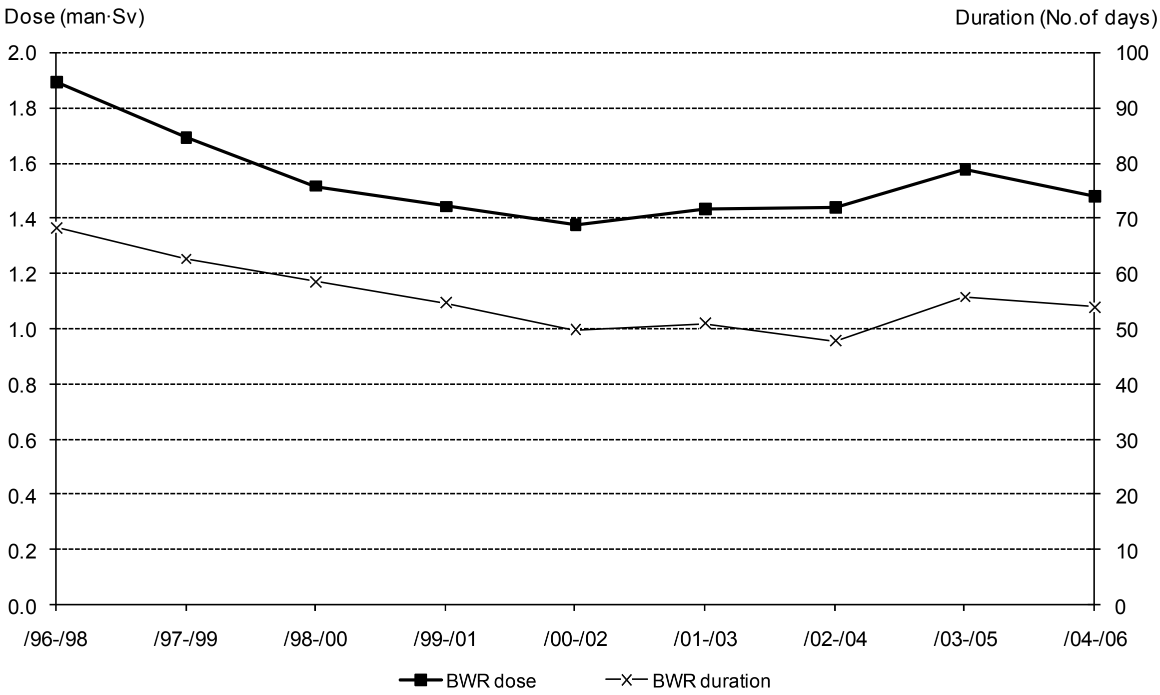
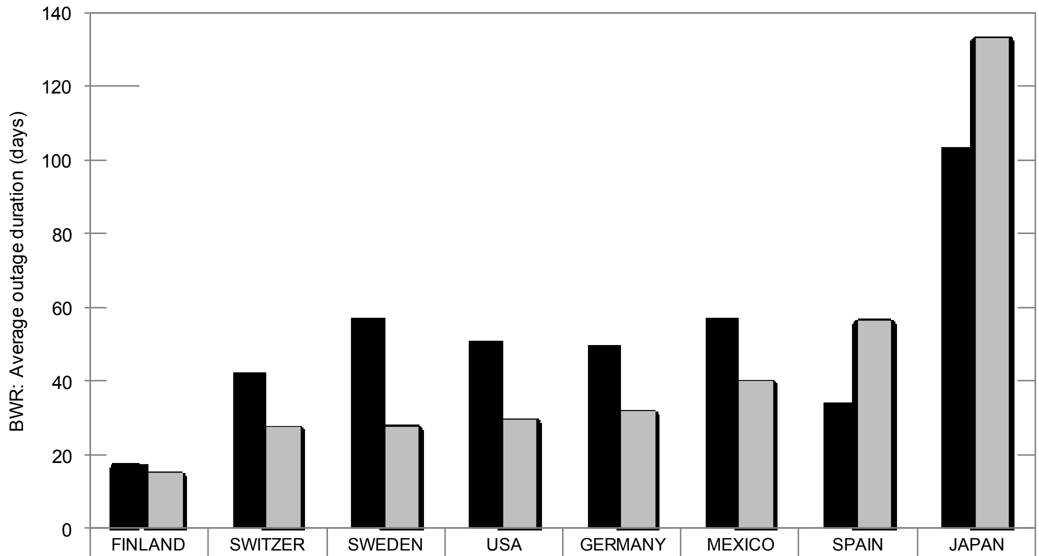
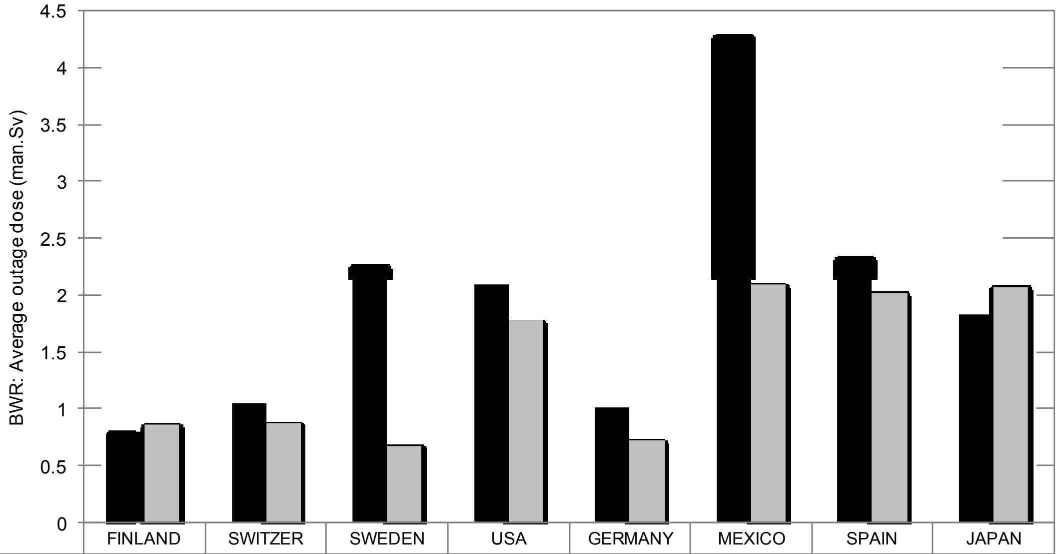


Figure 12: Average outage duration by country for BWR



	FINLAND	SWITZER	SWEDEN	USA	GERMANY	MEXICO	SPAIN	JAPAN
■Duration 1996-1998	18	43	57	51	50	57	34	104
■Duration 2004-2006	15	28	28	30	32	40	57	133

Figure 13: Average outage dose by country for BWR (man·Sv/reactor)



	FINLAND	SWITZER	SWEDEN	USA	GERMANY	MEXICO	SPAIN	JAPAN
■Dose 1996-1998	0.79	1.04	2.25	2.08	1.00	4.28	2.33	1.82
■Dose 2004-2006	0.86	0.87	0.67	1.77	0.72	2.08	2.02	2.07

PWR Evolution

As shown in Figure 14, there has been a regular decrease of both PWR outage dose and duration from 1996-1998 to 2004-2006, with a stabilisation of the outage duration at around 53 days since 2001-2003. However, the decrease of average outage collective dose from 1.3 to 0.9 man·Sv/reactor (30% decrease) is much higher that of average outage duration, which saw a decrease from 60 days to 53 days (12% decrease).

If the data per country are analysed, it appears that France, with an outage duration of about 60 days, represents about 40% of the total number of PWRs. Japan represents about 10% of the total reactors taken into account in this analysis, however, its outage duration of about 100 days is about 50% higher than those of the other countries considered.

The distributions of the PWR average outage duration and average outage doses by country for the periods 1996-1998 and 2004-2006 are shown in Figures 15 and 16.

For the period 2004-2006, a strict correlation between outage duration and outage dose is again difficult to establish, however it can be noted that countries with the lowest average outage collective dose (0.4 man·Sv/reactor for Belgium, Netherlands, Switzerland, Spain, United Kingdom) belong, with the exception of the United Kingdom, to the set of countries having the lowest outage duration (below 40 days). Conversely, Japan, with the longest average outage duration (> 100 days) has the highest average outage collective dose (1.3 man·Sv/reactor).

The comparison between the 1996-1998 and 2004-2006 data for the average outage duration shows, except for South Africa and Japan, a decrease (about 50% decrease for Brazil and about 70% decrease for Netherland). Moreover, except for China, the average outage dose decreased during the period considered (about 70% lower for Netherlands and Spain).

Figure 14: Average outage dose (man·Sv/reactor) and average outage duration for PWR

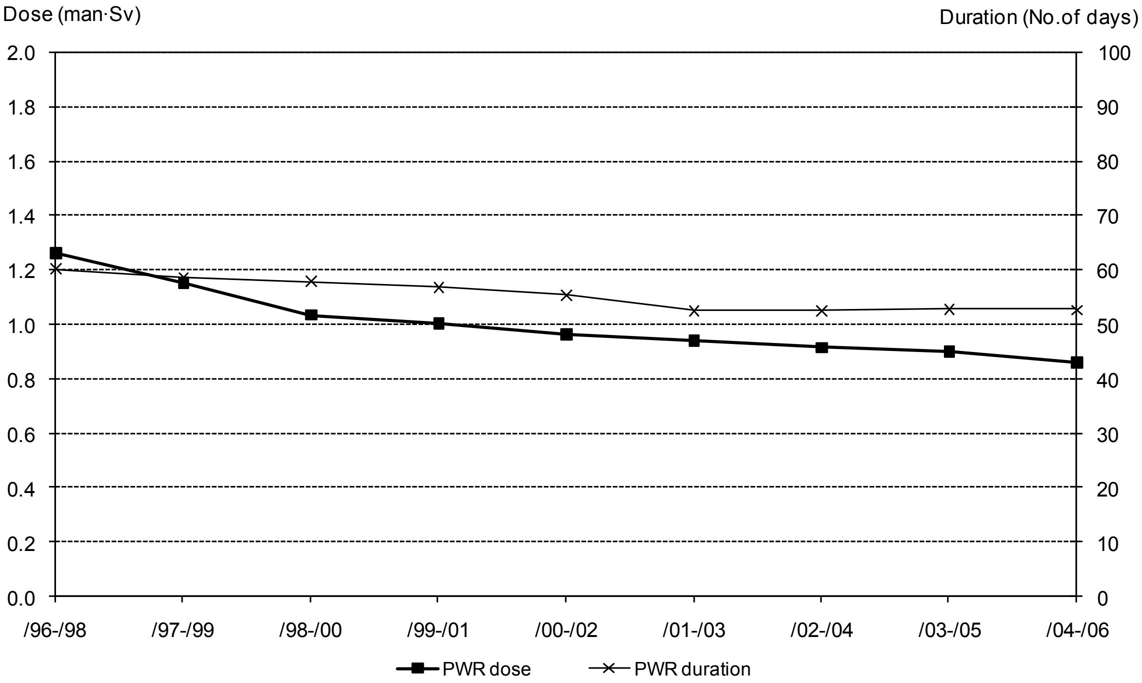
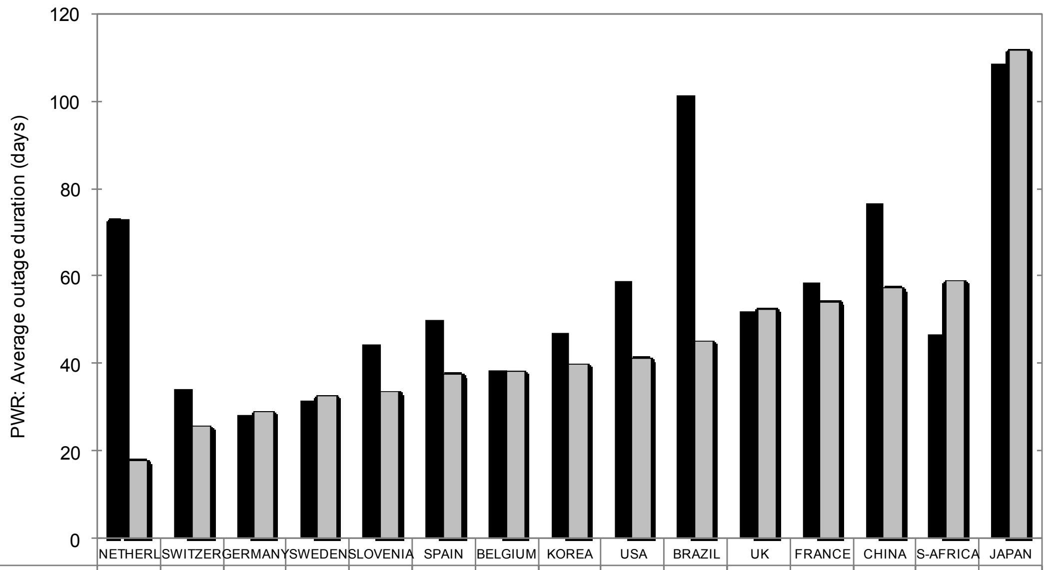
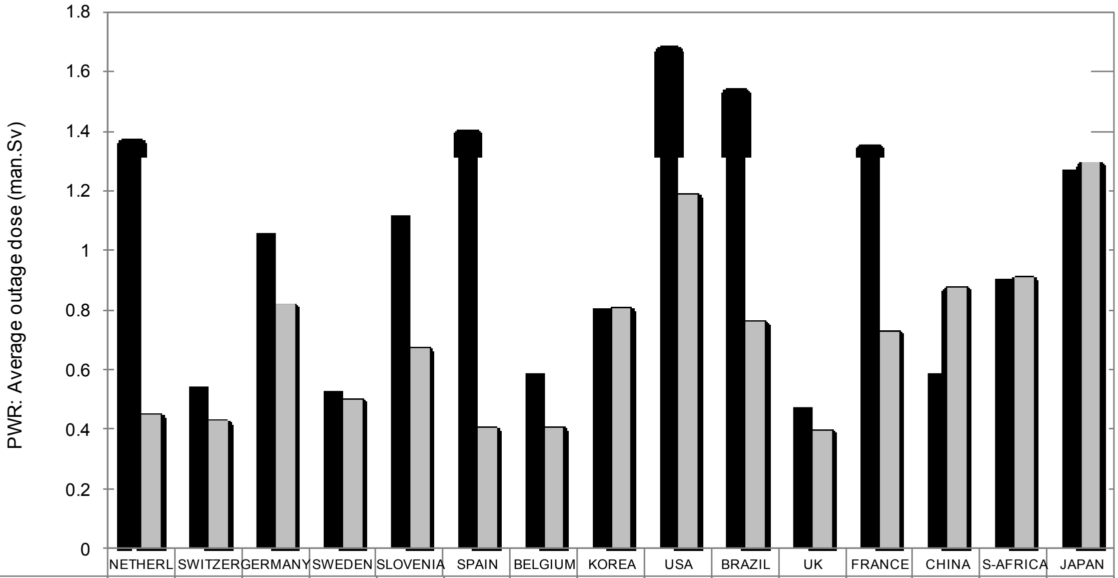


Figure 15: Average outage duration by country for PWR



	NETHERL	SWITZER	GERMANY	SWEDEN	SLOVENIA	SPAIN	BELGIUM	KOREA	USA	BRAZIL	UK	FRANCE	CHINA	S-AFRICA	JAPAN
Duration 1996-1998	73	34	28	32	44	50	38	47	59	101	52	59	77	47	109
Duration 2004-2006	18	26	29	33	34	38	38	40	41	45	53	54	57	59	112

Figure 16: Average outage dose (man·Sv/reactor) by country for PWR



	NETHERL	SWITZER	GERMANY	SWEDEN	SLOVENIA	SPAIN	BELGIUM	KOREA	USA	BRAZIL	UK	FRANCE	CHINA	S-AFRICA	JAPAN
■ Dose 1996-1998	1.37	0.54	1.06	0.53	1.12	1.40	0.59	0.81	1.68	1.54	0.48	1.35	0.59	0.91	1.27
■ Dose 2004-2006	0.45	0.43	0.82	0.50	0.67	0.41	0.41	0.81	1.19	0.76	0.40	0.73	0.88	0.91	1.29

VVER evolution

As shown in Figure 17 for VVERs, there is a regular decrease from 1996-1998 to 2004-2006 of both outage dose (from 0.7 to 0.4 man·Sv/reactor) and outage duration (from 66 days to 47 days). However, as for the PWRs, the decrease is higher in terms of average outage collective dose (43%) than for average outage duration (29%).

The analysis of the data per country reveals that the general trend depends mainly on Bulgaria and Armenian reactors. In these two countries (representing around 20% of the reactors considered), the average outage duration has been considerably reduced from about 90-100 days in the period 1996-1998 to 40-50 days on average in the period 2004-2006, which is comparable to the other countries.

The distributions of the VVER average outage duration and average outage doses by country for the periods 1996-1998 and 2004-2006 are shown in Figures 18 and 19.

The comparison between the 1996-1998 and 2004-2006 data for the average outage duration shows, except for Hungary, a decrease (about 50% decrease for Armenia and Bulgaria). Moreover, the average outage dose is decreasing during the period considered (about 60% lower for Slovak Republic and Armenia).

Figure 17: Average outage dose (man·Sv/reactor) and average outage duration for VVER

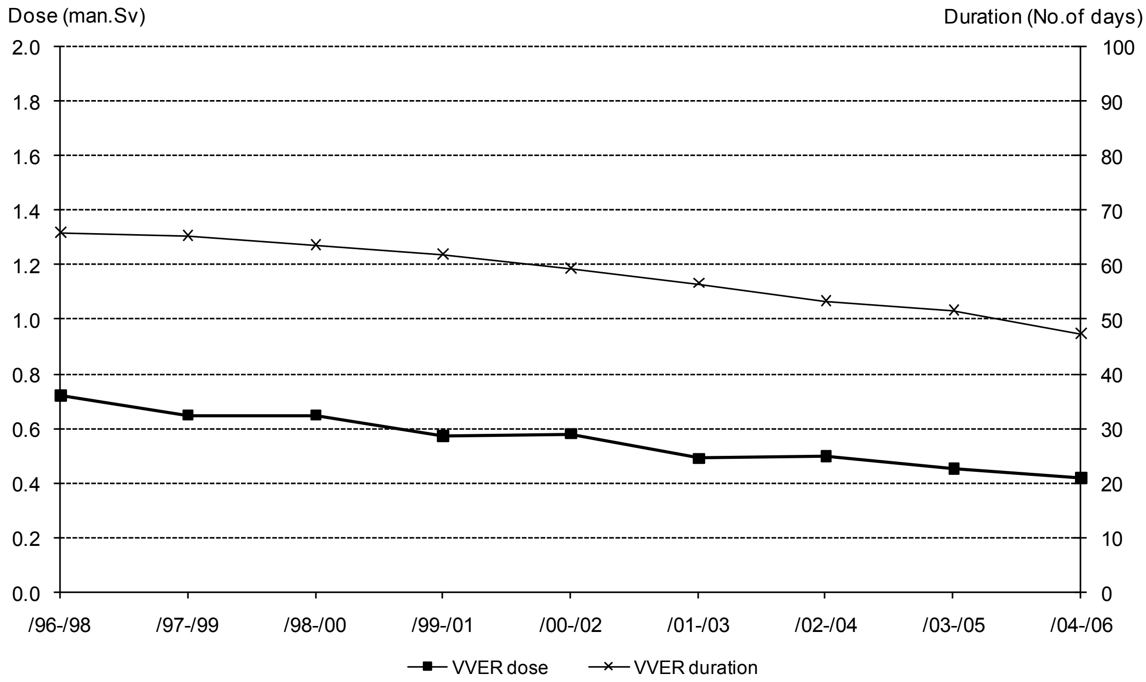
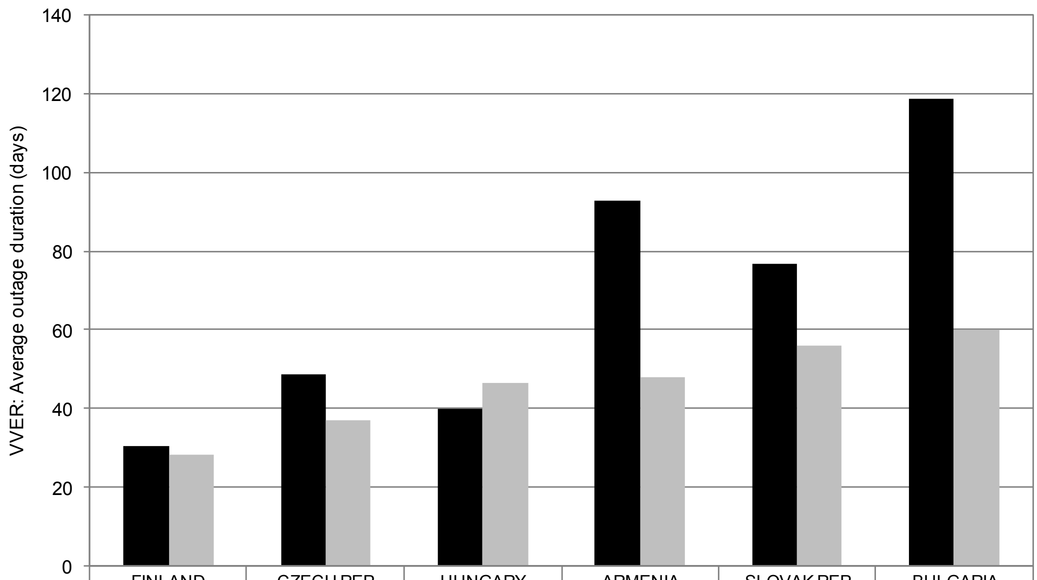
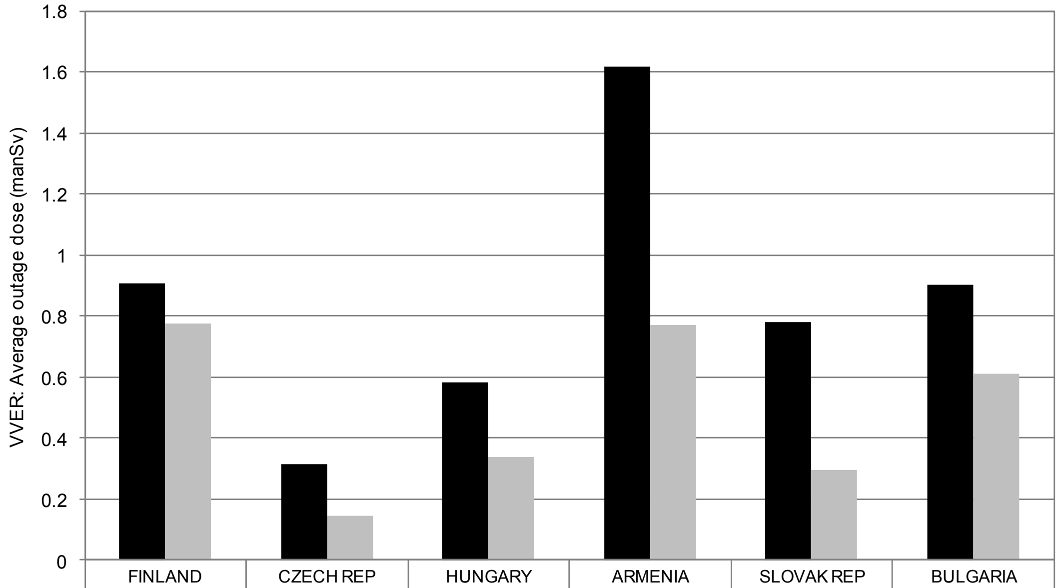


Figure 18: Average outage duration by country for VVER



	FINLAND	CZECH REP	HUNGARY	ARMENIA	SLOVAK REP	BULGARIA
■Duration 1996-1998	31	49	40	93	77	119
■Duration 2004-2006	28	37	47	48	56	60

Figure 19: Average outage dose (man·Sv/reactor) by country for VVER



	FINLAND	CZECH REP	HUNGARY	ARMENIA	SLOVAK REP	BULGARIA
Dose 1996-1998	0.91	0.31	0.58	1.62	0.78	0.90
Dose 2004-2006	0.78	0.14	0.34	0.77	0.30	0.61

Synthesis

In terms of the average outage duration from 1996-1998 to 2004-2006, the above trends show a decrease for all types of reactors. For the three reactors types (PWR, BWR, VVER) the outage duration is, on average, in the range of 50 days for 2004-2006 compared to around 65 days ten years earlier.

Reactor design plays a more important role in terms of outage collective dose. Even if the average outage collective dose has been decreasing for the three reactor types over the period considered, differences between reactor types are still important with, on average, outage collective doses for 2004-2006 of more than three times higher for BWRs (1.5 man·Sv/reactor) than for VVERs (0.4 man·Sv/reactor) and around two times higher than for PWRs (0.9 man·Sv/reactor). This confirms the fact that a strict correlation between outage duration and outage collective dose is difficult to demonstrate. However, within each reactor type category, it usually can be seen that the plants with the lowest outage duration are also those presenting low outage collective dose.

3. MAJOR EQUIPMENT EXPERIENCE

3.1 Steam generator replacements: Collective exposures

Since 1979, 86 steam generator replacements (SGR) have been performed, mainly in North-America and in Europe.

Figure 20 presents the evolution of the average collective dose per steam generator replaced since 1979. Figure 21 presents the average, minimum and maximum collective doses over the last fifteen years. SGR collective doses per steam generator replaced have been decreasing regularly, reaching about 0.3 man·Sv on average during the last four years. This average covers quite large variations and the best results correspond to two SGRs performed in 2007 (USA) and 2004 (Belgium) with 0.18 and 0.10 man·Sv per steam generator replaced, respectively.

Figure 20: Evolution of the average collective dose per steam generator replaced since 1979

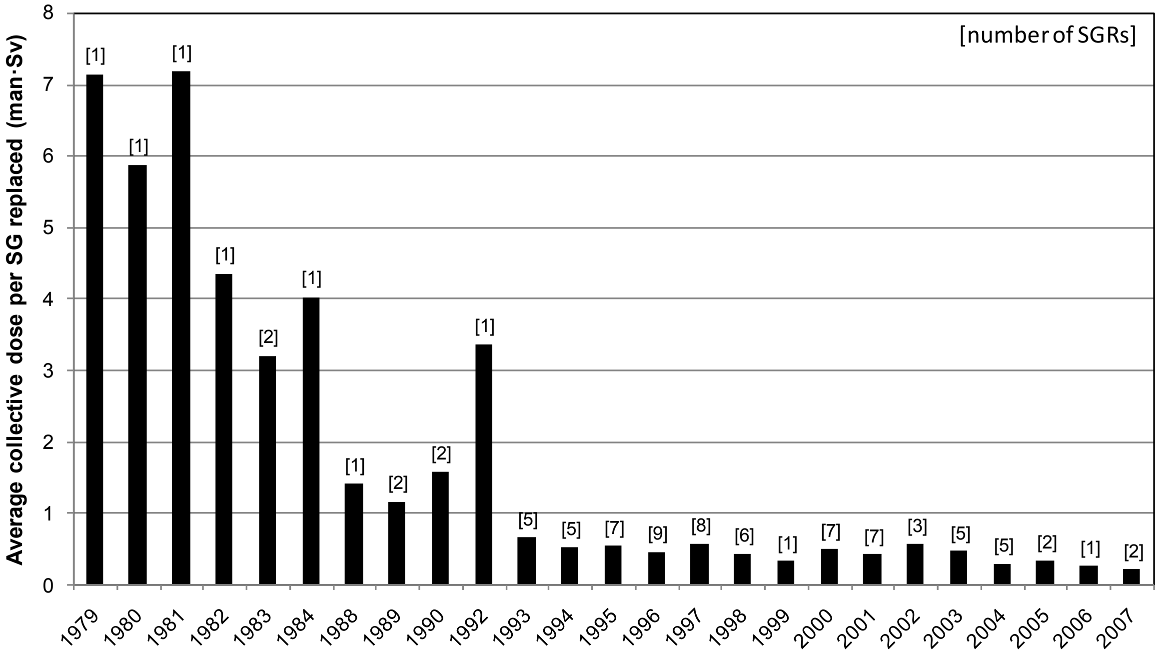
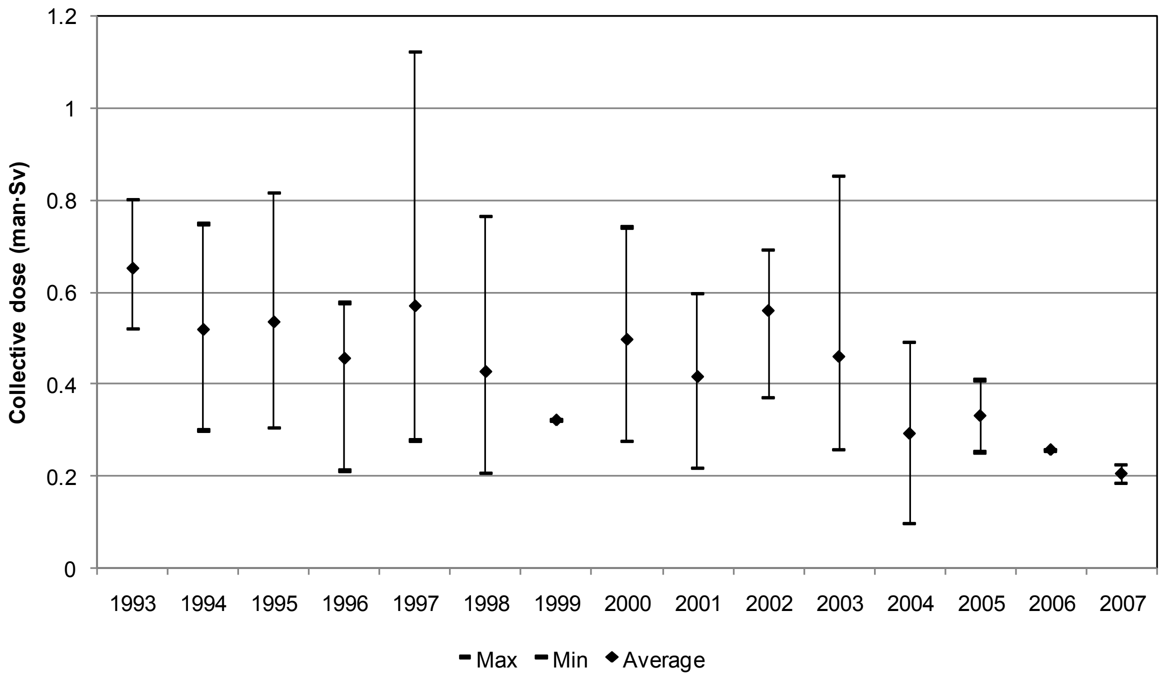


Figure 21: Average collective dose per steam generator replaced since 1993 (average, minimum and maximum dose)



4. ISOE EXPERIENCE EXCHANGE ACTIVITIES

While ISOE is well known for its occupational exposure data and analyses, the programme's strength comes from its objective to share such information broadly amongst its participants. The combination of ISOE symposia, ISOE Network and technical visits provides a means for radiation protection professionals to meet, share information and build links between ISOE regions to develop a global approach to occupational exposure management. This section provides information on the main information and experience exchange activities within ISOE during 2007.

4.1 ISOE ALARA Symposia

ISOE International ALARA Symposium

The NATC organised, in co-operation with EPRI, the 2007 ISOE International Symposium, held 15-17 January 2007 in Fort Lauderdale, USA and sponsored by the OECD/NEA and IAEA. ATC, ETC and the NEA Secretariat participated in this symposium. The symposium was attended by 100 participants from 14 countries. Three distinguished papers were selected by the participating technical centres for presentation at the 2008 ISOE International ALARA Symposium in Asia:

- Ohr, K., *Moving Beyond Time, Distance and Shielding: Developing the Concept of Organisational ALARA*, Quad Cities Generating Station/Exelon (USA).
- Bourne, C., *The Evolution of Remote Monitoring at Vogtle NPP*, Vogtle NPP (USA).
- Kochery, I., *Sustained Performance in Radiation Protection at Vogtle NPP*, Vogtle NPP (USA).

Proceedings and conclusions of the Symposium are available on the ISOE Network.

The 2008 and 2009 ISOE International ALARA Symposium will be organised by the ATC and IAEA respectively.

ISOE Regional ALARA Symposia

ATC, in collaboration with the KHNP and KINS (Korea), prepared and organised the 2007 ISOE Asian Regional ALARA Symposium, which was held 12-14 September 2007 in Seoul, Korea, with attendance of about 40 individuals from 4 countries. A technical visit to Ulchin Nuclear Power Station was held on 14 September 2007. The following awards were noted:

- Distinguished paper: Lee, G.J., *CCTV System for Radiation Work Management*, Yonggwang NPP/KHNP (Korea).
- Special award: Choi J.H., *Good Practice Results Report – Sizewell B Benchmarking*, Kori NPP/KHNP (Korea).

In 2008, two Regional Symposiums will be organised:

- ETC: 2008 ISOE European ALARA Symposium, 24-27 June 2008 in Turku, Finland, and

- NATC: 2008 ISOE North American ALARA Symposium, 13-16 January 2008 in Fort Lauderdale, USA.

4.2 The ISOE Network (www.isoe-network.net)

The ISOE Network is a comprehensive information exchange website on dose reduction and ALARA resources for ISOE members, providing rapid and integrated access to ISOE resources through a simple web browser interface. An enhanced version of the network was formally launched in 2006 with the objective to provide the ISOE membership with a "one-stop" web-based portal for ISOE information and experience exchange. The network, containing both public and members-only resources, provides ISOE members with access to a broad and growing range of ALARA resources, including ISOE publications, reports and symposia proceedings, web forums for real-time communications amongst participants, members address books, and online access to the ISOE occupational exposure database.

ALARA Library

The ALARA Library, one of the most used website features, provides ISOE members with a comprehensive catalogue of ISOE and ALARA resources to assist radiation protection professionals in the management of occupational exposures. The ALARA Library includes a broad range of general and technical publications, reports, presentations and proceedings. In 2007, the following products were made available:

- ISOE Annual Report 2005
- ISOE Annual Report 2006
- ISOE News No. 10
- Symposia Proceedings: Presentations and papers from the 2007 ISOE International ALARA Symposium (Fort Lauderdale, USA)
- Information Sheets :
  - The 2006 European preliminary dosimetric results, ETC (Oct. 2007).
  - Japanese dosimetric results and trends in FY 2006, ATC (Oct. 2007).
  - 2006 Korean dosimetric results, ATC (Nov. 2007).

ISOE occupational exposure database

In order to increase user access to the data within ISOE, the ISOE occupational exposure database, previously only available on CD-ROM as an annual update, is now available to members through the ISOE Network. Since 2005, the database statistical analysis module, known as MADRAS, has been available on the Network. Major categories of pre-defined analyses include:

- benchmarking at unit level;
- average annual collective dose per reactor;
- annual total collective dose;
- annual collective dose per TWh;
- contribution of outside personnel and outages to total collective dose;
- evolution[1] of the number of reactor units;

1. Trends or developments over time.

- 3-year rolling average for collective dose per reactor; and
- miscellaneous queries.

Outputs from these analyses are presented in graphical and tabular format, and can be printed or saved locally by the user for further use or reference.

The ISOE programme is also moving to further enhance database use through the development of data input modules to allow on-line entry and submission of the ISOE data questionnaires. It is expected that this will be implemented and operational in the 2008 timeframe.

RP Forum

While the ALARA Library presents a comprehensive resource for the user, if more specific information is needed, the user can also access the RP Forum to submit a question, comment or other information relating to occupational radiation protection that can be addressed by other users of the Network. In addition to a common user group for all members, the forum contains a dedicated regulators group, common utilities group, and several utilities sub-groups organised by reactor type: PWR, BWR or CANDU. All questions and answers entered in the RP Forum are searchable using the website search engine, increasing the potential audience of any entered information.

During 2007, the following requests were posted on the Network. For each request, a synthesis of all answers was prepared by ETC and made available on the RP Forum.

Date	Country	Title
Jan. 07	Sweden: Ringhals	Effects on source-terms and dose rates of increasing fuel cycle from 12 to 18 month
July 07	Sweden: Ringhals	Possibility of remove temporary shielding by operational staff without RP authorisation
Sept. 07	France: EDF	Renting of HP Equipment
Sept. 07	Sweden: SKB	Release of activity from transport casks
Sept. 07	Sweden: Forsmark	Quick screening for internal contamination
Oct. 07	U.K.: Sizewell B	Crud build-up liquid radwaste discharge tanks and pipes
Oct. 07	U.K.: Sizewell B	Management of electronic Dosimeter Dose Alarms

4.3 ISOE benchmarking visits

The ISOE programme has expanded into organising voluntary site benchmarking visits to facilitate the direct exchange of radiation protection practice and experience amongst the Participating Utilities in the 4 technical centre regions. These visits are organised at the request of a utility with the assistance of a technical centre(s), and included in programme of work for the coming year. The intent of such visits is to identify good radiation protection practices at the host plant in order to share such information directly with the visiting plant. While both the request for and hosting of such visits under ISOE are voluntary on the utilities and the technical centres, all post-visit reports are to be made available to the ISOE members (according to their status as utility or authority member) through the ISOE Network website in order to facilitate the broader distribution of this information to within ISOE. Highlights of visits conducted during 2007 are summarised below.

Benchmarking visits organised by ETC

NEI, INPO and EPRI (United States, April 2007)

In light of a large US project being elaborated by both the Nuclear Regulatory Commission and the nuclear industry organisations (NEI: Nuclear Energy Institute; INPO: Institute of Nuclear Power Operations; EPRI: Electric Power Research Institute) targeting the year 2020, the French utility EDF asked the ISOE European Technical Centre (CEPN) to organise a benchmarking visit in the United States to discuss potential methods of dose reduction as well as costs and effectiveness of possible actions. The first objective of this visit was therefore to review and discuss the components of the US 2020 Radiation Protection Policy.

The elaboration and implementation of the 2020 RP Policy relies mainly on three US nuclear industry organisations, NEI, INPO and EPRI which are funded by the energy companies and work in a very close relationship with them. This can be illustrated through two examples. It is interesting to note that the NEI, whose aim is to set overall nuclear energy industry policy and direction, works from a specific matrix team approach to resolve issues. When problems are raised, NEI implements specific Executive Working Groups composed of chief nuclear officers (CNO) and/or Task Forces made up of radiation protection managers (RPM) and senior technical staff. These groups work on general policy and strategy issues, and also advise and provide oversight on the activities of the Task Forces who deal with more technical and detailed regulatory matters and can develop input to policy, positions and action plans. Through this approach, global decisions are relayed by CNOs in a top-down approach as well as by RPMs in a more bottom-up manner. This process allows the nuclear industry to react quickly and efficiently when a problem arises. The other example deals with INPO's evaluations. One of INPO's missions is to conduct evaluations of all US nuclear power plants to assess their radiation protection performance and identify early signs of decline. As INPO is funded by energy companies, these evaluations can be regarded as a kind of self-assessment that allows a constant evaluation of radiation protection against standards of excellence and a continuous progress.

NEI, INPO and EPRI have launched a long-term radiation protection project to be implemented by 2020 (to encompass the period in which it is expected that the first nuclear power plants will be brought on line) whose main work areas are to:

- Assure that future RP workforce needs are met;
- Establish a stable, predictable safety-focused regulatory environment;
- Improve execution of RP fundamentals;
- Standardise RP practices;
- Reduce radiation dose/fields; and
- Improve RP technologies utilisation.

In a general way, EDF is facing and addressing the same topics and issues as the US nuclear industry, including for instance, radiation protection requirements for new plants and maintaining adequate human resources. In this framework, options for improved co-operation between the United States and France could be considered.

Paks NPP (Hungary, September 2007)

At the request of EDF, the ISOE ETC/CEPN organised in September 2007 a 4-day benchmarking visit to the Paks NPP in Hungary. The aim of the visit was to identify good practices in occupational radiation protection and provide these to both EDF and all other utilities through the ISOE Network. The visiting team was composed of the radiation protection manager of Paluel nuclear power plant in France and two representatives of the ISOE ETC/CEPN. In summary, the team identified several good practices that favour the good implementation of radiation protection at Paks NPP, specifically:

- the network of so-called nominated workers;
- the education and training programme, in particular the training centre;
- the PASSPORT information system; and
- the organisation of the chemistry department.

The nominated workers are not RP staff who have received special RP training. Rather, they come from different departments in the plant or from contractor firms. They are the main correspondents of the Radiation Protection Section in their departments and have special duties in radiological protection. The group of the nominated workers can be considered as a real and efficient radiological protection network within the plant. This network favours the diffusion of radiation protection culture into the different departments as well as the communication and the exchange of feedback experience between them. Moreover, the nominated workers provide an important contribution towards optimising radiation protection when preparing their technical activities.

The education and training programme set up by the Training Department seems globally effective and adapted to the reality of Paks NPP issues. The training centre, equipped with scale-one (life-size) mock-ups of nearly all materials, provides excellent training conditions for operators in the preparation of important new tasks (for example, the change of steam generator feed pipes).

Paks NPP has introduced the PASSPORT information software system, which appears to be very effective for the preparation of outages and is well accepted in the plant. The PASSPORT System is used to plan the maintenance activities, prepare the jobs and radiation work permits, and track the dosimetry. In particular, the fact that both the maintenance planning and the corresponding dose planning can be prepared using of the system favours the preparation of the outages.

Finally, the chemistry department employs several chemical engineers which allows an effective brainstorming on source term management. Moreover, even if the chemistry and radiation protection personnel are not in the same department, the Radiation Protection Section is very sensitive to the importance of the source term due to the fact that most of the engineers of the section are chemists.

Benchmarking visits organised by ATC

ATC participated in a benchmarking visit to France and Finland which was organised by the Nuclear Safety Research Association (NSRA) in Japan under the commissioned research project from the Japanese government, Nuclear and Industrial Safety Agency of METI. The project aims to identify differences in exposure situations between Japan and other countries. The main purpose of the visit was to investigate the ALARA approach of the regulatory bodies in France and Finland, and to contribute to the future exposure reduction strategy in Japan. This involved visits to the French nuclear safety authority, ASN, as well as CEPN and EDF in France, and the Finnish nuclear safety authority, STUK, in Finland. The visiting team was composed of representatives of utilities, contractors, NSRA and the ISOE ATC/JNES. In this visit, the co-operation of the ISOE ETC and the ISOE members in Finland contributed to the successful outcomes. The visit identified the following differences in approaches:

- In France and Finland, the regulation of exposures in all fields, including medical treatment and RI facilities, is performed by one organisation (ASN in France and STUK in Finland). In Japan, nuclear installations, medical treatment and RI facilities are regulated by separate regulatory bodies.
- In France and Finland, the spirit of ALARA is written in the law, and government ordinances and guideline provide for its practical implementaiton. In Japan, only the "Regulation Concerning Prevention from Radiation Hazards due to Ionizing Radiation" provides for the ALARA spirit.
- The many radiation protection specialists employed in the French and Finnish regulatory bodies (ASN: 60 persons; STUK: 5 persons) carefully check from the ALARA perspective the radiation work in each stage of planning, execution and assessment. In Japan, the regulatory body for nuclear installations does not have inspectors working full-time in radiation protection. Inspectors for Safety Management of Nuclear Installations, who are stationed at nuclear installations throughout the country, perform radiation protection inspections as part of the overall nuclear safety activity.

4.4 Other information exchange activities

In addition to the activites described above, other information provided by the technical centres to ISOE participants included the following:

- IAEA: Information on how to access the IAEA Power Reactor Information System (PRIS);
- NATC:
  - Provided response to South Texas request for non-outage dose data for PWRs including sister plant comparisons from 1995 to 2005.
  - Collected information on US RP software modules for a European nuclear utility.
  - Preliminary report on US PWR CRUD burst remote monitoring techniques and layout to provide plant piping dose trends during first 72 hours of PWR shutdowns.

New technical centre documents and reports

ATC completed development of an ISOE handbook, based on the ISOE annual reports, database and other products, which describes the ISOE organisation, dose trends analysis, and the worldwide regulations on ALARA. The goal of this work is to demonstrate the use of ISOEDAT to Japanese utilities to improve ISOE usage, and motivate users towards continued dose reduction.

5. ISOE PROGRAMME MANAGEMENT ACTIVITIES FOR 2007

In 2007, the ISOE programme continued to focus on the collection and analysis of occupational exposure data and on the effective exchange of operational radiation protection information and experience, including enhanced inter-regional co-operation and co-ordination. This was facilitated through the ISOE ALARA Symposia, ISOE Network website and ISOE-organised benchmarking visits (see Section 4 for details). These initiatives have continued to position the ISOE programme to better address the operational needs of its end users (radiation protection professionals) in the area of occupational radiation protection and ALARA practices at nuclear power plants.

5.1 Renewal of ISOE Terms and Conditions for 2008-2011

During 2006 and 2007, the ISOE Working Group on Strategic Planning (WGSP) undertook a programme review, in preparation for the renewal of the ISOE Terms and Conditions for the period 2008-2011. At its 17th annual meeting in November 2007, the ISOE Steering Group re-approved the ISOE Terms and Conditions for an additional four-year period, for which the main text and appendices were updated to better reflect operational and organisational practices within ISOE. All current participants were requested to confirm their continued participation under the ISOE Terms and Conditions for 2008-2011.

5.2 Management of the official ISOE databases

Official database release: ETC continued to manage the official ISOE database, preparing and distributing in December 2006 and January 2007 the CD-ROM version of the database under ACCESS with 2005 data directly to European participants, and to the other technical centres for distribution to their regional members. Copies were also distributed to some US participating utilities during the 2007 ISOE International ALARA Symposium (USA). The first release of the ISOEDAT database with data from 1969 to 2006 (partial) was made available in July 2007 through the ISOE Network, followed by regular updates on the Network. The end-of-year release of the database and ISOE Software on CD-ROM was distributed to all Official Participants following the annual ISOE Steering Group meeting.

Development of ISOEDAT online: The WGDA ISOEDAT-Web Working Group, with NEA resources/lead development and ETC assistance, continued development of the web-enabled data input modules as part of the ISOEDAT web migration project, Phase 2.

Use of the ISOE 3 reporting system: The use of the ISOE 3 reporting system continued to be low throughout 2007. At its 2006 annual meeting, the Steering Group agreed to strategically address the objective of the ISOE 3 reporting system through better use the ISOE Network. The focus will be on enhancing the exchange of radiation protection information and experience through the effective use of the ISOE Network resources. In 2007, all ISOE 3 reports were migrated to the ISOE Network ALARA Library.

5.3 Management of the ISOE Network

The ISOE Network, formally launched in early 2006, serves as the central portal for ISOE-related information and resources (including the ISOE database). The ISOE Network was developed by ETC and NEA and is managed by ETC. The Network was promoted throughout 2007 by various means including the ISOE Newsletter, Symposia, User Survey, National Co-ordinators and the ISOE Annual Report. Following direction of the Steering Group, and initiative was launched in 2007 to review the layout of the website with a view towards improving its operational usefulness for ISOE members.

At the end of 2007, about 407 utility and 67 regulatory member accounts had been created. National Co-ordinators have been requested to validate the user information for their countries. This task was still pending completion at the end of 2007.

5.4 ISOE management and programme activities

As part of the overall operations of the ISOE programme, ongoing technical and management meetings were held throughout 2007, including:

Meeting	Date
Working Group on Data Analysis	May 2007; Nov. 2007
• Expert Group on Work Management	March 2007; May 2007; Sept. 2007; Dec. 2007
• Task Team on Decommissioning	May 2007
• ISOEDAT-web Working Group	ongoing ad-hoc meetings between NEA and ETC
ISOE Bureau	May 2007; Nov. 2007
Technical Centres	Nov. 2007
17th ISOE Steering Group Meeting	Nov. 2007

ISOE Steering Group and ISOE Bureau

The ISOE Steering Group continued to focus on the management of the ISOE programme, reviewing the progress of the programme at its annual meeting 2007, approving the programme of work for 2008 as well as the new ISOE Terms and Conditions for the period 2008-2011. Under the new terms, the Steering Group will be formally referred to as the ISOE Management Board. The Steering Group also approved the ongoing development of the web-based data input modules, and a proposal for the redesign of the ISOE Network to better address user needs.

The mid-year meeting of the ISOE Bureau focussed on the status of ISOE activities, the new ISOE Terms and Conditions, and planning for the ISOE Annual Session 2007. The Bureau approved a new quarterly reporting template for the technical centres, based on a 4 mandatory tasks and 5 optional tasks that are subject to prioritisation and completion of mandatory tasks. The organisation of the ISOE Achievements Report and Programme of Work reflects these tasks.

ISOE Working Group on Data Analysis

The Working Group on Data Analysis (WGDA) continued its cycle of semi-annual meetings in order to more proactively address issues and develop technical products of use to the ISOE membership. The WGDA continued work on a series of short and medium term tasks identified in 2006, focussing largely on the integrity and consistency of the ISOE database and dataset. In this regard, the WGDA recommended that countries include as part of their normal data submission information on RWP man-hrs from Table B. The WGDA also reviewed the structure and content of the 16th ISOE Annual Report 2006 and made recommendations for several types of analyses to be included. Finally, a new position of WGDA vice-chair was created.

ISOEDAT-web Working Group: The ISOEDAT-web working group continued work on the ISOEDAT web migration project, Phase 2, focussing on the development of online data input modules, with a projected completion date of late 2007/early 2008.

Task Team on Decommissioning: This task team continued its work to improve data collection, analyses and benchmarking for reactors undergoing decommissioning, with the aim to prepare a proposal for consideration by the ISOE Steering Group in 2008.

Expert Group on Work Management: Under the auspices of the WGDA, the EGWM meet three times during 2007 to develop an update to the 1997 report on "Work Management in the Nuclear Power Industry", taking into account new experience and technology in occupational radiation dose reduction, and 15 years of information exchange under the ISOE programme. The group intends to have a final report by mid-2008.

Meeting of Technical Centres

In order to improve the co-ordination between the technical centres, harmonise practices and solve technical problems, the Technical Centre have agreed to regular meetings to look at co-ordination and operational issues.

6. PRINCIPAL EVENTS OF 2007 IN ISOE PARTICIPATING COUNTRIES

As with any summary data, the information presented in Section 2 above provides only a broad overview and graphical presentation of average numerical results from the year 2007. 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 2007 and which may have influenced the occupational exposure trends. These are presented as reported by the individual countries[1]. It is noted that the national reports contained in this section may include dose data arising from a mix of operational and/or official dosimetry systems.

BRAZIL

Dose information

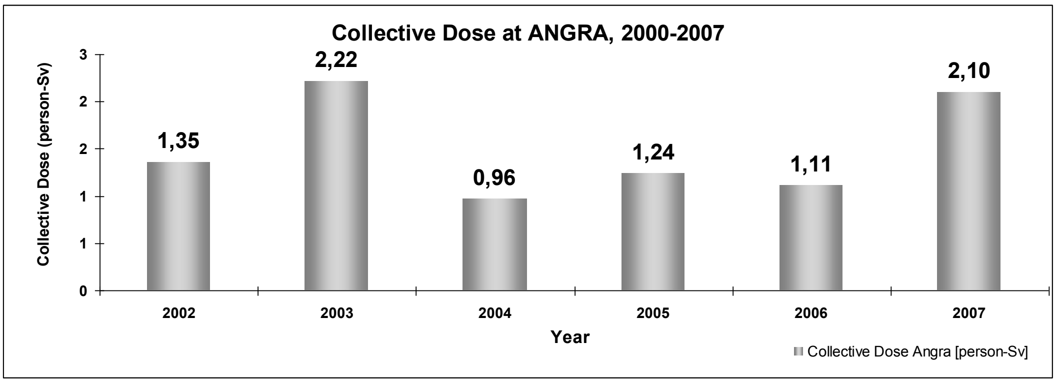
Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	2	1.05

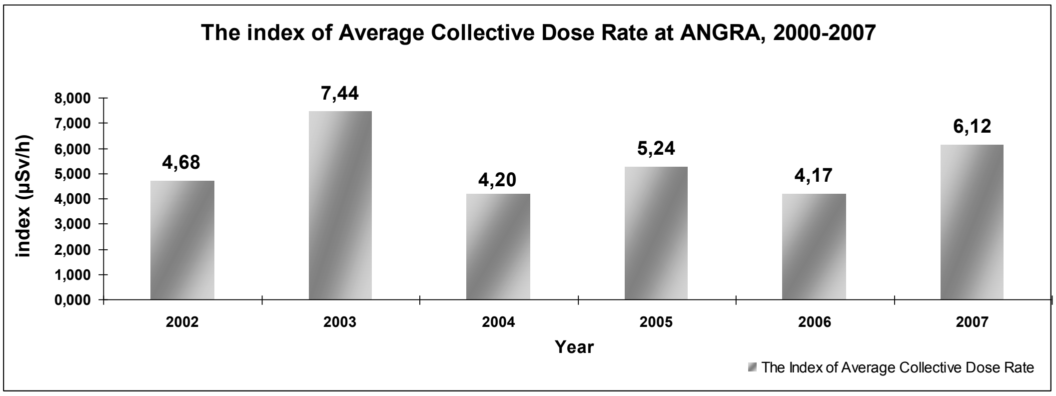
Principal events

Summary of national dosimetric trends

The total collective dose (CD) at Angra in 2007 was 2.10 person·Sv (Unit 1: 1.83 person·Sv; Unit 2: 0.27 person·Sv). The total number of exposed radiation workers was 3576 (Unit 1: 1914; Unit 2: 1662).

1. Due to various national reporting approaches, dose units used by each country have not been standardised.





Events influencing dosimetric trends

The main contributions to the collective dose (CD) at Angra were 3 planned refuelling outages. The highest radiation risk activities were replacement of the core fuel assemblies (fuel handling) and steam generator Eddy Current inspections.

Number and duration of outages

- 1P14a: 52 days (standard maintenance outage with refuelling)
- 1P15: 63 days (standard maintenance outage with refuelling)
- 2P5: 37 days (standard maintenance outage with refuelling)

Unexpected events

- Angra 1:
  - Foreign Material inside primary System, causing fuel failures.
  - Burned a reactor coolant pump motor.
- Angra 2:
  - Damage of two reactor coolant pump.
  - A Flange of the reactor vent line system leak during plant start up after refuelling.

Issues of concern in 2008

- Refuelling outage 16th cycle (Unit 1)
- Refuelling outage 6th cycle (Unit 2)

Technical plans for major work in 2008

- Setup of Teledosimetry;
- Install new Vehicles Portal Monitor;
- Steam Generator Replacement at Angra 1.

BULGARIA

Dose information

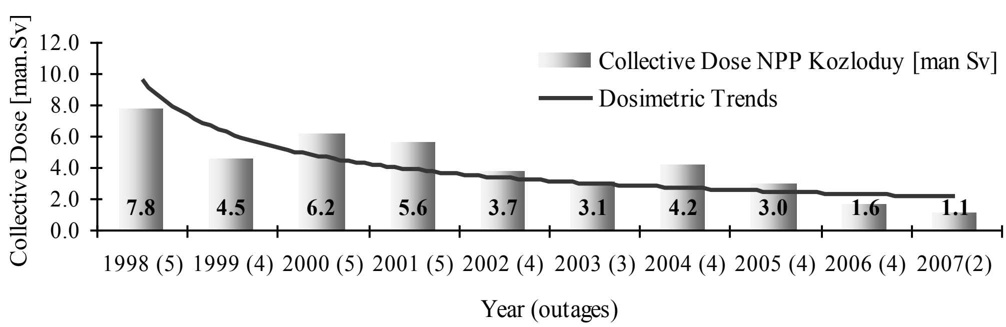
Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
VVER-1000	2	0.41
Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
VVER-440	2	0.06

Principal events

Summary of national dosimetric trends

The total collective dose (CD) at NPP Kozloduy in 2007 was 1.06 man·Sv (for utility employees 0.83 man·Sv, and for contractors' employees 0.23 man·Sv). The average individual effective dose was 0.33 mSv, and the maximum individual effective dose was 8.57 mSv.

Collective Dose (CD) at NPP Kozloduy, 1998-2007



Number and duration of outages

Unit No.	Outage information	Number of outages
Unit 5	59 d	for refuelling, maintenance and some modernisation activities
Unit 6	49 d	for refuelling, maintenance and some modernisation activities

New plants on line/plants shut down:

Cold shutdown of units 3 and 4.

Organisational evolutions

Reduction of the plant personnel by ≈ 10 %.

Technical plans for major work in 2008

Some dismantling works on units 1 and 2.

Regulatory plans for major work in 2008

Preparing activities for decommissioning of units 1 and 2.

CANADA

Dose Information

	Ontario Power Generation			**Bruce Power**	
	Pickering A (1-4)	Pickering B (5-8)	Darlington (1-4)	Bruce A (1-4)	Bruce B (5-8)
	(p-mSv)			(p-mSv)	
Total W.B. Dose	2148	3724	4107	4684.19	4238.29
Internal Dose (W.B)	468	752	343	749.50	408.06
Maintenance (Planned & Forced Outage), Tot. WB dose	1757	2815	3764	4272.01	3722.21
	Pickering (A&B)		Darlington	Bruce (A&B)	
Individual dose distributions:	# individuals			# individuals	
0-5.00 mSv	2451		1668	8370	
5.01-10.00 mSv	202		151	559	
10.01-15.00 mSv	38		49	171	
15.01-20.00 mSv	8		1	12	
> 20.0 mSv	0		0	1	
Number of people badged	7521		5243	9113	
Number of people exposed	2699		1635	2727	

	New Brunswick Power	
External and internal site dose	External (mSv)	Internal (mSv)
	596.4	67.9
	Total: 664.3 mSv	

Maintenance dose by unit and dates of outage:		
Planned outage: 6-30 April	493	31
Unplanned outages: 24 September-11 October	11.8	5.3
16-19 November	1.9	1.1
2-5 December	2.6	1.3
Individual dose distribution	# individuals	
0 mSv	1305	
< 5 mSv	772	
< 10 mSv	22	
>= 10 mSv	0	
Number of people badged	2099	

Summary of national dosimetric trends

Ontario Power Generation

Pickering-A (Unit 1-4): Year end CRE (WB) performance was better than target (537 mSv/unit (53.7 rem/unit) versus 787.6 mSv/unit (78.76 rem/unit) target). Internal dose performance was also better than the annual target (117 mSv/unit (11.7 rem/unit) versus 184.0 mSv/unit (18.40 rem/unit) target). With respect to external dose performance, better than planned performance can be attributed to improvements in work planning and oversight by RP. With respect to internal dose performance, the Pickering-A Tritium Reduction Team has been successful in lowering tritium emissions through a comprehensive strategy which included: improvements to ventilation system management (damper positioning, dryer performance); improved oversight and follow up of tritium related events; and improvements to leak management. In addition, Pickering-A received a new 2250 cfm "portable" dryer for use during outages. This will be mobilised in 2008 for P841.

Pickering B (Unit 5-8): The CRE by the end of December was 84% of the target 931 mSv/unit (93.1 rem/unit) vs a target of 1 108 mSv (110.8 rem). The dose incurred was from IOP. Actual dose was revised to include the QDP dose which was calculated after the EPR due date. The actual CRE (WB) performance was due to initiatives and good RP work practices utilised in the P761 outage. These initiatives include the use of reactor face shield caps, zone coverage using tele-dosimetry, and use of sub-micron filters in the HT system. As a result, the dose rates at the reactor face, bases of boilers and other system components are observed lower than previous outages. The CIRE (internal dose) performance by the end of December was 188 mSv/unit (18.8 rem/unit) vs a target of 212 mSv/unit (21.2 rem/unit), 88% of the target. The dose incurred was from P761 outage & IOP work.

Darlington (Unit 1-4): YE station total CRE (WB) was 4107 mSv (410.7 rem; 102.7 rem/unit), worse than the target of 3 760 mSv (376 rem; 94 rem/unit). The main contributors were the forced outages D731/D743/D711 and the planned outage D721. Station YE internal dose (CIRE) performance was better than target (88.5 mSv/unit (8.85 rem/unit) versus the target of 100 mSv/unit (10 rem/unit)) due the good use of RPPE by workers, supplemental vault drying provided by portable dryers, tightening of leaking closure plugs and scheduling reactor vault work to minimise internal dose.

Bruce Power

Bruce Power has significantly increased the scope of the outage work programs. Life extension of Units 3 and 4 has necessitated increased 2007 outage scope for feeder and boiler inspections, as well as a feeder replacement and the inclusion of a West Shift program for Unit 3. Concerns over feeder thinning also increased the scope of feeder inspections in the Unit 6 outage in 2007. There was also a pressure tube removal in the Unit 6 outage in 2007.

Radiation hazard levels have been increasing at Bruce B. Recent analysis indicates that an important fraction of this increase is associated with fuelling system modifications such as the core-conversion program and the introduction of fuelling-with- flow. Modifications to fuelling operation sequence and fuel carrier design is expected to mitigate further introduction of cobalt to the PHT system.

Improvements have been made to the teledosimetry system, allowing broader use and improving system reliability.

Boiler I/D cleaning, which is part of the source term removal program, was performed in the Unit 6 outage and resulted in a dose rate reduction of 75% in the steam generators tube bundle area.

Improvement in the dryer performance and availability, and introduction of supplementary Munters dryers has resulted in an average containment concentration of tritium during outages which are approximately 50% of historical outage values.

New Brunswick Power

ALARA highlights for 2007 included: the lowest station dose since 1991; the first time in station operation that no worker received more than 10 mSv; and the internal dose from tritium was half the already low average of previous years. Reasons for these successes included:

- increased awareness of ALARA among station personnel through training and focus on work group dose targets
- implementation of Radiation Exposure Permits
- increased priority on repairing heavy water leaks
- only one feeder required replacement during the planned outage (50 mSv)

CHINA

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	5	

Principal events

Qinshan 1

Summary of national dosimetric trends

For Qinshan 1 NPP, the annual collective dose for the year 2007 was 1,007.69 man·mSv, or 0.455 man·Sv/TWh.

Events influencing dosimetric trends

The duration of 10th refuelling outage in Qinshan 1 NPP was 77 days with the collective dose of 1007.44 man·mSv. 59 days with 949.95 man·mSv are counted in the year of 2007 and the others are counted in the year of 2008. The dose rate in primary circuit was increased by 30% because of the cladding fault of Sb-Be neutron source. The Reactor Pressure Vessel Head was replaced in 2007 with the collective dose about 155 man·mSv.

Number and duration of outages

	10th refuelling outage
Time	1
Duration	From 28 Oct. 2007 - 12 Jan. 2008. Duration: 77 days

Component or system replacements

Reactor Pressure Vessel Head was replaced.

Technical plans for major work in 2008

For the purpose of reduction the collective dose received during refuelling outage, some ALARA measures are taken or under planned in the coming year.

CZECH REPUBLIC

The evaluation of summary of dosimetric trends expressed in CED is based on the values obtained from film dosimetry. The values of personal doses during outages were overtaken from electronic personal dosimetry system.

Dukovany NPP

Summary of dosimetric trends

There are four units of PWR-440 type 213 in commercial operation since 1985. The collective effective dose (CED) during the year 2007 was 0.609 man·Sv. CED was 0.034 man·Sv and 0.575 man·Sv for utility and contractors employees, respectively. The total number of exposed workers was 1 801 (572 utility employees; 1 229 contractors). The average annual collective dose per unit was 0.152 man·Sv. The CED for 2007 has been the second lowest value during the whole time of Dukovany NPP operation.

The maximal individual effective dose 11.71 mSv was reached by contractors worker carrying out insulation works during outages.

Number and duration of outages

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

	Outage information	CED [man·Sv]
Unit 1	63 days, standard maintenance outage with refuelling	0.269
Unit 2	32 days, standard maintenance outage with refuelling	0.084
Unit 3	29 days, standard maintenance outage with refuelling	0.157
Unit 4	29.5 days, standard maintenance outage with refuelling	0.129

Major evolutions

The actual collective dose at all outages in 2007 has been the fifth lowest during the last ten years. Very low values of outages and total effective doses represents results of good primary chemistry water regime, well organised radiation protection structure and strictly implementation of ALARA principles during the working activities related to the works with high radiation risk.

Temelín NPP

Summary of dosimetric trends

There are two units of PWR 1 000 MWe type V320 in commercial operation since 2004. The collective effective dose (CED) during the year 2007 was 0.264 man·Sv. The CED was 0.040 man·Sv and 0.224 man·Sv for utility and contractors employees, respectively. The total number of exposed workers was 1 521 (503 utility employees; 1 018 contractors). The average annual collective dose per unit was 0.132 man·Sv. The CED for 2007 is almost the same as in 2006, although there were three outages in 2007 (in 2006 only two outages).

The maximal individual effective dose of 6.38 mSv was received by contract workers carrying out reactor dismantling and reassembly.

Number and duration of outages

The main contributions to the values of collective effective dose were 3 planned outages.

	Outage information	CED [man·Sv]
Unit 1 (1^{st})	78 days, standard maintenance outage with refuelling	0.104
Unit 1 (2^{nd})	55 days, standard maintenance outage with refuelling	0.069
Unit 2	68 days, standard maintenance outage with refuelling	0.104

Major evolutions

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

Issues of concern in 2008

In Czech Republic an initiative was started by the ČEZ, a.s. to promote the use of electronic personal dose meters as official dose meters. Czech regulatory body stipulates technical requirements and different conditions, under which such an electronic dosimetry system may be operated.

FINLAND

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
BWR Olkiluoto	2	0.590
VVER Loviisa	2	0.360

Principal events

Summary of national dosimetric trends

Dose trends at Finnish NPPs [man·Sv]

	2007	2006	2005	2004	2003
Olkiluoto 1 (BWR)	0.259	1.875	0.456	1.062	0.274
Olkiluoto 2 (BWR)	0.921	0.326	1.830	0.452	0.758
Average	0.590	1.1005	1.143	0.757	0.516
Loviisa 1 (VVER-440)	0.406	0.682	0.468	2.003	0.609
Loviisa 2 (VVER-440)	0.313	0.980	0.343	0.489	0.332
Average	0.360	0.831	0.406	1.246	0.471

Events Influencing Dosimetric Trends 2007

Olkiluoto

At Olkiluoto 2 (OL2) the 2007 outage was a maintenance outage and at Olkiluoto 1 (OL1) a refuelling outage. In 2007 OL1 outage lasted 8 days and OL2 17 days. The collective dose of the OL1/OL2 outage period was 1.031 man·Sv. Main outage tasks included:

- Cleaning of turbine plant, OL1

- Replacements of valves (321 V4), OL2
- Replacement of generator rotor, OL2
- Pipe system replacements of condensate lines, OL2

During OL2 outage two unforeseen events took place at the turbine plant. At turbine bearing 2 an oil leak was detected and next to the HP turbine a small fire took place.

Loviisa

On both units outages were short refuelling outages. Durations were 19 days 20 hours (LO1) and 14 days 21 hours (LO2). During short refuelling outages no significant maintenance work is usually performed. Thus, LO1 outage ended up with a collective dose 0.373 man·Sv and LO2 0.283 man·Sv. On both units outage and annual collective doses were the lowest in operating history. In view of individual doses insulation work on primary components was the most significant task. The highest individual dose was 9.24 mSv.

Events Influencing Dosimetric Trends 2008

Olkiluoto

In 2008 maintenance outage will be done at OL1 unit and refuelling outage at OL2. Estimated outage durations are 15 days for OL1 and 7 days for OL2. Steam dryers of both reactors (OL1/OL2) have been replaced. Therefore the general levels of dose rates are expected to decrease at turbine plants.

Loviisa

In 2008 at unit 1 planned outage type is extended inspection outage (39 days) where some major maintenance work will be performed on reactor components. On RPV head control rod drive mechanism nozzles will be repaired and on reactor internals defective locking bolts of the core basket baffle plate will be changed. At unit 2 the planned outage type is a normal maintenance outage (22 days). Renewal of plant I&C systems will continue as planned.

A new 10-year risk-informed in-service inspection program will be implemented starting 2008. Consequently doses of inspection work are expected to decrease compared to the previous 10-year period.

Other issues in Olkiluoto

TVO is building a new EPR nuclear power plant Olkiluoto 3 (OL3). OL3 is a pressurised water reactor ca. 1,600 MWe. Commercial operation of the new unit is planned to start 2011.

Regulatory plans for major work in 2008.

Periodic safety reviews of the Loviisa plant were carried out in 2005-2007 in connection of relicensing. The periodic review will be completed at the Olkiluoto plant by the end 2008. ALARA aspects are an essential part of these reviews.

In 2006, there was a change of the Radiation Act concerning a periodic approval of the personal dosimetry services in Finland. The approval can be granted by STUK for a time period which shall not exceed 5 years. The approval process will be finalised during 2008.

The regulatory work concerning OL3 licensing will continue. Also the licensing work dealing with the modernisation of old NPPs RP measurement systems especially in Olkiluoto will continue.

FRANCE

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	58	0.63
Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR		
GCR	5	0.019
Fast Neutron Reactor	1	0.020
Heavy Water/ Gas cooled	1	0.012

Summary of national dosimetric trends

The average collective dose per reactor for French NPPs for the year 2007 was 0.63 man·Sv per reactor, with an objective of 0.73 man·Sv per reactor.

The collective average dose for the year 2007 for the 900 MWe (3 loops: 34 reactors) was 0.72 man·Sv by reactor. The collective average dose for the 1300 MWe and 1450 MWe (4 loops: 24 reactors) was 0.49 man·Sv by reactor.

In 2007 there were 21 short outages, 24 standard outages, 4 ten-yearly outages, one steam generator replacement, and one vessel head replacement. . The outage collective dose represents 85% of the annual collective dose.

The collective neutron dose was 0.39 man·Sv (0.32 from the fuel transportation).

Individual dose

At the end of 2007, there were no workers from highly exposed occupational categories (insulation, scaffolding, welding, mechanicals) with recorded doses over 16 mSv on 12 rolling months. There were only 2 workers over 16 mSv, and no worker with a 12 months dose over 18 mSv.

Principal events

The recording level of the operational dosimetry (EPD recording level) has been modified from 10 μSv to 1 μSv for each entry in the controlled area.

Considering the events observed during non-destructive testing by radiography, EDF has decided to create a specific co-ordination unit during outages.

EDF 3 loops reactors

The main contributors were 15 short outages, 15 standard outages (with 2 Steam Generators replacement and 1 vessel head replacement), and 2 ten yearly outages. Nine reactors had no outage and 1 had an unscheduled outage.

The lowest dose for a ten-yearly outage was 1.232 man·Sv at Cruas 2, and the highest dose for a ten yearly outage was 1.381 man·Sv on Gravelines 6.

In 2007, the lowest dose for a standard outage was Chinon 3 with 0.456 man·Sv. The lowest dose for a short outage was Chinon 4 with 0.161 man·Sv. The lowest dose for a SG replacement was 0.673 man·Sv at Dampierre 4. The lowest dose for the vessel head replacement was 0.131 man·Sv at Cruas 1.

EDF 4 loops reactors

In 2007, 6 reactors had short outages, 9 reactors had a standard outage (with 2 vessel head replacements), and 2 had ten-yearly outages. Seven reactors had no outage.

In 2007, the lowest dose for a standard outage was Civaux 1 with 0.313 man·Sv. The lowest dose for a short outage was Chooz 2 with 0.098 man·Sv. The lowest dose for a ten yearly outage was 1.400 man·Sv at Saint Alban 1, and the highest dose for a ten yearly outage was 1.480 man·Sv at Paluel 3. The lowest dose for the vessel head replacement was 0.212 man·Sv at Penly 2.

Major evolutions

Modification of the dose recording level measured by operational dosimeters from 10 µSv to 1 µSv. The impact on collective dose is an increase of the dose results of about 7%. Following a specific analyis of non-destructive testing (NDT) by gamma rays operations, EDF decided to implement a special crew in charge of co-ordination of gamma rays NDT during each outages.

A "national engineering project for PWR high dosimetry cleaning" performed decontamination of the most contaminated circuits of two units. At Gravelines 3, the dose cost was 178 man·mSv for a calculated gain over five years of 2218 man·mSv. At Bugey 2, the dose cost was 60 man·mSv for a calculated gain over five years of 214 man·mSv.

RP incidents

All the events are « level 0 » on the INES scale, except one classiefied as level 1: exposure over the quarter of the regulatory limit during the containment cavity decon (Paluel 4, August 2007).

New targets

The target in the field of collective dose for 2008 is 0.65 man·Sv. In the field of individual dose, the target is to maintain the good result of "no worker over 18 mSv", and less than 30 workers over 16 mSv on 12 rolling months.

Issue of concern in 2008

In the field of internal exposure: use of a new software to whole body measurements on all sites.

In November 2008, EDF will begin use of neutron EPDs, with the goal to use them on all sites by March 2009.

Regulatory plans for major work in 2008

The inspections concerning the construction phase of FLA3 unit will continue as well as the reviewing process of the preliminary safety report. In deed, without waiting for transmission of the complete commissioning application file, envisaged by EDF for about 2010, the Institute for Radiation Protection and Nuclear Safety (IRSN) which is the technical support organisation of the Nuclear Safety Authority (ASN) has already initiated an advance review of certain topics requiring lengthy investigation (including radiation protection and optimisation at the design phase).

The year 2007 was marked by the implementation of a new legislative and regulatory framework created notably by the Act on transparency and security in the nuclear field (TSN) of 13th June, 2006. Pursuant to this TSN Act, numerous decrees were published, including the decree which overhauls the administrative procedures that apply to nuclear installations. This will notably lead the operators to review their general operating rules, including the chapter concerning the radiation protection.

GERMANY

Dose information

Operating reactors		
Reactor type	**Number**	**Total annual collective dose [man·Sv]**
PWR	11	11.44 man·Sv
BWR	6	6.6 man·Sv

Principal events

Political situation

The political situation is unchanged compared to 2006. The agreement for phasing out the peaceful use of nuclear energy created by the former red-green government in June 2000 is still valid under the new conservative/social – democratic government. Nevertheless, there is an ongoing discussion on that issue influenced by the question of supply security and climate change.

According to the political agreement, the units Biblis A, Neckarwestheim 1, Brünsbüttel and Biblis B should be finally shut down until 2009.

Utilities operating the older plants submitted requests for the transfer of production capacities from newer plants to older plants. The decision about this matter is still pending and will finally be decided by courts. RWE has the option to transfer production capacities from Mülheim-Kärlich to Biblis Unit B in order to delay the final shut down of Biblis B for several years.

Summary of national dosimetric trends

NPPs in operation

For NPP Biblis Unit A, the oldest unit in operation, the collective dose in the first half of 2007 amounts to 1.6 man·Sv. Unit B has accumulated a collective dose of about 1.9 man·Sv in the first half of 2007. For the BWRs a slightly decreasing collective dose trend can be identified.

NPPs under decommissioning

10 units on 6 sites are in the status of immediate dismantling. NPP Obrigheim (final shut down in May 2005) has performed decontamination of the primary system. Average decon. factor: 625, collective dose: 46 man·mSv. A paper will be proposed for the Symposium in Turku (2008). NPP Würgassen has dismantled the lower core structure. A paper will also be proposed for the Turku Symposium. In NPP Stade the steam generators were removed with good success: 32.5 man·mSv (total dose 2007: 364 man·mSv)

Special developments

The pilot project performed under the supervision of the authority for the realisation of legal dosimetry with EPDs has been delayed and will probably be finished end of 2007. In 2008 a field test in selected NPPs is planned as a VGB-Project. It is expected that in the future a new initiative for the development of a concept for an electronic RP passport will be launched as the initiative expected for 2007 was postponed.

The German legislation passed a regulation according to the performance of internal dosimetry. If the intake of activity resulting in a dose more than 1 mSv per year including the activity of ^{3}H with a resulting dose of 0,5 mSv per year could not be completely excluded, policies and procedures have to be established by the operator to evaluate the doses of deposition of radioactive materials. In focus are the dose-calculation and reporting for outside workers. German VGB-experts have worked out a systematic for the supervision of possible intakes in practice.

Increased attention is given to the question of keeping the qualification of RP personnel on a high level. The VGB-Group is discussing qualification concepts, especially regarding the qualification of outside workers.

Since 2003 an initiative by the Federal Ministry on Environment, Nature Conservation and Reactor Safety (BMU) is on the way to update the current sub-legal nuclear regulatory framework to implement the current state of the art in science and technology. In 11 so called modules requirements on different aspects on the operation of nuclear power plants are specified. Module 9 is devoted to radiation protection.

Early 2006 a public hearing was performed by BMU to allow stakeholder to comment on the draft regulations. Currently an update on the technical regulations is under the way. In parallel a ordinance is in preparation to bring into force these technical regulations. Either on the technical requirements as on the concept of an ordinance a strong national debate is ongoing esp. between BMU, the Länder and the KTA – an prediction of the outcomes is not possible same as a prediction on the schedule for setting the requirements and the ordinance in force.

Special events

- On 28 June 2007 a fire in a transformer of BWR Krümmel resulted in a reactor trip. The plant shut down was handled by the operator in a procedure which was not adequate to the technical conditions given by the event. The procedure selected by the operator was chosen because of a non-optimal communication between him and the shift-leader. The rules for decision finding and communication are laid down in a guideline developed by the VGB-Simulator-Training-Centre and applied during training courses. The event did not create any safety risk for the plant or the environment. Nevertheless, this event caused an increased public echo and was taken by the authorities and politicians in favour with phasing out the nuclear option to question the reliability of the utility organisation. As a consequence, two managers had to resign and some administrative structures and rules have to be analysed and modified.
- During outage of Biblis A in September 2006 deficiencies concerning the correct assembling of heavy load wall plugs were observed, which may have safety significance. Based on these findings Biblis B was shut down too in October 2006. A detailed program was started to first inspect in detail all affected wall plugs and second to repair those which are incorrect assembled. It is expected, that after Biblis Unit B has started operation again in November 2007 also unit A will terminate the outage by the end of the year. As a result of the replacement of wall plugs for both units including scaffolding, shielding and isolation replacement a collective dose of about 2.1 man·Sv happened. Since shut down Biblis A for outage in September 2006 the collective dose accumulated up to 5.2 man·Sv. For Biblis B the collective dose reached 2.5 man·Sv since shut down for inspection in October 2006.
- Due to the findings at Biblis inspections were performed in Gundremmingen B and C resulting in the finding of some wall plugs not mounted according to specifications. But the specified carrying capacity was not compromised and safety is regarded by the responsible authority not affected.
- Due to the inspection of wall plugs in NPP Brunsbüttel unspecified assemblings have been found. The investigation is still ongoing.

HUNGARY

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
VVER	4	0.618 (with electronic dosimeters); 0.615 (with film badges)

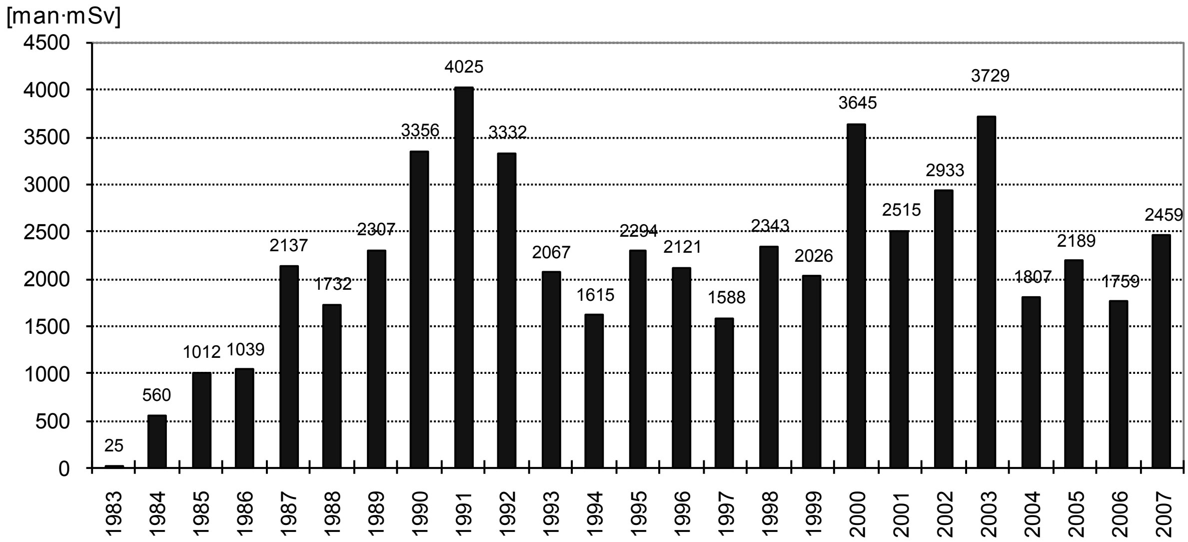
Principal events

Summary of national dosimetric trends

Upon the result of operational dosimetry the collective radiation exposure was 2 473 man·.mSv for 2007 at Paks NPP (1 813 man·mSv with dosimetry work permit + 660 man·mSv without dosimetry work permit). The collective dose was 2 459 man·mSv in 2007 with film badges. The highest individual radiation exposure was 16.3 mSv, which was well below the dose limit of 50 mSv/year, and our dose constrain of 20 mSv/year.

The collective dose increased in comparison to the previous year. The higher collective exposures were mainly ascribed to the one "so called" long outage on Unit 1. The main reason of this increase is that while the outage performed on Unit 4 in 2006 resulted in 439 person·mSv collective doses, the outage performed on Unit 1 in 2007 resulted in 995 person·mSv. If taking into consideration the – planned and non-planned – extra works performed during last year, then it might be stated, that the value of the collective dose for 2007 was justified.

Development of the annual collective dose values at Paks Nuclear Power Plant (based on the results of film badge monitoring by the authorities)



From 2000, data is quoted as individual dose equivalent /Hp(10)/

Events influencing dosimetric trends

There was one general overhaul (long maintenance outage) in 2007. The collective dose of outage was 995 man·mSv on Unit 1.

Number and duration of outages

The duration of outages were as follows: Unit 1: 72 days; Unit 2: 30 days; Unit 3: 41 days; Unit 4: 28 days.

Major evolutions

The four units of the Paks NPP were put into operation between 1983 and 1987. Taking into account the designed lifetime (30 years), they should be shut down between 2013 and 2017. In possession of our present technical knowledge it can be considered as a real long-term goal to extend the designed lifetime of the units with twenty years.

Safety-related issues

There was a serious incident occurred at Unit 2 on 10 April 2003. Thirty irradiated fuel assemblies damaged in the Pit 1. The damage of the fuel assemblies was caused by the overheating of the assemblies, due to insufficient cooling, followed by a thermal shock produced by the inrush of cold water into the tank after opening the tank lid. The recovery in the Pit 1 was started on 15 October 2006, and it was ended on 30 April 2007. Upon the result of operational dosimetry the collective dose was 47 man·mSv from 15 October to 31 December, and it was 74 man·mSv from 1 January to 30 April for the recovery.

In 2007 there were two significant changes relating to the personal dosimetry control. On the one hand the Dosimetry Modul of the PassPort system was started on 15 January 2007 linked to the Integrated Technical System of the plant; on the other hand from 1 May 2007 the one-month wearing film-dosimeters have been ceased. Since that time each worker has been using two-month wearing film-dosimeters.

Technical plans for major work in 2008

- We will start the replacement of the installed workplace and technological monitoring system.
- Long outage on Unit 2.

ITALY

Dose information

Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	1	0.0005
BWR	2	0.0065
GCR	1	0.0005

Principal events

Events influencing dosimetric trends

BWR: Decommissioning activity in Caorso NPP, especially referred to the fuel elements transfers to the reprocessing site in la Haque (France).

JAPAN

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	23	1.35
BWR	32	1.47
All types	55	1.42
Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
GCR	1	0.03
LWCHWR	1	0.09

Principal events

Summary of national dosimetric trends

The total collective dose in the fiscal year 2007 for all operating reactors was 78.15 man·Sv, which was higher than the fiscal year 2006 value of 67.40 man·Sv. The average annual collective doses per unit for all operating units, for BWRs and for PWRs were 1.42 man·Sv, 1.47 man·Sv and 1.35 man·Sv respectively. The BWR and PWR collective doses per unit for 2007 increased from the previous year by 0.09 man·Sv and 0.26 man·Sv, respectively.

Events influencing dosimetric trends

The increase in collective dose was mainly due to the increase of inspection and modification works during the periodic inspections.

Number and duration of outages

Periodic inspections were completed at 18 BWRs and 14 PWRs in the fiscal year 2007. The average outage durations for periodic inspections were 158 days for BWRs and 102 days for PWRs.

Major evolutions

The preparation of guidelines and manuals was carried out by the regulatory body in order to implement the improved inspection system. The inspection system will be introduced as the integrated part of the operational safety activities based on the "overall maintenance plan" focusing on important operational actions to ensure safety. In this system, the inspection is shifted from a uniform inspection to a fine inspection according to the characteristics of each plant, allowing operating periods of 18 or 24 months (currently 13 months).

Component or system replacements

Replacements of reactor vessel head were carried out at some PWR plants.

Regulatory plans for major work in 2008.

The implementation of the improved inspection system is anticipated, and it is expected that the maintenance optimisation will promote a decrease in exposures at Japanese plants.

REPUBLIC OF KOREA

Dose information

Operating reactors		
Reactor type	**Number of reactors**	**Average annual collective dose per unit [man·Sv]**
PWR	16	0.60
CANDU	4	0.80
All types	**20**	**0.64**

Principal events

Summary of national dosimetric trends

For the year of 2007, 20 NPPs were in operation: 16 PWR units and 4 CANDU units. The average collective dose per unit for the year 2007 was 0.64 man·Sv higher than 0.55 man·Sv in 2006. As in previous years, the outages of units in 2007 contribute the major part to the collective dose, 86.0% of the collective dose was due to works carried out during the outages. There were in total 11, 366 people involved in radiation works in 20 operating units and the total collective dose was 12.807 man·Sv.

Number and duration of outages

Periodical inspection was completed at 14 PWRs and 4 CANDUs. The total duration for periodical inspection was 662 days for PWRs and 112 days for CANDUs.

Major evolutions

- There was tremendous improvement of facilities in Kori Unit 1, which had a plan to get life extension, through replacing the major equipment and reinforcing the safety facilities.
- 2007 ISOE Asian ALARA workshop was held in Seoul, Korea from 12-14 September, 2007.

Issues of concern in 2008

- License renewal will be approved by the government to operate Kori Unit 1 for 10 years additionally.
- Reactor will be installed in Shin Kori Unit 1 which has been being built near the Kori Nuclear Power Site. In total 6 PWR type nuclear power plants are being constructed in Korea and 2 of them are advanced power reactor, APR 1400.

MEXICO

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
BWR	2	2.74

Principal events

Summary of national dosimetric trends

2007 was a year with two refuelling outages: one for each of the two Laguna Verde NPS units. Although the Laguna Verde NPS dosimetric trend continues downwards and the 2007 collective dose has resulted the lowest among the years with two refuelling outages, it is also a fact that such a dose was significantly higher than expected.

Events influencing dosimetric trends

The actual collective dose for 2007 resulted far higher than expected (2.74 vs. 1.90 man·Sv) due to delayed collateral effects caused by a methodology that started up two cycles ago aiming to prevent intergranular stress corrosion cracking (IGSCC) in reactor internals: Hydrogen plus Noble Metals addition. That caused a reductive effect in water chemistry and promoted the release of Cobalt from the oxide layers of reactor internals. An additional complication is the fact that, once a plant adopts an Hydrogen-Noble Metals regime, the amount of Zinc that can be added is limited; this is a double unfortunate situation for the control of Cobalt, since Zn is one of the most effective methods for that.

Number and duration of outages

- Unit 1 – 12^{th} refuelling outage: 27 days
- Unit 2 – 9^{th} refuelling outage: 26 days

Major evolutions

Project for power uprate to 120% of the nominal power for both Laguna Verde units got consolidated. The project will start 1n 2008 and finish in 2010.

Unexpected events

Co-60 increased in feedwater by a factor of 7 for Unit 1, and by a factor of 3 for Unit 2 compared to a baseline from previous four years. This was due as stated above, to a collateral effect of Hydrogen and Noble Metals injection startup, aiming to reactor internals protection from corrosion cracking. These increases were reflected during both Units 2007 refuelling outages as an increase in Drywell dose rates of 50% and 33% respectively.

New/experimental dose-reduction programmes

The Co-60 burst has pushed the plant towards actions focused to prompt source term control and reduction. Once having suffered the effects of the unexpected event in the Unit 1 refuelling outage, provisions were taken to optimise dose in the Drywell and to control the source term as long as possible towards the Unit 2 RFO. The main measures consisted in maintaining the RWCU in operation during most of the outage, soft shutdown, and followup of EPRI BWR water chemistry shutdown guides. Additional efforts will made to reduce the source term, described in the section of Technical Plans for major Work in 2008.

Technical plans for major work in 2008

- The works for a power uprate to 120% will start 1n 2008 and finish in 2010. Include the removal and substitution, for both Units, of turbines, generator, condenser internals, steam heaters, main steam reheaters, and associated pipes, valves and components. This big design change will require longer refuelling outages (45 days for 2008 and 2009; 57 days per Unit for 2010).
- Regarding source term control, a program of work has been developed and approved. it includes the continuing application of the measures described for 2007, empowered by the additional application of new technologies like the PRC resins.

THE NETHERLANDS

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	1	0.234
Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
BWR	1	0.00035

Principal events

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. The modification works for transferring the plant into a "safe enclosure" (for 40 years) have been completed per 1st July in 2005. In the past years a number of buildings have been demolished and several decommissioning activities have been carried out. New systems were built for ventilation, water treatment and monitoring of emissions. For the next years every year some surveillance and maintenance activities will continue to be carried out. The collective annual dose in 2007 was 0.35 man·mSv, mainly due to some extra inspections. For 2008 no special activities are foreseen.

The Borssele plant (515 MWe), operated by NV EPZ, is a baseload unit. Up to this year it has enjoyed 34 years of commercial operation. Major backfittings were completed in the plant in 1997 and 2006. The plant electrical output has been raised in 2006 to 515 MWe. The annual outage in September lasted 16 days, 5 days longer than planned. It was an outage with some maintenance and inspection works. The collective dose in the outage was 0.173 man·Sv. The annual collective dose amounted 0.234 man·Sv.

In 2006 the average individual dose 0.35 mSv for plant and 0.54 mSv for contractor personnel. The highest annual individual dose was 2.75 mSv for plant and 4.48 mSv for contractor personnel. In 2008 a short (12 days) outage is foreseen. Related to the future of the plant: programmes and plans for enabling long term operation (LTO) until 2034 are being developed in the organisation.

ROMANIA

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
CANDU	2	0.271

Principal events

Summary of national dosimetric trends

Occupational exposure at Cernavoda NPP (February 1996 – December 2007)			
	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
2005	389.3	342.29	731.59
2006	302.27	258.79	561.06
2007	83.34	187.49	270.83

Events influencing dosimetric trends

An unplanned outage was done at Unit 1 between 21-30 September 2007, in order to repair some components of Pressure and Inventory Control on Primary Heat Transport System. Other activities with major contribution to the collective dose were feeders inspection/measuring, and fueling machine bridge maintenance. Finally this unplanned outage had a 40% contribution to the collective dose for the year 2007. At Unit 2, a 10 day planned outage between 20-29 October 2007 had a 7% contribution to the collective dose for the year 2007.

At the end of 2007:

- there were 6 employees with individual doses exceeding 5 mSv;
- the maximum individual dose since the beginning of the year was 7.03 mSv;
- The contribution of internal dose due to tritium intake was 30.7% for 2007; well bellow the last three years.

New plants on line/plants shut down

On 2nd November 2007, after the planned outage, Cernavoda NPP Unit#2 (CANDU 6 design) started commercial operation.

Major evolutions

During 2007 our National Regulatory Body, CNCAN, continued to issue new rules and regulations:

- Ord. 305/2007 for approval of "Guide on periodically verification of physical security systems of nuclear facilities".
- Ord. 303/2007 for approval of "Guide on physical security during transportation of nuclear materials".
- Ord. 304/2007 for approval of "Guide on preventive protection of nuclear facilities".

Radiation protection-related issues

Since Unit 2 fuel load and first criticality efforts have been made for the integration of both units radiation protection programs and systems related to personnel dosimetric surveillance (i.e. Personal Alarm Dosimeters databases and computers serving Liquid Scintillator Counters for tritium analysis in urine samples, in Unit 1 and Unit 2, were connected with the unique DOSERECORDS system). Also DOSERECORDS (a package consisting of a database and a number of specific programs) was adapted to support and work with dose information from both units. This unique dosimetric surveillance system allows us to ensure that individual dose limits are not exceeded no matter an employee works in Unit 1, Unit 2 or both units.

Organisational evolutions

After commissioning of Unit #2 a new branch of SNN-SA corporation was established, "CNE Cernavoda", including former CNE-PROD (Unit #1) and CNE-INVEST (Unit #2).

Issues of concern in 2007

There was no planned outage of Unit 1 during 2007. The major issue was the first criticality and commercial operation for Unit #2 (CANDU 6 project).

At Cernavoda NPP Unit 2, in commercial operation since November 2007, was implemented the Radiation Monitoring System (RMS). At Unit 1 is under way modernisation of radiation protection systems: liquid effluent monitor, gaseous effluent monitor, inter-zonal contamination monitors, area alarming gamma monitors) which will be integrated under a common, Unit 1 and Unit 2, RMS.

After three consecutive years (2004, 2005 and 2006) of major concern on individual and collective internal doses, due to the increase of tritium dose rate in the Reactor Building (boiler room and accessible areas), important steps were done to decrease this type of exposure. Corrective and preventive actions and recommendations, aiming both work planning (exposure control) and technical aspects, worked efficiently: at the end 2007 internal dose contribution to the total collective dose was 30.7%.

For the future, in order to prevent the extension of this problems, in Unit #2 was installed a drying unit on the entrance of the ventilation tubes serving reactor building in order to decrease the influence of the humidity of air on tritium fields.

Before the commercial operation, in Unit 2 the “Tritium in Air Monitoring” was operational and integrated in the Radiation Monitoring System. Modernisation of the “Tritium in Air Monitoring” system in Unit 1 will be finished at the end of planned outage 2008.

For long term a heavy water de-tritiation facility project is in progress. A pilot-plant is under commissioning to test the technology to be applied to reduce tritium concentration in our CANDU reactor moderator system.

Issues of concern in 2008

The main concerns for 2008 are important works, with high radiological impact, to be performed during Planned Outage of Unit 1, including:

- fuel channels inspection;
- replacement of four vertical neutron flux detectors;
- preventive maintenance of fuelling machine bridge components;
- ECT inspection of steam generators tubes;
- Reactor Building Leak Rate Test.

RUSSIAN FEDERATION

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR (VVER)	15	0.907
Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR (VVER)	2	0.101

Principal events

Summary of national dosimetric trends

Collective doses

Personnel, contractors and total collective doses for of all operating VVERs are shown in the following Table.

Nuclear Power Plant		Personnel [man·Sv]	Contractors [man·Sv]	Total [man·Sv]
Balakovo	Unit 1, VVER-1000	0.318	0.191	0.509
	Unit 2, VVER-1000	0.375	0.553	0.928
	Unit 3, VVER-1000	0.211	0.203	0.414
	Unit 4, VVER-1000	0.197	0.193	0.390
	Total for Balakovo NPP	**1.101**	**1.140**	**2.241**
Kalinin	Unit 1, VVER-1000	0.687	0.165	0.852
	Unit 2, VVER-1000	0.475	0.177	0.652
	Unit 3, VVER-1000	0.115	0.060	0.175
	Total for Kalinin NPP	**1.277**	**0.402**	**1.679**
Kola	Unit 1, VVER-440	0.331	0.230	0.561
	Unit 2, VVER-440	0.680	0.443	1.123
	Unit 3, VVER-440	0.730	0.548	1.278
	Unit 4, VVER-440	0.223	0.192	0.415
	Total for Kola NPP	**1.964**	**1.413**	**3.377**
Novovoronezh	Unit 3, VVER-440	2.253	0.233	2.486
	Unit 4, VVER-440	2.198	0.877	3.075
	Unit 5, VVER-1000	0.486	0.078	0.564
	Total for Novovoronzh NPP	**4.937**	**1.188**	**6.125**
Volgodonsk	**Unit 1, VVER-1000**	**0.084**	**0.101**	**0.185**

In 2007, the total effective annual collective dose (personnel and contractors) of all Russian operational VVER type reactors was 13.607 man·Sv and increased at 3.110 man·Sv in comparison with 2006.

The main reason of the total collective dose increase was connected to the expansion of the planned maintenance work at some units:

- At three operating Novovoronezh Unit 3-5, 2.350 man·Sv annual collective dose increase was in 2007 than previously. The main part of this increase falls on Novovoronezh Unit 4 where 90 days major maintenance outage took place. The total reactor refuelling, repairing of DU500 welds and welding depositions by using surface plastic processing, reactor vessel template cutting were performed during this outage. It resulted in 2.730 man·Sv of total collective dose for this outage. This was 1.757 man·Sv more than collective dose at previous outage.
- At Kola Unit1-4, the annual collective dose increased at 0.776 man·Sv in 2007 than previously. The main part of this increase falls on Kola Unit 3 where 56 days major

maintenance outage took place. In addition to scheduled work, the pipes of accidental dumping lubricating oil system at all six reactor coolant pumps were replaced by contractors. In 2007, Kola Unit 3 outage collective dose was 1.159 man·Sv, at 0.709 man·Sv more than at previous outage.

Individual doses

In general, there was no exceeding of the main legislative dose limit (100 mSv averaged over defined periods of 5 years) and established by concern ROSENERGOATOM control level of 20 mSv at all plants with VVERs in 2007. Only 3 persons (2 workers of the plant maintenance department at Kola and 1 worker of the plant maintenance department at Novovoronezh) received annual effective individual dose more than 19 mSv. The maximum value of the recorded dose was 19.5 mSv.

Planned outages duration and collective doses

Name of reactor	Duration [days]	Collective dose [man·Sv]
Balakovo 1	42	0.476
Balakovo 2	60	0.906
Balakovo 3	28	0.367
Balakovo 4	40	0.362
Kalinin 1	47	0.712
Kalinin 2	49	0.552
Kalinin 3	50	0.165
Kola 1	33	0.509
Kola 2	52	1.019
Kola 3	56	1.159
Kola 4	34	0.377
Novovoronezh 3 (*)	100	2.114
Novovoronezh 4	90	2.730
Novovoronezh 5	51	0.445
Volgodonsk 1	49	0.149

(*) At Novovoronezh 3, an unplanned repairing outage was performed from 4 to 12 November 2007. The total collective dose (personnel and contractors) for this outage was 0.046 man·Sv.

Main dose-reduction activities in 2007

- Annual collective dose budget procedure was enacted at all Russian nuclear power plants.
- Experimental work on selection of optimal radiation-resistant elastomers and tungsten powder types for radiation shields manufacturing was performed.
- Final stage of “Best health physicist of NPPs” contest was held in March 2007 in Obninsk, Russia.
- Some new modules of Concern ROSENERGOATOM personnel dose control computer based system were developed to meet new requirements.
- Standard program of occupational exposure optimisation at the stage of preparation to the planned outage was developed.
- Standard program of occupational exposure analysis following the planned outage was developed.

Issues of concern for 2008

- Development of preparatory activity aimed at implementation of 18 months fuel cycle for VVER-1000 reactors.
- Development of standard program aimed at providing occupational radiation protection during the specially radiation dangerous works.
- Manufacturing of pilot lot of radiation shields on the bases of tungsten compounds.
- Experimental testing of the system of personnel monitoring in RCA.

SLOVAK REPUBLIC

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
VVER	6	0. 233
Reactors in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
GCR	1	*Not involved in ISOE*

Principal events

Summary of national dosimetric trends

Bohunice NPP (2 units – Bohunice 3, 4): The total annual effective dose in Bohunice NPP in 2007 calculated from legal film dosimeters was 608.215 man·mSv (employees 31.055 man·mSv, outside workers 577.16 man·mSv). The maximum individual dose was 15.246 mSv (contractor).

JAVYS NPP (2 units – Bohunice 1, 2): The total annual effective dose in JAVYS NPP in 2007 calculated from legal film dosimeters was 471.427 man·mSv (employees 57.65 man·mSv, outside workers 413.777 man·mSv). The maximum individual dose was 7·675 mSv (employee).

Mochovce NPP (2 units): The total annual effective dose in Mochovce NPP in 2007 calculated from legal film dosimeters was 318.598 man·mSv (employees 32.597 man·mSv, outside workers 286.001 man·mSv). The maximum individual dose was 4.829 mSv (contractor).

Events influencing dosimetric trends

Bohunice NPP: The high collective exposure in 2007 continues during the recent years due to the modernisation works in Bohunice NPP

JAVYS NPP: Unit 1 has not been in the operation since 01.01.2007 due to planned shut down. Its status is: preparation stage for decommissioning. This is the reason why the collective exposure is lower than in previous years.

Mochovce NPP: Standard outages were performed in the year 2007 on both units.

Number and duration of outages

Bohunice NPP:

- Unit 3: 66.1 days major maintenance outage combined with the modernisation works. The total collective exposure was 410.23 man·mSv.
- Unit 4: 62.2 days standard maintenance outage combined with the modernisation works. The total collective exposure was 267.87 man·mSv.

JAVYS NPP:

- Unit 1: out of operation since 01.01.2007
- Unit 2: 56.3 days major maintenance outage. The total collective exposure was 340.235 man·mSv.

Mochovce NPP:

- Unit 1: 33.5 days standard maintenance outage. The total collective exposure was 191.702 man·mSv.
- Unit 2: 26.3 days standard maintenance outage combined with the modernisation works. The total collective exposure was 96.257 man·mSv.

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

New plants on line/plants shut down

There is planned completion of the Mochovce unit 3 and 4. Basic design of the completion was elaborated and submitted to the state authority for approval.

Major evolutions

JAVYS NPP: preparation for the decommissioning of Unit 1. Preparation for upgrading of the radiation protection systems and releasing materials from the radiation controlled area to the environment.

Component or system replacements

Bohunice NPP:

- installation of devices for computerised assignment of film dosimeters to the workers and the control of their collection before entering to the radiation controlled area.
- upgrading of the software for the calculation of the doses to the members of the critical groups in the surroundings from the radioactive discharges from Bohunice site to the environment.
- upgrading of the vehicle radioactivity monitoring system at the main NPP gate.
- replacement of major electronic parts of stationary NPP radiation protection system.

JAVYS NPP:

- installation of devices for computerised assignment of film dosimeters to the workers and the control of their collection before entering to the radiation controlled area.

- upgrading of the vehicle radioactivity monitoring system at the main NPP gate.
- upgrading of the aerosol discharge monitoring system in the ventilation stack.

Mochovce NPP:

- there was installed a new radiation portal monitor for workers at the main entrance to the plant and a new vehicles monitors were installed in order to replace the older ones.

Safety-related issues

Bohunice NPP: NPP received the new RP licence for operation of the Bohunice NPP valid for next 5 years.

JAVYS NPP: Preparation for the decommissioning of both units.

Mochovce NPP: NPP got the new RP licence for operation of the Mochovce NPP valid for next 5 years.

New/experimental dose-reduction programmes

Mochovce NPP: A method for dose rate decrease on the primary circuit system by a specific radioactivity removal has being implemented for last 2 years. As a result, decrease of dose rate about 15% was obtained.

Issues of concern in 2008

Bohunice NPP: start of a new project – to build a new nuclear information system including the radiation work order system that will replace the existing one.

JAVYS NPP: definite shut down of Unit 2 is planned for 21.12.2008.

Technical plans for major work in 2008

Bohunice NPP:

- installation accident monitors on the live steam pipelines;
- start of the use of DIS dosimeters with DBR-1 reader;
- start of the use of DMC 2000GN dosimeters;
- upgrading of the HPGe detectors and TRICARB in the spectrometry laboratory.

JAVYS NPP:

- start of the use of DIS dosimeters with DBR-1 reader;
- project for the usage of electronic personal dosimeters for emergency personnel;
- enhancement of the dose rate measurement points to the different rooms within the site including the emergency shelters.

Mochovce NPP:

- another radiation portal monitor at the main entrance to the plant installation.
- modernisation of distributing cabinets of the stable RP monitoring system is taking place in the year.

Regulatory plans for major work in 2008

- Licensing process of the Unit 3 and 4 NPP Mochovce.
- Licensing process of the decommissioning of NPP JAVYS V1.
- Inspections of outages in all operated units.

SLOVENIA

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	1	0.86

Principal events

Summary of national dosimetric trends

There is one two loop PWR of Westinghouse design operating in Slovenia since 1982. It is owned by the state utilities of Slovenia and Croatia. The plant has been continuously upgraded during last ten years and the electrical power output in year 2007 was 727 MWe. Radiological performance indicators of Krško nuclear power plant (PWR) for the year 2007 were:

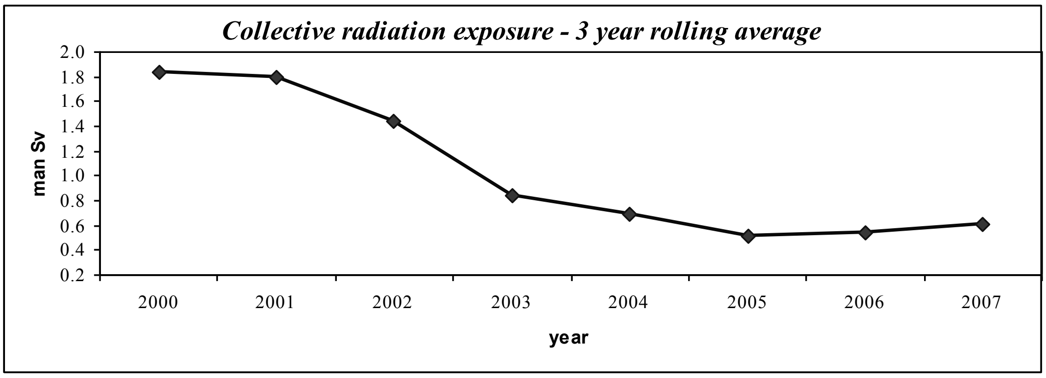
- Collective radiation exposure was 0.89 man·Sv and 0.164 man·mSv per GWh electrical output.
- Maximum individual dose was 11 mSv, average dose per person was 0.90 mSv.

Planned outage (6.10.07-6.11.07), 32 days:

Refuelling outage collective dose was 0.79 man·Sv. The plant has finished its second 18 months operating cycle with 511 days of continuous operation. The refuelling outage of 32 days is completed in the beginning of November and the plant started its 23rd fuel cycle.

Trends in collective dose:

The collective dose in 2007 was 0.89 man·Sv. The three years average is 0.61 man·Sv and the trend is illustrated in the figure below.



Dose rate trend at primary system points is slowly decreasing. It is due to more stabilised oxide layer in the new steam generators, stable operation regime in 22nd fuel cycle and first usage of 0.1 micron reactor coolant filter. Also, the change to the 18 months fuel cycles has been proved beneficial for collective dose trends.

Major outage activities:

The refuelling outage collective dose was 0.79 man·Sv. It is higher then average since the replacement of thermal insulation was done on about 500 m of the piping in the reactor containment. This modification together with containment sump strainers installation was performed on the request of the nuclear safety authority. It took together 0.33 man·Sv of the collective dose.

Other

After replacement of the steam generators in 2000 and low pressure turbine rotors in 2006, the plant has replaced turbine moisture separators and about 200m of the secondary side piping in year 2007.

REPUBLIC OF SOUTH AFRICA

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	2	0.736

Principal events

Summary of national dosimetric trends

During 2007, the two unit Koeberg Nuclear Power Station had 1 outage. This lead to a decreasing trend year-on-year due to the previous 2 years having outages on both units. The outage dose was high in comparison to an outage average.

Events influencing dosimetric trends

The outage dose remained high due to a large number of safety related modifications being performed on the plant. This included a Reactor Pressure Vessel Head replacement (281.08 mSv) and Containment Building sump modification (20.87 mSv).

Number and duration of outages

One outage was held during 2007. Approximately 87.7% of the total dose accrued during 2007 for Koeberg was due to the 88 day outage on unit 1. During this outage 20 modifications were performed in the radiation controlled zone. The highest of these included Reactor Pressure Vessel Head Replacement (281.08 mSv); Containment Building Sump Modification (20.87 mSv); Installation of Hydrogen Re-Combiners (10.05 mSv); Modification of Fire Fighting Sprinkling Valves in Containment (3.47 mSv); Seismic Inspection of Reactor Building (3.74 mSv); and the Inspection of Containment Tie Rods (32.97 mSv).

Component or system replacements

The Reactor Pressure vessel (RPV) Head was replaced, which entailed the control rod drive mechanisms being cut off of the old RPV Head and re-welded onto the new RPV Head.

Issues of concern in 2008

Dose reduction initiatives have been set as a priority focus for Koeberg nuclear power station.

Technical plans for major work in 2008

A Feasibility study is in progress for a Full System Decontamination.

SPAIN

In the year 2007 the average dose per refuelling outage was 0.572 person·Sv for PWR (5 units). The average dose per outage for BWRs was 4.123 person·Sv (2 units). Per plant, the annual collective doses and the outage collective doses are shown in the following table:

NPP	Type	Outage Coll. Doses (person·Sv)	No. Days	Annual Coll. Doses (person·Sv)	Comments
Almaraz I	PWR	——	——	0.046	No outage
Almaraz II	PWR	0.524	40	0.624	
Ascó I	PWR	0.704	32	0.685	(*)
Ascó II	PWR	0.603	39	0.584	(*)
Vandellos II	PWR	0.748	127	0.838	
Trillo	PWR	0.282	27	0.299	
S.M Garoña	BWR	1.297	33	1.548	
Cofrentes	BWR	6.949	92	6.749	(*)

(*)The reason of the discrepancy observed between outage and annual collective doses is that the outage doses are operational doses, recorded with DLD (recording level 0.001 mSv or 0.005 mSv) and the annual doses are official doses, recorded with TLD (recording level 0.100 mSv).

Regarding the annual collective dose in PWRs, the PWR average for this year has been 0.51 person·Sv while the three-year rolling average has been 0.42 person·Sv. This last value is higher than values obtained in previous years as it can be seen in table below.

In relation to the annual collective dose in BWRs, the total collective dose average has been 4.15 person·Sv and the three-year rolling average has increased to 2.29 person·Sv. Such increase is due to the high doses of Cofrentes.

	PWR			BWR		
Year	Outages	Collective doses (person·Sv)	3 year rolling average	Outages	Collective doses (person·Sv)	3 year rolling average
2002	5	0.49	0.49	1	1.52	1.29
2003	6	0.43	0.44	2	2.16	1.52
2004	4	0.31	0.41	0	0.46	1.38
2005	5	0.38	0.37	2	2.32	1.65
2006	5	0.38	0.36	0	0.41	1.06
2007	5	0.51	0.42	2	4.15	2.29

During this year Almaraz II doses associated to 17^{th} refuelling outage have been higher than the outages of previous years mainly due to the following tasks: the replacement of 16 resistances in the pressuriser, the replacement of Microtherm for a reflective isolation in order to avoid the potential obstruction of the SP drains in case of a break of the high energy line, the inspection of the vessel head by NDT and the modification of the fuel transfer carriage control.

Almaraz NPP has carried out the transport of two irradiated fuel rods in a special BG18 container to the SCK-CEN in Mol (Belgium) to analyse the level of corrosion. This transport has been the first of this kind in Spain and has been performed without incidences and with doses practically negligible.

Jose Cabrera NPP, currently in the pre-decommissioning phase, has presented the licensing documents for the authorisation of the Individualised Temporary Storage (ITS) for spent fuel (authorisation foreseen by end 2007).

The downward trend in collective dose, both in normal operation and in the current state, confirms the effectiveness of the ALARA guidelines implemented. Performance of new tasks with appropriate specific treatment based upon ALARA criterion have included the decontamination of the primary circuit as well as the cutting and conditioning of control rod drive shafts.

In Vandellós II refuelling outage doses have been higher than expected due to problems in the modification of the essential services water system which increased the outage duration. On the other hand there has been a significant reduction in the source term in the primary circuit (about 50%) due to zinc addition. Assembly and disassembly of the lower internal of the vessel has also decreased from 10 person·mSv to 1.542 person·mSv due to implementation of ALARA criterion.

Collective dose (6949 person·mSv) in the 16th fuel outage of Cofrentes NPP has been higher than expected due to problems in the welding subtask of the replacement of all 145 CRDM (control rod drive mechanism) insertion/withdrawal tubes to repair small leakages caused by intergranular corrosion in several tubes. On the contrary, permanent shielding installed in RHR and RWCU have resulted in a reduction between 50% and 70% of the historical trend.

From the regulatory point of view, 2007 was the second year in force of the new system to supervise NPP-Integrated System for Supervision of NPP (SISC) with a total of 143 findings of which: 1 white finding, 140 green findings and 2 cross-cutting findings. 9 findings corresponded to the occupational radiation protection cornerstone: 4 to Cofrentes, 2 for Vandellós II, 1 for Trillo, 1 for Ascó I and 1 for Ascó II. At the end of 2006 there was a white finding for Ascó in the occupational radiation protection cornerstone related to an unexpected radiological exposure during removal of the Lower Vessel Internals at Ascó II NPP.

The Spanish Regulatory Body (CSN) has approved the Individualised Temporary Storage (ITS) and full decontamination of primary system at José Cabrera NPP and the provisional license of SM Garoña NPP by 2009.

Another interesting issue has been the preparation by CSN of the IAEA mission to compare Spanish regulatory practices to international standards and good practices and the subsequent launching of CSN self-assessment after IAEA visit. The IAEA mission took place at the beginning of 2008 with excellent preliminary results for the CSN.

SWEDEN

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	3	0.41
BWR	7	1.06
All types	10	0.86
Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
BWR	2	0.07

**Barsebäck 1 and 2 in final cold shutdown, in service operation planning for decommissioning.*

Principal events

Summary of national dosimetric trends

Since 2005, the collective and individual doses at the Swedish nuclear power plants are at the same level. During 2007, about 4 350 persons were registered as receiving at least 0.1 mSv during at least one month (dosimeter read-out period) of the year. This resulted in a total collective dose of 8.8 man·Sv, an average individual dose of 2.0 mSv and a highest annual individual dose of 19.5 mSv. Two intakes of radionuclides, resulting in an effective committed dose higher than 0.25 mSv (lowest value for registration) were detected during the year. Note that the values presented here include the doses received at the two closed reactor units at Barsebäck NPP (116 persons with dose > 0.1 mSv, collective dose: 0.15 man·Sv, average dose: 1.33 mSv and max. dose: 9.7).

Events influencing dosimetric trends

In general, there are several projects in progress for modernisation, plant life extension and power upgrades. The increase in number and extent of these projects has required an increasing amount of installation work to be done during operation, which influences the dosimetric trends.

The resulting radiation doses during 2007 were largely as expected, taking the existing radiation environments and the planned outage and refurbishment activities into account. One notable exception was the outage at Oskarshamn 2 resulting in a collective dose of 1 man·Sv higher than planned. The major cause for this deviation was insufficient planning and steering of one of the projects, replacement of pipes and installation of Scrap Traps in the FW system.

At Forsmark, Oskarshamn and Ringhals NPP efforts to reduce fuel damages are continued. Foreign material exclusion programmes "*Clean systems*" are in place, no fuel damages with major impact on radiation levels has occurred during the last years. Ringhals Units 1, 2 have declining source terms while Ringhals 3, 4 have a slight increase in source term.

Number and duration of outages

Plant	Type	Length of Outage (Days)	Collective Dose (man·Sv)	Comments
Forsmark 1	BWR	18	0.451	Extended 6 d for diesel overhaul.
Forsmark 2	BWR	21	0.321	Extended 7 d for diesel overhaul and another 2 days because of work on valves on pressure relief and steam system.
Forsmark 3	BWR	41	0.665	Extended 5 d.
Oskarshamn 1	BWR	75	1.235	Extended 42 d for plugging Nitrogen connection pipes to the CRDM housing.
Oskarshamn 2	BWR	69	1.916	Insufficient planning and steering of the replacement of pipes and installation of Scrap Traps in the FW system resulted in 1 man·Sv exceeded collective dose.
Oskarshamn 3	BWR	14	0.271	In compliance with planned dose and time schedule.
Ringhals 1	BWR	43	1.168	Extended 8 d due to for instance low flow in Containment Spray Heat Exchanger and putting modified PRM system in operation.

Plant	Type	Length of Outage (Days)	Collective Dose (man·Sv)	Comments
Ringhals 2	PWR	31	0.354	Extended 8 d due to technical problems with Fuel Handling Grip. Additional works on check valves that entailed drainage to 2/3 loops.
Ringhals 3	PWR	76	0.269	Extended 54 d due to delay in project GREAT (GRadual Energy Addition unit Three)
Ringhals 4	PWR	26	0.379	Extended 3 d due to for instance maintenance on Spray Valve.

New plants on line/plants shut down

Barsebäck Unit 1 and 2 are since 1999 respectively 2005 in final cold shutdown for decommissioning.

Component or system replacements

Forsmark 3: Exchange of all high pressure super heaters and a total replacement of all tubes in all moist separators/reheaters. The total collective dose estimated approximately 110 man·mSv. Baffle plates were fitted in the steam dryer (reactor) to prevent vibrations.

Unexpected events

Forsmark: In the beginning of the year Forsmark 1 had an unplanned stop for 1½ month due to replacement of the outer rubber sealing between dry- and wet well. The replacement was due to ageing rubber material. The work had to be performed from drywell and without any preparatory planning period. Total collective dose received was 220 man·mSv, which under the circumstances was a very good result. Forsmark 3 experienced continued problems with fuel failures. Two such occurred during 2007, but did not result in any significant uranium contamination.

Ringhals: An unexpected event occurred during balancing of a Reactor Coolant Pump Impeller. Water with high content of radioactivity was hidden in recesses and was suddenly spread as water mist when the impeller rotated at 1500 rpm. Two workers and the areas around the pump shaft were contaminated and this incident has lead to Authorities inspection and improved routines and communication between purchaser and vendor.

New/experimental dose-reduction programmes

It was finally decided, after an investigation in collaboration between the Swedish NPPs, to revise the Alpha value. From 2008 onwards the valid value is 10 MSEK per man·Sv (approx. 1,060,000 Euro/man·Sv), it was increased from 4.6 million SEK/man·Sv.

Barsebäck: performed full system decontaminations on Unit 2 in November-December 2007 and on Unit 1 in January-February 2008. The resulting *Df* was better than planned for both units.

Organisational evolutions

Barsebäck Test and Maintenance Centre: With the overriding goal to reduce doses and to raise safety, Barsebäck NPP is used for national training courses for the entire nuclear industry in Sweden. The courses are focused on giving the base for training and knowledge of work-methods, safety regulations and what is expected to maintain a good safety and ALARA culture, as well as a good professional performance. The first course started up in April 2008 for maintenance personal and contractors. Up to now approximately 250 persons have participated.

During autumn 2008 courses for professional training in reactor hall services, control-rod drive services and valve maintenance starts up.

Issues of concern in 2008

In general, new regulations concerning admission control and security will come into force during 2008; this involves comprehensive measures at all nuclear installations.

Forsmark: The licensing and construction of an intermediate storage for used RV internals with induced activity will take place as well as licensing of an extended landfill for very low radioactive waste.

Technical plans for major work in 2008

Forsmark 1: Installation of particle filters (cyclone filters) in the primary system in order to avoid fuel failures due to foreign materials. Such filters have already been installed at Forsmark 2 and Forsmark 3. Wetwell will be drained from water, cleaned and inspected. Pressure relief valves (system 314) will be modified in order to eliminate vibrations.

Forsmark 2: Pressure relief valves (system 314) will be modified in order to eliminate vibrations. Working platforms will be erected in wetwell as a preparation for the replacement of the outer rubber sealing between dry- and wetwell 2009. This replacement were performed 2007 at Forsmark 1, but for Forsmark 2 the method for replacement (working from wetwell) will be possible to do with considerable lower dose due to longer planning and preparatory period.

Forsmark 3: Wetwell will be drained from water, cleaned and inspected.

Oskarshamn: Modernisation and power upgrade in progress, Unit 3 will be in cold shut down for 100 days. Power upgrade 18% is planned and major projects are exchange of reactor internals and HP Turbine.

Ringhals: Modernisation of RPS (Reactor Protection System) and installation of a diversified/ redundant Residual Heat Removal and Cooling Water systems at R1 continues as well as the TWICE project at Ringhals 2 (Ringhals TWo Instrumentation and Control Exchange).

Regulatory plans for major work in 2008.

On the 1 July 2008 the former two nuclear supervision authorities, *the Swedish Radiation Protection Authority* and *the Swedish Nuclear Power Inspectorate*, were merged into *the Swedish Radiation Safety Authority* (Strålsäkerhetsmyndigheten). This merger influences temporarily available resources for occupational radiation protection supervision in the nuclear area. During 2008 the supervision will be carried out on a basic level and no special ventures are planned. Furthermore, due to retirement and staff turnover, the staffing situation for regulatory oversight of the NPP occupational radiation protection is weakening. The focus is set on new employments, consolidation of resources and creating strategies for integrating and carrying out occupational radiation protection supervision within the total nuclear supervision programme.

SWITZERLAND

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	3	0.371
BWR	2	0.957
All types	5	0.606

Principal events

Summary of national dosimetric trends

The total annual collective dose for all five Swiss NPP was 3028 man mSv (0.114 man mSv/GWh netto ele., identical to last year). On the other hand there is neither positive nor negative trend visible on the five years average doses in the last decade. The highest maximum individual dose of 11.6 mSv is remarkable low. Only five out of the 4 127 persons working in the NPP received doses above 10.0 mSv. It seems that the dose constraint (10.0 mSv), which is defined by the NPP themselves, has a positive influence on the optimisation of radiation protection. There was no incorporation dose above 0.1 mSv detected.

Events influencing dosimetric trends

The exact preparation of the outages, the slightly reduced dose rates on the components in the main cooling system, as well as the small numbers of leakers in the last years (2007 and 2005: no leaker in any NPP, 2006: only one in NPP Gösgen) contributed to the positive development of the collective dose last year.

Number and duration of outages

The NPP Beznau 1 performed a short outage of 11 days (only fuel shuffling). The other NPP performed one planned outage each with duration ranging from 18 days to 30 days.

Unexpected events (with influence on the radiological status)

In NPP Leibstadt a hotspot with 5 Sv/h in contact was found in the draining tube of the fuel element storage pool. Fortunately the access to the room was restricted. The few persons, who had access, achieved an effective dose of max. 1.0, 0.4 and 0.2 mSv during periodical inspections before the source of this exposure was detected. The recovery and save disposal of the hotspot was performed without any measurable personal dose.

UNITED KINGDOM

Dose information

Operating reactors		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
PWR	1	0.045
GCR (AGR)	14	0.07
GCR (Magnox)	4	0.044
Reactors in cold shutdown or in decommissioning		
Reactor type	**Number**	**Average annual collective dose per unit [man·Sv]**
GCR (Magnox)	18	0.044

Principal events

Summary of national dosimetric trends

With the exception of Sizewell B all of UK's nuclear power plants are gas-cooled. Doses were lower than the previous year on the Advanced Gas Cooled Reactors (AGRs) at Hinkley Point and Hunterston because of a reduced scope of in-vessel inspection and repair together with improved focus on dose management. However the doses from these two reactor sites still represented 80% of the collective dose for the AGRs.

Events influencing dosimetric trends

The average annual collective dose at the AGR sites was again dominated by doses received during in-vessel work at the AGRs at Hinkley Point and Hunterston. Previous inspections of these power plants had detected defects in the boiler pipework, requiring additional inspections and repairs. This work continued in 2007 necessitating prolonged work inside the reactor vessels, in areas of higher doserate.

Number and duration of outages

The gas-cooled reactors operate to a two-yearly outage frequency so each site typically has one reactor outage per annum. Refuelling of the gas-cooled reactors is carried out on-load. The highest outage doses on the gas-cooled reactors were received at Hinkley Point B and Hunterston B plants with outage doses of approximately 0.2 man·Sv and 0.59 man·mSv respectively. The majority of the doses at Hinkley Point B and Hunterston were associated with in-vessel inspections and repair rather than routine outage tasks.

Sizewell B did not have a refuelling outage during 2007 and the plant operated continuously throughout the year. On-line doses were dominated by radiological protection and solid waste processing activities. Replacement of the Fuel Storage Pond Flask Fill Bay gate seals was carried out for the first time since 1998. This work recorded a collective dose of around 3 man·mSv, significantly lower than when the task has been carried out previously.

Decommissioning Sites: Major evolutions

All Magnox sites are now owned by the Nuclear Decommissioning Authority, a government owned management unit, with sites operated or being decommissioned under contract by a number of consortia. Of the original Magnox reactor fleet only two sites remain in power operation, Oldbury and Wylfa. These sites are due to permanently close at the end of 2008 and 2010 respectively. Of the decommissioning sites some are completely defuelled and are at various stages of decommissioning. Other sites are shutdown with the reactors still fuelled and with air cooling. Magnox defuelling continues to be rate limited by the capacity of the Sellafield reprocessing plant to receive and process fuel.

UK future nuclear energy policy

In May 2007 the UK government published a white paper that proposes building a new generation of Nuclear Power Plants to replace the existing UK nuclear capacity that is due to be largely closed by 2020. The government decision was influenced by the imperative of reducing the UK's carbon emissions and by the necessity to secure long-term energy supply.

UNITED STATES

The lowest annual average collective dose ever achieved in the US by the 104 operating reactor units was accomplished in 2007. The average annual collective doses for PWRs (69 operating units) and BWRs (35 operating units) are as follows:

Dose information

	Average annual collective dose per unit in person·rem (man·Sv)		
	2005	**2006**	**2007**
PWR	78 (0.78)	87 (0.87) [69 Units]	69 (0.69)[69 Units]
BWR	179 (1.79)	146 (1.46) [34 units]	154 (1.54)[35 Units]

BWR dose for 2007 includes Brown Ferry 1 partial.

In 2007, Kewaunee achieved the lowest US PWR three-year-rolling average of 30 person-rem. Also, the lowest US BWR three-year-rolling average of 88 person-rem was achieved by Oyster Creek in 2007.

The continued low average collective doses reflect the US nuclear industry's continuing commitment to the lowering of occupational doses through implementation of effective exposure reduction initiatives such as source term reduction programmes, efficient outages, enhanced reactor coolant chemistry control and effective ALARA programs in the traditional areas of control of time, distance and shielding.

In 2007, there were 37 PWR units in refuelling outages compared with 50 PWR units in 2006. The total number of US PWR and BWR refuelling outages were 57 units in 2007 and 66 units in 2006. The number of refuelling outages in a given year has a major impact on the annual country occupational dose.

Two-unit PWR sites generally have 2 refuelling outages in a single year every third year when the units are on a 18-month fuel cycle. This can lead to lower total refuelling outages in certain years in the US. For example, in 2004, there was a significant reduction in US PWR annual dose, attributed in part to fewer refuelling outages during that year.

In 2007, the 104 US units achieved a capacity factor of 91.8%.

Thirty-five BWR units operate in the US: 14 one-unit sites, 9 two-unit sites and 1 three-unit site (Browns Ferry 1, 2, 3). Sixty-nine PWR units operated in the US in 2007: 15 one-unit sites, 24 two-unit sites and 2 three-unit sites (Palo Verde 1, 2, 3; Onocee 1, 2, 3). Palo Verde Units 1, 2, 3 (Arizona) is the largest US site with 1 311, 1 314 and 1 247 MWe, respectively, with a total generation of 3 872 MWe. The smallest site in the US is Ft. Calhoun (Nebraska) at 478 MWe. The oldest US unit is Oyster Creek (New Jersey) which started commercial operations in April 1969. US sites designed with a single gaseous release stack at 2.5 times the highest structure are LaSalle County and Brown Ferry.

Thirty-two companies are licensed to operate nuclear reactors in the US in thirty-one states. Vermont has the highest nuclear generation of 73.7%. Others include South Carolina: 51.2%; New Jersey: 50.7%; Connecticut: 48.9%; Illinois: 47.8%. Palisades (Michigan) was granted a plant life extension of 20 years from the US Nuclear Regulatory Commission in 2007.

The highest ALARA expenditure reported to NATC in 2007 was DC Cook Nuclear Plant (Michigan) at $32 million for the removal of the RTD Bypass Lines to reduce lower containment dose rates during refuelling outages. Refuelling outage dose decreased from approximately 90 person-cSv pre-removal to 65 perseon-cSv post-removal.

U.S. Nuclear Regulatory Commission

Since 2000, the US NRC has used the three-year-rolling average collective dose as an indicator of a plant’s ALARA performance. In the Significance Determination Process for the occupational radiation safety cornerstone, each licensee’s three-year-rolling average is compared against criteria established earlier (1995-1997) of 1.35 man·Sv (135 person-rem)/unit for PWRs and 2.40 man·Sv (240 person-rem)/unit for BWRs to aid in determining the level of ALARA inspections for the next year. For 2005-2007, five (of 69) US PWRs exceeded the PWR criterion. For US BWRs during the same period, three (of 35) reactor units exceeded the criterion.

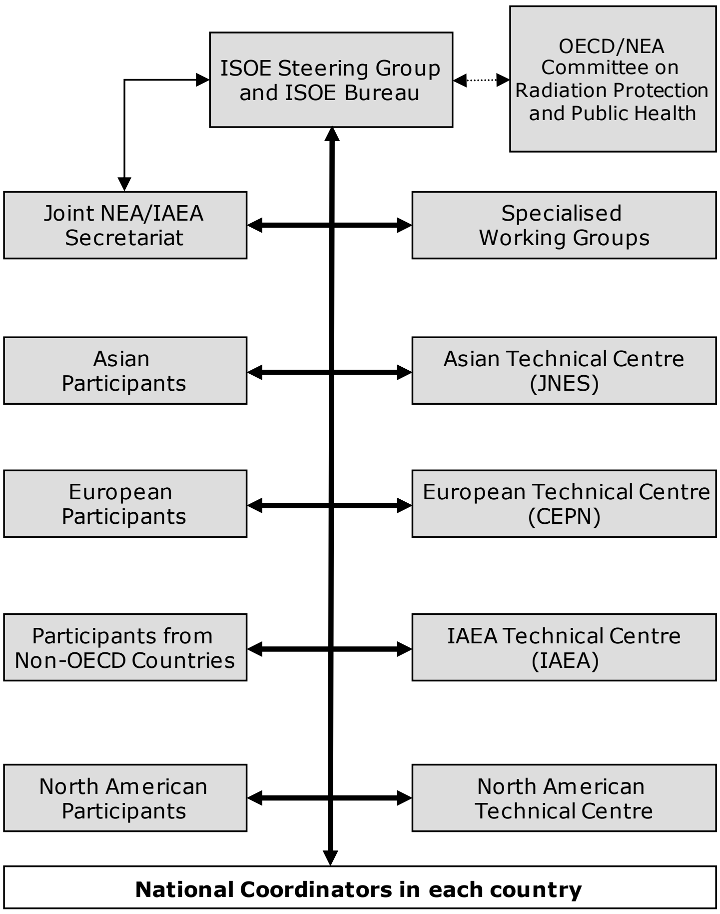
Annex 1

ISOE ORGANISATIONAL STRUCTURE AND PROPOSED PROGRAMME OF WORK FOR 2008

A.1 ISOE Organisational Structure

ISOE operates in a decentralised manner. A Steering Group composed of utility and regulatory authority representatives from all participating countries, supported by the joint NEA and IAEA Secretariat, provides overall direction. The ISOE Steering Group reports to the Steering Committee of the Nuclear Energy Agency through the NEA Committee on Radiation Protection and Public Health. More information on the organisational structure can be found on the NEA website (www.nea.fr).

Four ISOE Technical Centres (Europe, North America, Asia and IAEA) manage the programme's day-to-day technical operations, serving as contact point for the transfer of information from and to participants. A national co-ordinator in each country provides a link between the ISOE participants and the ISOE programme. A list of National Co-ordinators is given in Annex 6.



A.2 ISOE Programme of Work for 2008

The ISOE programme of work for the year 2008, approved at the 17th ISOE Steering Group Meeting (November 2007) will include:

1) ISOE database management

Data collection and management

Collection of ISOE 1 and ISOE 2 data: ISOE participants will provide their 2007 ISOE 1 and ISOE 2 data using the ISOE Software under Microsoft ACCESS and/or through the new ISOE Network data input modules, subject to their development and implementation status.

Collection of ISOE 3 reports: The ISOE Network will be used to exchange and record new ISOE 3-type information (i.e., radiation protection-related information for specific operations or tasks). All new ISOE 3 reports will be posted to the ISOE Network ALARA Library using a new form/template to be available on the website. All posted information will be searchable by keywords or topics in order to achieve the ISOE 3 experience exchange objective through implementation of an effective web-based information exchange ALARA-information portal.

Management of the official ISOE databases

- **On-line Update of Data:** Data available through the ISOE Network analysis module will be first updated by ETC in June 2008, and then at regular intervals through the rest of the year. Subject to the development schedule of the on-line data input modules, data submitted directly through the ISOE Network will be available as soon as the data is validated.
- **Official Database release:** The annual CD-ROM of the complete database, including 2007 data, will be released at the end of 2008.

Continued development of ISOEDAT on-line

- Phase 2 of the ISOEDAT web migration, focussing on development of web-enabled data entry modules for ISOE 1, will be completed and implemented on the ISOE Network according to the schedule proposed by the WGDA and development team. Phase 3, which will address migration of the ISOE 2 questionnaire, will be undertaken using the development basis of Phase 2.

2) ISOE management and programme activities

ISOE Steering Group/Management Board

The ISOE Steering Group (renamed the ISOE Management Board under the new ISOE Terms and Conditions, 2008-2011), supported by the ISOE Bureau, will continue to focus on ISOE programme management by reviewing and directing the progress of the programme at its annual meeting, developing and approving the programme of work for the coming year, and providing direction to its sub-groups.

ISOE Working Group on Data Analysis

The Working Group on Data Analysis (WGDA) will:

- Undertake and disseminate identified technical analyses (including standard routine analyses) of use to the ISOE membership, and contribute to the development of the ISOE Annual Report;
- Perform further analyses to clarify and enhance data from nuclear power plants which are in shut-down or some stage of decommissioning;
- Perform other technical analysis as directed by the Steering Group, based on end-user feedback and in support of the ISOE Annual Reports.

ISOE WGDA Expert Group on Work Management

The ad-hoc Expert Group on Work Management (EGWM) will complete a revision to the report "Work Management in the Nuclear Power Industry (OECD/NEA 1997)". The outcome will be a new ISOE publication on "Work Management to Optimise Occupational Radiation Protection in the Nuclear Power Industry", for which approval by the ISOE Steering Group will be requested by the end of 2008.

Schedule of Meetings for 2008

Regular meetings of the ISOE programme will continue according to the following schedule:

Meeting*	Feb	May	Sept	Nov
WGDA Expert Group on Work Management (EGWM)	X	X	X	
Technical Centre Co-ordination meeting		X		X
ISOE Bureau		X		X
Working Group on Data Analysis			X	
18th ISOE Management Board Meeting and ISOE International ALARA Symposium (in Japan)				X

**Ad-hoc meetings not included.*

ISOE Publications and Reports

The following ISOE publications and reports will be produced and published in 2008. Products will be made available through the ISOE Network as appropriate.

- **ISOE Annual Report 2007:** Publish the 17th Annual Report (2007) in September 2008.
- **ISOE Terms and Conditions:** Implement the revised ISOE Terms and Conditions (2008-2011).
- **ISOE News:** Continue to electronically issue current ISOE information through the ISOE News, according to ISOE Steering Group decision on frequency of publication.
- **ISOE Symposia Proceedings:** ETC will update the ISOE Network with available symposia proceedings and presentations, as provided to the ETC by each centre.
- **Report:** Work Management to Optimise Occupational Radiation Protection in the Nuclear Power Industry.
- **Benchmark Visit Reports:** Reports of benchmarking visits organised under ISOE will be made available to the ISOE membership through the ISOE Network. Additionally, ETC will, for its benchmarking visits organised outside of ISOE resources, do its best to make the reports available to ISOE Participants after agreement of the plant visited.

- **ISOE Brochure:** Publish ISOE Brochure and develop and electronic version linked to detailed information on the ISOE Network.

3) ISOE ALARA Symposium (International and Regional)

International Symposia:

- 2008 ISOE International ALARA Symposium, Tsuruga, Japan (13-14 November 2008), organised by ATC.
- 2009 ISOE International ALARA Symposium, Vienna, Austria (12-15 October 2009), organised by IAEA.

Regional Symposia:

- 2008 ISOE North American ALARA Symposium, Ft. Lauderdale, USA (14-16 January 2008), organised by NATC.
- 2008 ISOE European Regional Symposium, Turku, Finland (24-27 June 2008), organised by ETC.

4) ISOE Network Website Management and Technical Centre input

Network Website Management

Continue development and implementation of ISOE Network website enhancements subject to Steering Group guidance and based on a cohesive strategy to improve accessibility, ease of use, functionality and completeness of information. This work will be undertaken by a small task team, and will include efforts to improve website usefulness, unify servers, simplify passwords, develop mechanisms for continued feedback and promote the system amongst all members. Training sessions on the use of the ISOE Network tools will be organised to meet user needs (organised by the ETC on request). Improvements in the ALARA Library Search Function will be implemented by ATC and ETC. A new website structure, approved by the Steering Group, will be implemented.

Technical Centre Input for the ISOE Network

Technical Centres will continue to make their information available for posting on the ISOE Network. The ETC will continue to post all information and products from all regions as it is made available.

5) Information sheets, technical reports and information exchange

Technical Centre Information Sheets planned for 2008

Yearly analyses	**ATC**	**ETC**
European Dosimetric Results for 2007		X
Japanese Dosimetric Results for 2007	X	
Korean Dosimetric results for 2007	X	
Special analyses		
Evolution of Annual Outage Duration in all ISOE Regions (1997-2007)		X
Evolution of Steam Generator Replacement Dosimetric Results		X
Use of the Monetary Value of the Man-Sievert		X

Information Exchange Activities

The Technical Centres will continue to respond to special requests from users for technical feedback, and share this information with all participants globally, according to the access privileges as utility or authority member.

6) ISOE-organised benchmarking visits

The following site benchmarking visits will be organised in 2008 by the technical centres in co-ordination with the ISOE WGDA and Management Board:

ETC	Two EDF benchmarking visits organised by CEPN using ISOE contacts but not ISOE resources.
IAEATC	Benchmarking exercise at Cernovoda 1 (CANDU)

7) Other topics

Promotion of ISOE Use

- All users will be notified of the updated website through targeted emails. Other potential users and stakeholders will receive the revised ISOE promotional brochure.
- A mechanism for gathering feedback from users and providing information to users will be implemented through the ISOE Network and other means as appropriate.
- Further information on ISOE will be distributed to non-OECD country participants through IAEA Technical Co-operation Projects to IAEA Member States (non-OECD countries)

Annex 2

LIST OF ISOE PUBLICATIONS

Reports

1. *Occupational Exposures at Nuclear Power Plants: Sixteenth Annual Report of the ISOE Programme, 2006,* OECD, 2008.
2. *Occupational Exposures at Nuclear Power Plants: Fifteenth Annual Report of the ISOE Programme, 2005,* OECD, 2007.
3. *Occupational Exposures at Nuclear Power Plants: Fourteenth Annual Report of the ISOE Programme, 2004*, OECD, 2006.
4. *Occupational Exposures at Nuclear Power Plants: Thirteenth Annual Report of the ISOE Programme*, *2003*, OECD, 2005.
5. *Optimisation in Operational Radiation Protection,* OECD, 2005.
6. *Occupational Exposures at Nuclear Power Plants: Twelfth Annual Report of the ISOE Programme, 2002,* OECD, 2004.
7. *Occupational Exposure Management at Nuclear Power Plants: Third ISOE European Workshop, Portoroz, Slovenia, 17-19 April 2002,* OECD 2003.
8. *ISOE – Information Leaflet*, OECD 2003.
9. *Occupational Exposures at Nuclear Power Plants: Eleventh Annual Report of the ISOE Programme, 2001,* OECD, 2002.
10. *ISOE – Information System on Occupational Exposure, Ten Years of Experience*, OECD, 2002.
11. *Occupational Exposures at Nuclear Power Plants: Tenth Annual Report of the ISOE Programme, 2000*, OECD, 2001.
12. *Occupational Exposures at Nuclear Power Plants: Ninth Annual Report of the ISOE Programme, 1999*, OECD, 2000.
13. *Occupational Exposures at Nuclear Power Plants: Eighth Annual Report of the ISOE Programme, 1998,* OECD, 1999.
14. *Occupational Exposures at Nuclear Power Plants: Seventh Annual Report of the ISOE Programme, 1997*, OECD, 1999.
15. *Work Management in the Nuclear Power Industry*, OECD, 1997 (also available in Chinese, German, Russian and Spanish).
16. *ISOE – Sixth Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1996*, OECD, 1998.
17. *ISOE – Fifth Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1995,* OECD, 1997.
18. *ISOE – Fourth Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1994,* OECD, 1996.
19. *ISOE – Third Annual Report: Occupational Exposures at Nuclear Power Plants: 1969-1993,* OECD, 1995.
20. *ISOE – Nuclear Power Plant Occupational Exposures in OECD Countries: 1969-1992*, OECD, 1994.
21. *ISOE – Nuclear Power Plant Occupational Exposures in OECD Countries: 1969-1991,* OECD, 1993.

ISOE news

No. 10: July 2007	No. 5: April 2005
No. 9: March 2006	No. 4: December 2004
No. 8: December 2005	No. 3: July 2004
No. 7: October 2005	No. 2: March 2004
No. 6: June 2005	No. 1: December 2003

ISOE information sheets

Asian Technical Centre	
No. 31: Nov. 2007	2006 Korean dosimetric results
No. 30: Oct. 2007	Japanese dosimetric results: FY 2006 data and trends
No. 29: Nov. 2006	Japanese Dosimetric Results : FY 2005 Data and Trends
No. 28: Nov. 2005	Japanese Dosimetric Results : FY 2004 Data and Trends
No. 27: Nov. 2004	Achievements and Issues in Radiation Protection in the Republic of Korea
No. 26: Nov. 2004	Japanese occupational exposure during periodic inspection at PWRs and BWRs ended in FY 2003
No. 25: Nov. 2004	Japanese dosimetric results: FY2003 data and trends
No. 24: Oct. 2003	Japanese Occupational Exposure of Shroud Replacements
No. 23: Oct. 2003	Japanese Occupational Exposure of Steam Generator Replacements
No. 22: Oct. 2003	Korea, Republic of; Summary of national dosimetric trends
No. 21: Oct. 2003	Japanese occupational exposure during periodic inspection at PWRs and BWRs ended in FY 2002
No. 20: Oct. 2003	Japanese dosimetric results: FY2002 data and trends
No. 19: Oct. 2002	Korea, Republic of; Summary of national dosimetric trends
No. 18: Oct. 2002	Japanese occupational exposure during periodic inspection at PWRs and BWRs ended in FY 2001
No. 17: Oct. 2002	Japanese dosimetric results: FY2001 data and trends
No. 16: Oct. 2001	Japanese occupational exposure during periodical inspection at PWRs and BWRs ended in FY 2000
No. 15: Oct. 2001	Japanese Dosimetric results: FY 2000 data and trends
No. 14: Sept. 2000	Japanese Occupational Exposure During Periodical Inspection at LWRs Ended in FY 1999
No. 13: Sept. 2000	Japanese Dosimetric Results: FY 1999 Data and Trends
No. 12: Oct. 1999	Japanese Occupational Exposure During Periodical Inspection at LWRs Ended in FY 1998
No. 11: Oct. 1999	Japanese Dosimetric Results: FY 1998 Data and Trends
No. 10: Nov. 1999	Experience of 1st Annual Inspection Outage in an ABWR
No. 9: Oct. 1999	Replacement of Reactor Internals and Full System Decontamination at a Japanese BWR
No. 8: Oct. 1998	Japanese Occupational Exposure During Periodical Inspection at LWRs Ended in FY 1997
No. 7: Oct. 1998	Japanese Dosimetric Results: FY 1997 data

No. 6: Sept. 1997	Japanese Occupational Exposure during Periodical Inspection at LWRs ended in FY 1996
No. 5: Sept. 1997	Japanese Dosimetric Results: FY 1996 data
No. 4: July 1996	Japanese Occupational Exposure during Periodical Inspection at LWRs ended in FY 1995
No. 3: July 1996	Japanese Dosimetric Results: FY 1995 data
No. 2: Oct. 1995	Japanese Occupational Exposure during Periodical Inspection at LWRs ended in FY 1994
No. 1: Oct. 1995	Japanese Dosimetric Results: FY 1994 data
European Technical Centre	
No. 46: Oct. 2007	European dosimetric results for 2006
No. 44: July 2006	Preliminary European dosimetric results for 2005
No. 43: May 2006	Conclusions and recommendations from the Essen Symposium
No. 42: Nov. 2005	Self-employed Workers in Europe
No. 41: Oct. 2005	Update of the annual outage duration and doses in European reactors (1994-2004)
No. 40: Aug. 2005	Workers internal contamination practices survey
No. 39: July 2005	Preliminary European dosimetric results for 2004
No. 38: Nov. 2004	Update of the annual outage duration and doses in European reactors (1993-2003)
No. 37: July 2004	Conclusions and recommendations from the 4th European ISOE workshop on occupational exposure management at NPPs
No. 36: Oct. 2003	Update of the annual outage duration and doses in European reactors (1993-2002)
No. 35: July 2003	Preliminary European dosimetric results for 2002
No. 34: July 2003	Man-Sievert monetary value survey (2002 update)
No. 33: March 2003	Update of the annual outage duration and doses in European reactors (1993-2001)
No. 32: Nov. 2002	Conclusions and Recommendations from the 3rd European ISOE Workshop on Occupational Exposure Management at Nuclear Power Plants
No. 31: July 2002	Preliminary European Dosimetric Results for the year 2001
No. 30: April 2002	Occupational exposure and steam generator replacements - update
No. 29: April 2002	Implementation of Basic Safety Standards in the regulations of European countries
No. 28: Dec. 2001	Trends in collective doses per job from 1995 to 2000
No. 27: Oct. 2001	Annual outage duration and doses in European reactors
No. 26: July 2001	Preliminary European Dosimetric Results for the year 2000
No. 25: June 2000	Conclusions and recommendations from the 2nd EC/ISOE workshop on occupational exposure management at nuclear power plants
No. 24: June 2000	List of BWR and CANDU sister unit groups
No. 23: June 2000	Preliminary European Dosimetric Results 1999
No. 22: May 2000	Analysis of the evolution of collective dose related to insulation jobs in some European PWRs
No. 21: May 2000	Investigation on access and dosimetric follow-up rules in NPPs for foreign workers
No. 20: April 1999	Preliminary European Dosimetric Results 1998
No. 19: Oct. 1998	ISOE 3 data base – New ISOE 3 Questionnaires received (since Sept 1998)
No. 18: Sept. 1998	The Use of the man-Sievert monetary value in 1997
No. 17: Dec. 1998	Occupational Exposure and Steam Generator Replacements, update
No. 16: July 1998	Preliminary European Dosimetric Results for 1997

No. 15: Sept. 1998	PWR collective dose per job 1994-1995-1996 data
No. 14: July 1998	PWR collective dose per job 1994-1995-1996 data
No. 12: Sept. 1997	Occupational exposure and reactor vessel annealing
No. 11: Sept. 1997	Annual individual doses distributions: data available and statistical biases
No. 10: June 1997	Preliminary European Dosimetric Results for 1996
No. 9: Dec. 1996	Reactor Vessel Closure Head Replacement
No. 7: June 1996	Preliminary European Dosimetric Results for 1995
No. 6: April 1996	Overview of the first three Full System Decontamination
No. 4: June 1995	Preliminary European Dosimetric Results for 1994
No. 3: June 1994	First European Dosimetric Results: 1993 data
No. 2: May 1994	The influence of reactor age and installed power on collective dose: 1992 data
No. 1: April 1994	Occupational Exposure and Steam Generator Replacement
IAEA Technical Centre	
No. 9: Aug. 2003	Preliminary dosimetric results for 2002
No.8: Nov. 2002	Conclusions and Recommendations from the 3rd European ISOE Workshop on Occupational Exposure Management at Nuclear Power Plants
No. 7: Oct. 2002	Information on exposure data collected for the year 2001
No. 6: June 2001	Preliminary dosimetric results for 2000
No. 5: Sept. 2000	Preliminary dosimetric results for 1999
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. 3: April 1999	IAEA technical co-operation projects on improving occupational radiation protection in nuclear power plants
No. 2: April 1999	IAEA Publications on occupational radiation protection
No. 1: Oct. 1995	ISOE Expert meeting
North American Technical Centre	
NATC-No. 05-6	3-year rolling average annual dose comparisons Canadian CANDU (2002-2004)
NATC-No. 05-5	3-year rolling average annual dose comparisons US BWR (2002-2004)
NATC-No. 05-2	US BWR refuelling outage duration and dose trends for 2004
NATC-No. 05-1	US PWR refuelling outage duration and dose trends for 2004
NATC-No. 04-4	3-year rolling average annual dose comparisons US PWR (2002-2004)
No. 02-6: 2002	Monetary value of person-rem avoided
No. 02-5: July 2002	US BWR 2001 Occupational Dose Benchmarking Chart
No. 02-4: July 2002	US PWR 2001 Occupational Dose Benchmarking Chart
No. 02-2: July 2002	3-year rolling average annual dose comparisons US BWR (1999-2001)
No. 02-1: Nov. 2002	3-year rolling average annual dose comparisons US PWR (1999-2001)
No. 8: 2001	Monetary Value of person-REM Avoided: 2000
No. 7: 2001	U.S. BWR 2000 Occupational Dose Benchmarking Charts
No. 6: 2001	U.S. PWR 2000 Occupational Dose Benchmarking Charts
No. 5: 2001	3-year rolling average annual dose comparisons CANDU, 1998 – 2000
No. 4: 2001	3-year rolling average annual dose comparisons US BWR, 1998 – 2000
No. 3: 2001	3-year rolling average annual dose comparisons US PWR, 1998 – 2000

No. 2: 1998	Monetary Value of person-REM Avoided 1997
No. 1: July 1996	Swedish Approaches to Radiation Protection at Nuclear Power Plants: NATC site visit report by Peter Knapp

ISOE topical session reports

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

ISOE international and regional symposia

Asian Technical Centre	
Sept. 2007 (Seoul, Korea)	2007 ISOE Asian Regional ALARA Symposium
Oct. 2006 (Yuzawa, Japan)	2006 ISOE Asian Regional ALARA Symposium
Nov. 2005 (Hamaoka, Japan)	First Asian ALARA Symposium
European Technical Centre	
March 2006 (Essen, Germany)	2006 ISOE International ALARA Symposium
March 2004 (Lyon, France)	Fourth ISOE European 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
April 2000 (Tarragona, Spain)	Second EC/ISOE Workshop on Occupational Exposure Management at Nuclear Power Plants
Sept. 1998 (Malmö, Sweden)	First EC/ISOE Workshop on Occupational Exposure Management at Nuclear Power Plants
North American Technical Centre	
Jan. 2007 (Ft. Lauderdale, FL, USA)	2007 ISOE International ALARA Symposium
Jan. 2006 (Ft. Lauderdale, FL, USA)	2006 ISOE North American ALARA Symposium
Jan. 2005 (Ft. Lauderdale, FL, USA)	2005 ISOE International ALARA Symposium
Jan. 2004 (Ft. Lauderdale, FL, USA)	2004 North American ALARA Symposium
Jan. 2003 (Orlando, FL, USA)	2003 International ALARA Symposium
Feb. 2002 (Orlando, FL, USA)	North-American National ALARA Symposium
Feb. 2001 (Orlando, FL, USA)	2001 International ALARA Symposium
Jan. 2000 (Orlando, FL, USA)	North-American National ALARA Symposium
Jan. 1999 (Orlando, FL, USA)	Second International ALARA Symposium
March 1997 (Orlando, FL, USA)	First International ALARA Symposium

Annex 3

ISOE PARTICIPATION AS OF DECEMBER 2007

Officially participating utilities: detailed information on operating reactors

Country	Utility	Plant name	
Armenia	Armenian (Medzamor) NPP	Medzamor 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 5, 6	
Canada	Bruce Power	Bruce A3, A4 (A1, A2)*	Bruce B5, B6, B7, B8
	Ontario Power Generation	Darlington 1, 2, 3, 4	Pickering A1, A4 (A2, A3)* Pickering B5, B6, B7, B8
	Hydro Quebec	Gentilly 2	
	New Brunswick Power	Point Lepreau	
		*(*laid-up)*	
China	Guangdong Nuclear Power Joint Venture Co., Ltd	Daya Bay 1, 2	
	Qin Shan Nuclear Power Co.	Qinshan 1	
	Ling Ao Nuclear Power Co. Ltd	Ling Ao 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	Électricité de France (EDF)	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	E.ON Kernkraft GmbH	Brokdorf Grafenrheinfeld Grohnde	Isar 1, 2 Unterweser
	EnBW Kernfraft AG	Philippsburg 1, 2	Gemeinschaftskraftwerk-Neckar 1, 2
	RWE Power AG	Biblis A, B Emsland	Gundremmingen B, C
	Vattenfall Europe Nuclear Energy GmbH	Brunsbüttel	Krümmel
	(Where multiple owners and/or operators are involved, only Leading Undertakings are listed)		

Hungary	Magyar Vilamos Muvek Zrt	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 1,2	
	Kansai Electric Power Co.	Mihama 1, 2, 3 Ohi 1, 2, 3, 4	Takahama 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 Atomic Power Co.	Tokai 2	Tsuruga 1, 2
Korea, Republic of	Korean Hydro and Nuclear Power	Wolsong 1, 2, 3, 4 Kori 1, 2, 3, 4	Ulchin 1, 2, 3, 4, 5, 6 Yonggwang 1, 2, 3, 4, 5, 6
Lithuania	Ignalina Nuclear Power Plant	Ignalina 2	
Mexico	Comisiòn Federal de Electricidad	Laguna Verde 1, 2	
The Netherlands	N.V. EPZ	Borssele	
Pakistan	Pakistan Atomic Energy Commission	Chasnupp 1	Kanupp
Romania	Societatea Nationala Nuclearelectrica	Cernavoda 1, 2	
Russian Federation	Rosenergoatom	Balakovo 1, 2, 3, 4 Kalinin 1, 2, 3 Kola 1, 2, 3, 4	Novovoronezh 3, 4, 5 Volgodonsk 1
Slovak Republic	JAVYS	JAVYS 2	
	Slovenské Electrárne	Bohunice 3, 4	Mochovce 1, 2
Slovenia	Krsko Nuclear Power Plant	Krsko 1	
South Africa, Republic of	ESKOM	Koeberg 1, 2	
Spain	UNESA	Almaraz 1, 2 Asco 1, 2 Cofrentes	Santa Maria de Garona Trillo Vandellos 2
Sweden	Forsmarks Kraftgrupp AB (FKA)	Forsmark 1, 2, 3	
	OKG Aktiebolag AB (OKG)	Oskarshamn 1, 2, 3	
	Ringhals AB (RAB)	Ringhals 1, 2, 3, 4	
Switzerland	Forces Motrices Bernoises (FMB)	Mühleberg	
	Kernkraftwerk Gösgen-Däniken (KGD)	Gösgen	
	Kernkraftwerk Leibstadt AG (KKL)	Leibstadt	
	Nordostschweizerische Kraftwerke AG (NOK)	Beznau 1, 2	
Ukraine	Ministry of Fuel and Energy of Ukraine	Khmelnitski 1, 2 Rovno 1, 2, 3, 4	South Ukraine 1, 2, 3 Zaporozhe 1, 2, 3, 4, 5, 6
United Kingdom	British Energy	Sizewell B	

United States	American Electric Power	D.C. Cook 1, 2	South Texas 1, 2
	Arizona Public Service Co.	Palo Verde 1, 2, 3	
	Constellation Energy	Calvert Cliffs 1, 2 Ginna	Nine Mile Point 1, 2
	Progress Energy	H. B. Robinson 2	
	Entergy Nuclear NE	Indian Point 2, 3	
	Exelon	Braidwood 1, 2 Byron 1, 2 Clinton 1 Dresden 2, 3 LaSalle County 1, 2 Limerick 1, 2	Oyster Creek 1 Peach Bottom 2, 3 Pilgrim 1 Quad Cities 1, 2 TMI 1
	First Energy Corporation	Beaver Valley 1, 2 Davis Besse 1	Perry 1
	Florida Power and Light	Duane Arnold 1 Seabrook	St. Lucie 1, 2 Turkey Point 3, 4
	Nuclear Management Company	Kewaunee 1 Monticello 1 Palisades 1	Point Beach 1, 2 Prairie Island 1, 2
	Pacific Gas and Electric Co.	Diablo Canyon 1, 2	
	PPL Susquehanna LLC	Susquehanna 1, 2	
	South Carolina Electric Co.	Virgil C. Summer 1	
	Southern California Edison Co.	San Onofre 2, 3	
	Southern Nuclear Company	Vogtle 1, 2	
	TXU Electric	Comanche Peak 1, 2	

Officially participating utilities: Detailed information on definitively shutdown reactors

Country	Utility	Plant Name	
Bulgaria	Nuclear Power Plant Kozloduy	Kozloduy 1, 2, 3, 4	
Canada	Ontario Power Generation	NPD	
	Hydro Quebec	Gentilly 1	
France	Électricité de France (EDF)	Bugey 1 Chinon A1, A2, A3	Chooz A St. Laurent A1, A2
Germany	E.ON Kernfraft GmbH	Würgassen	Stade
	EnBW Kernkraft AG	Obrigheim	
	Energiewerke Nord GmbH	AVR Jülich	
	RWE Power AG	Mülheim-Kärlich	
	(Where multiple owners and/or operators are involved, only Leading Undertakings are listed)		
Italy	SOGIN	Caorso Garigliano	Latina Trino
Japan	Japan Atomic Power Co.	Tokai 1	
	Japan Atomic Energy Agency	Fugen (LWCHWR)	
Lithuania	Ignalina Nuclear Power Plant	Ignalina 1	
The Netherlands	BV GKN	Dodewaard	
Russian Federation	Concern Rosenergoatom	Novovoronezh 1, 2	
Slovak Republic	JAVYS	JAVYS 1	
Spain	UNESA	Jose Cabrera	Vandellos 1
Sweden	Barsebäck Kraft AB	Barsebäck 1, 2	
Ukraine	Ministry of Energy of Ukraine	Chernobyl 1, 2, 3	
United States	Amergen Energy Company	TMI 2	

	Entergy Nuclear NE	Indian Point 1	
	Exelon	Dresden 1 Peach Bottom 1	Zion 1, 2
	Nuclear Management Company	Big Rock Point 1	
	Pacific Gas and Electric Company	Humboldt Bay 3	
	Southern California Edison Co.	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	Direction Générale du Travail (DGT) du Ministère de l'emploi, de la cohésion sociale et du logement, represented by l'Institut de Radioprotection et de Sûreté Nucléaire (IRSN)
Germany	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, represented by GRS
Italy	Agenzia Nazionale per la Protezione dell'Ambiente (ANPA)
Japan	Ministry of Economy, Trade and Industry (METI)
Korea, Republic of	Ministry of Education, Science and Technology (MEST); Korea Institute of Nuclear Safety (KINS)
Lithuania	Radiation Protection Centre
Mexico	Commision Nacional de Seguridad Nuclear y Salvaguardias
The Netherlands	Ministerie van Sociale Zaken en Werkgelegenheld
Pakistan	Pakistan Atomic Energy Commission
Romania	National Commission for Nuclear Activities Control
Slovak Republic	Public Health Authority of the Slovak Republic
Slovenia	Slovenian Nuclear Safety Administration (SNSA); Slovenian Radiation Protection Administration (SRPA)
South Africa, Rep. of	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 (HSK, Swiss Federal Nuclear Safety Inspectorate)
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	The 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, Rep. of	IAEATC
France	ETC	Spain	ETC
Germany	ETC	Sweden	ETC
Hungary	ETC	Switzerland	ETC
Italy	ETC	Ukraine	IAEATC
Japan	ATC	United Kingdom	ETC
Korea, Republic of	ATC	United States	NATC
Lithuania	IAEATC		

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

ISOE Network and Technical Centre information

ISOE Network web portal	
ISOE Network	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, Urbana-Champaign, 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 co-operation

- European Commission (EC)

Annex 4

ISOE BUREAU, SECRETARIAT AND TECHNICAL CENTRES

Bureau of the ISOE Steering Group (2007)

Mr. Wataru Mizumachi (Chair, 2006-08)	Japan Nuclear Energy Safety Organisation JAPAN
Mr. Vasile Simionov (Chair-elect, 2006-08)	Cernavoda NPP ROMANIA
Mr. Jean-Yves Gagnon (Past Chair, 2004-06)	Centrale Nucleaire Gentilly-2, CANADA
Mr. Veli Riihiluoma (Vice-Chair, 2006-08)	Finnish Centre for Radiation and Nuclear Safety (STUK) FINLAND

ISOE Joint Secretariat

Mr. Brian Ahier
OECD Nuclear Energy Agency
12, boulevard des Îles
F-92130 Issy-les-Moulineaux, France
Tel: +33 1 45 24 10 45
Eml: brian.ahier@oecd.org

Mr. Pascal Deboodt
IAEA Technical Centre
International Atomic Energy Agency
Division of Radiation, Transport and Waste Safety
P.O. Box 100, A-1400 Vienna, Austria
Tel: +43 1 2600 26173
Eml: p.deboodt@iaea.org

ISOE Technical Centres

Asian Technical Centre (ATC)

Dr. Yoshihisa HAYASHIDA
Principal Officer
Asian Technical Centre
Japan Nuclear Energy Safety Organisation (JNES)
TOKYU REIT Toranomon Bldg. 8th Floor
3-17-1 Toranomon, Minato-ku,
Tokyo 105-0001, Japan
Tel: +81 3 4511 1953
Eml: hayashida-yoshihisa@jnes.go.jp

European Technical Centre (ETC)

Ms. Caroline SCHIEBER
European Technical Centre
CEPN
28, rue de la Redoute
F-92260 Fontenay-aux-Roses, France
Tel: +33 1 55 52 19 39
Eml: schieber@cepn.asso.fr

IAEA Technical Centre (IAEATC)

Mr. Pascal Deboodt
IAEA Technical Centre
International Atomic Energy Agency
Division of Radiation, Transport and Waste Safety
P.O. Box 100, A-1400 Vienna, Austria
Tel: +43 1 2600 26173
Eml: p.deboodt@iaea.org

North American Technical Centre (NATC)

Dr. David W. Miller
NATC Regional Co-ordinator
North American ALARA Center
Radiation Protection Department
Cook Nuclear Plant
One Cook Place
Bridgman, Michigan 49106, USA
Tel: +1 269 465 5901 x 2305
Eml: dwmiller2@aep.com

Annex 5

ISOE WORKING GROUPS (2007)

ISOE Working Group on Data Analysis (WGDA)

Chair: S. ZORRILLA (Mexico); Vice-Chair: J. KAULARD (Germany)

BELGIUM	
PETIT, Philippe	Electrabel
CANADA	
BUNDY, Kevin	Canadian Nuclear Safety Commission
GAGNON, Jean-Yves	Centrale Nucleaire Gentilly-2
CZECH REPUBLIC	
FARNIKOVA, Monika	Temelin NPP
KOC, Josef	Temelin NPP
FRANCE	
ABELA, Gonzague	EDF
D'ASCENZO, Lucie	CEPN (ETC)
SCHIEBER, Caroline	CEPN (ETC)
GERMANY	
KAPTEINAT, Peter	VGB-PowerTech
KAULARD, Jorg	Gesellschaft für Anlagen-und Reaktorsicherheit mbH
PFEFFER, Wolfgang	Gesellschaft für Anlagen-und Reaktorsicherheit mbH
JAPAN	
HAYASHIDA, Yoshihisa	Japan Nuclear Energy Safety Organization (ATC)
MIZUMACHI, Wataru	Japan Nuclear Energy Safety Organization (ATC)
KOREA (REPUBLIC OF)	
CHOI, Won-Chul	Korea Institute of Nuclear Safety (KINS)
MEXICO	
ZORRILLA, Sergio H.	Central Laguna Verde
ROMANIA	
SIMIONOV, Vasile	Cernovoda NPP
RUSSIAN FEDERATION	
GLASUNOV, Vadim	Russian Research Institute for Nuclear Power Plant Operation (VNIIAES)
SLOVENIA	
BREZNIK, Borut	Krsko NPP
SPAIN	
GARROTE PEREZ, Fernando	TECNATOM
GOMEZ-ARGUELLO GORDILLO, Beatriz	TECNATOM
GUZMAN LOPEZ-OCON, Olvido	Consejo de Seguridad Nuclear
LABARTA, Teresa	Consejo de Seguridad Nuclear
SWEDEN	
HENNIGOR, Staffan	Forsmarks Kraftgrupp AB
UNITED STATES OF AMERICA	
BROCK, Terry	U.S. Nuclear Regulatory Commission
DOTY, Rick	PPL Susquehanna LLC
MILLER, David .W.	D.C. Cook Plant (NATC)

WGDA Expert Group on Work Management

Chair: W. MIZUMACHI (Japan)

FRANCE	
BERTIN, Hélène	EDF
DROUET, François	CEPN (ETC)
SCHIEBER, Caroline	CEPN (ETC)
GERMANY	
STEINEL, Dieter	Philippsburg NPP
JAPAN	
HAYASHIDA, Yoshihisa	Japan Nuclear Energy Safety Organization (ATC)
MIZUMACHI, Wataru	Japan Nuclear Energy Safety Organization (ATC)
SUGAYA, Junko	Japan NUS Co., Ltd
KOREA (REPUBLIC OF)	
CHOI, Won-Chul	Korea Institute of Nuclear Safety (KINS)
MEXICO	
ZORRILLA, Sergio H.	Central Laguna Verde
ROMANIA	
SIMIONOV, Vasile	Cernovoda NPP
RUSSIAN FEDERATION	
GLASUNOV, Vadim	Russian Research Institute for Nuclear Power Plant Operation (VNIIAES)
SLOVENIA	
BREZNIK, Borut	Krsko NPP
SPAIN	
GARROTE PEREZ, Fernando	TECNATOM
SWEDEN	
HENNIGOR, Staffan	Forsmarks Kraftgrupp AB
UNITED KINGDOM	
LUNN, Matthew	Sizewell B NPP
RENN, Guy	Sizewell B NPP
UNITED STATES OF AMERICA	
DOTY, Rick	PPL Susquehanna LLC
HUNSICKER, John	VC Summer NGS
MILLER, David .W.	D.C. Cook Plant (NATC)
OHR, Ken	Quad Cities NGS

WGDA Task Team on Decommissioning

Chair: J. KAULARD (Germany)

ARMENIA	
AVETISYAN, Aida	Armenian Nuclear Regulatory Authority (ANRA)
FRANCE	
CROUAIL, Pascal	CEPN (ETC)
GERMANY	
JURETZKA, Peter	Stade NPP
KAULARD, Jorg	Gesellschaft für Anlagen-und Reaktorsicherheit mbH
JAPAN	
HAYASHIDA, Yoshihisa	Japan Nuclear Energy Safety Organization (ATC)
MIZUMACHI, Wataru	Japan Nuclear Energy Safety Organization (ATC)

MEXICO	
ZORRILLA, Sergio H.	Central Laguna Verde
ROMANIA	
SIMIONOV, Vasile	Cernovoda NPP
SPAIN	
ORTIZ RAMIS, Maria Teresa	ENRESA
SWEDEN	
LINDVALL, Carl Göran	Barsebäck Kraft AB
LORENTZ, Hakan	Barsebäck Kraft AB
UNITED STATES OF AMERICA	
MILLER, David W.	D.C. Cook Plant (NATC)

WGDA ISOEDAT-Web Working Group

France	
D'ASCENZO, Lucie	CEPN (ETC)
LEVY, Franck	CEPN (ETC)
JAPAN	
HAYASHIDA, Yoshihisa	Japan Nuclear Energy Safety Organization (ATC)
KOREA (REPUBLIC OF)	
CHOI, Won-Chul	Korea Institute of Nuclear Safety (KINS)
UNITED STATES OF AMERICA	
MILLER, David .W.	D.C. Cook Plant (NATC)
NEA Databank Services	
BOSSANT, Manuel	OECD/NEA
SOPPERA, Nicolas	OECD/NEA

ISOE Newsletter Editor

SLOVENIA	
Mr. Borut Breznik	Krsko NPP

Annex 6

ISOE STEERING GROUP AND NATIONAL CO-ORDINATORS[1]

Note: National Co-ordinators identified in **bold**.

ARMENIA	
ATOYAN, Vovik	Armenian Nuclear Power Plant Company
AVETISYAN, Aida	Armenian Nuclear Regulatory Authority
BELGIUM	
PETIT, Philippe	Electrabel (Tihange NPP)
GUISSET, Jean-Philippe	FANC-Federal Agency for Nuclear Control
BRAZIL	
do AMARAL, Marcos Antônio	Angra 1 & 2 NPP
BULGARIA	
VALTCHEV, Georgi	Kozloduy Nuclear Power Plant
KATZARSKA, Lidia	Bulgarian Nuclear Regulatory Agency
CANADA	
TRAHAN, Chris	Bruce Power
GAGNON, Jean-Yves	Centrale Nucleaire Gentilly-2
BUNDY, Kevin	Canadian Nuclear Safety Division
CHINA	
LI, Ruirong	Daya Bay NPS
CZECH REPUBLIC	
KOC, Josef	Temelin NPP, CEZ a.s.
URBANCIK, Libor	State Office for Nuclear Safety (SUJB)
FINLAND	
KONTIO, Timo	FortumPower and Heat Oy
RIIHILUOMA, Veli	Centre for Radiation and Nuclear Safety, STUK
FRANCE	
ABELA, Gonzague	EDF
GARCIER, Yves	EDF
COUASNON, Olivier	ASN
FERON, Fabien	IRSN
D'ASCENZO, Lucie	CEPN (ETC)
SCHIEBER, Caroline	CEPN (ETC)
GERMANY	
KAPTEINAT, Peter	VGB-PowerTech
BASCHNAGEL, Michael	RWE Power AG, Kraftwerk Biblis
KAULARD, Joerg	Gesellschaft fuer Anlagen-und Reaktorsicherheit mbH
PFEFFER, Wolfgang	Gesellschaft fuer Anlagen-und Reaktorsicherheit mbH
FRASCH, Gerhard	Bundesamt für Strahlenschutz

1. Note: The number of names listed in the Steering Group does not necessarily reflect the number of votes allocated to a particular country according to the ISOE Terms and Conditions.

HUNGARY	
BUJTAS, Tibor	PAKS Nuclear Power Plant Ltd.
ITALY	
ZACCARI, Vincenzo	SOGIN Spa
SGRILLI, Enrico	APAT
JAPAN	
HAYASHIDA, Yoshihisa	Japan Nuclear Energy Safety Organization (ATC)
MIZUMACHI, Wataru	Japan Nuclear Energy Safety Organization (ATC)
KOREA (REPUBLIC OF)	
CHOI, Won-Chul	Korea Institute of Nuclear Safety (KINS)
LITHUANIA	
PLETNIOV, Victor	Ignalina Nuclear Power Plant
MEXICO	
ZORRILLA, Sergio H.	Central Laguna Verde
THE NETHERLANDS	
MEERBACH, Antonius	NV EPZ
VAN DER WERF, Bob	Ministry For Environment
PAKISTAN	
MAHMOOD, Zhaffar	Chashma Nuclear Power Plant
NASIM, Bushra	Pakistan Nuclear Regulatory Authority
ROMANIA	
SIMIONOV, Vasile	CNE-PROD Cernavoda NPP
RODNA, Alexandru	National Commission for Nuclear Activities Control
RUSSIAN FEDERATION	
BEZRUKOV, Boris	Concern ROSENERGOATOM
GLASUNOV, Vadim	Russian Research Institute for Nuclear Power Plant Operation (VNIIAES)
SLOVAK REPUBLIC	
DOBIS, Lubomir	Bohunice NPP
VIKTORY, Dusan	Public Health Institute of the Slovak Republic
SLOVENIA	
BREZNIK, Borut	Krsko NPP
JANZEKOVIC, Helena	Slovenian Nuclear Safety Administration
JUG, Nina	Slovenian Radiation Protection Administration
SOUTH AFRICA (REPUBLIC OF)	
MAREE, Marc	Koeberg NPS
SPAIN	
GOMEZ-ARGUELLO GORDILLO, Beatriz	TECNATOM
GARROTE PEREZ, Fernando	TECNATOM
GUZMAN LOPEZ-OCON, Olvido	Consejo de Seguridad Nuclear
LABARTA, Teresa	Consejo de Seguridad Nuclear
SWEDEN	
SVEDBERG, Torgny	Ringhals AB
LINDVALL, Carl Göran	Barsebäck Kraft AB
LUND, Ingemar	Swedish Radiation Safety Authority
SWITZERLAND	
JAHN, Swen-Gunnar	HSK, Swiss Nuclear Safety Inspectorate

UKRAINE	
LISOVA, Tetyana	Ministry of Fuel and Energy of Ukraine
UNITED KINGDOM	
RENN, Guy	Sizewell B Power Station
ZODIATES, Tasos	Sizewell B Power Station
UNITED STATES OF AMERICA	
MILLER, David .W.	D.C. Cook Plant (NATC)
DOTY, Richard	PPL Susquehanna, LLC
BROCK, Terry	U.S. Nuclear Regulatory Commission
HOLAHAN, E. Vincent	U.S. Nuclear Regulatory Commission

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Occupational Exposures at Nuclear Power Plants – 2007

The Information System on Occupational Exposure (ISOE) was created by the OECD Nuclear Energy Agency in 1992 to promote and co-ordinate international co-operative undertakings in the area of worker protection at nuclear power plants. ISOE provides experts in occupational radiological protection with a forum for communication and exchange of experience.

The programme includes 71 participating utilities in 29 countries (334 operating units and 45 shutdown units), as well as the regulatory authorities of 25 countries. The ISOE database, annual symposia and ISOE Network website facilitate the exchange of operational experience and lessons learnt among participants.

The Seventeenth Annual Report of the ISOE Programme summarises occupational exposure data trends and ISOE achievements made during 2007. Principal developments in ISOE participating countries are also described.

ISOE is jointly sponsored by the OECD Nuclear Energy Agency and the International Atomic Energy Agency (IAEA).

ISOE Network: www.isoe-network.net

OECD Nuclear Energy Agency
Le Seine Saint-Germain – 12, boulevard des Îles
F-92130 Issy-les-Moulineaux, France
Tel.: +33 (0)1 4524 1015 – Fax: +33 (0)1 4524 1112
E-mail: nea@nea.fr – Internet: www.nea.fr

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