Occupational Dose Reduction at Nuclear Power Plants: Annotated Bibliography of Selected Readings in Radiation Protection and ALARA

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ABSTRACT

The ALARA Center at Brookhaven National Laboratory publishes a series of bibliographies of selected readings in radiation protection and ALARA in the continuing effort to collect and disseminate information on radiation dose reduction at nuclear power plants. This is volume 8 of the series. The abstracts in this bibliography were selected from proceedings of technical meetings and conferences, journals, research reports, and searches of the Energy Science and Technology database of the U.S. Department of Energy. The subject material of these abstracts relates to radiation protection and dose reduction, and ranges from the use of robotics, to operational health physics, to water chemistry. Material on the design, planning, and management of nuclear power stations is included, as well as information on decommissioning and safe storage efforts.

Volume 8 contains 232 abstracts, an author index, and a subject index. The author index is specific for

this volume. The subject index is cumulative and lists all abstract numbers from volumes 1 to 8. The numbers listed in boldface indicate the abstracts in this volume; the numbers not in boldface represent abstracts in previous volumes.

In addition, all information in this and previous volumes of the series is available through our on-line information system called ACE (ALARA Center Exchange). ACE is accessible through fax machines or personal computers interfaced with modems. The bibliography database and other databases are kept current with new abstracts, information on research projects, and recent news of international events related to ALARA at nuclear power plants. Access to the system is provided at no cost to the ALARA community. For password certification, a manual, and other information about our system, please contact the ALARA Center, Building 703M, Brookhaven National Laboratory, Upton, NY 11973, or call (516) 282-3228.

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National Laboratory, for developing the software program used to generate this report, and to Maria Beckman for her assistance in producing this report.

ABSTRACTS

1943. WINRE '92 - THIRD WORKSHOP ON INFORMATION MANAGEMENT IN NUCLEAR SAFETY, RADIATION PROTECTION, AND ENVIRONMENTAL PROTECTION. Edited by HOEPFNER, K.A. (Gesellschaft Fuer Anlagen-und Reaktorsicherheit (GRS) mbH, Koeln (Germany). WINRE-3, Koeln (Germany), 14-15 October 1992, CONF-9210460, 1993 (292 p).

The workshop puts much emphasis on the exchange of experience between experts from the West and from the Central and Eastern European countries. The representatives from the various countries and organizations are going to introduce their respective data banks, products, or services. The combination of papers and practical presentations will provide all with a qualified and comprehensive insight into the tried and tested as well as the new information management technologies in the specialist areas of nuclear safety, radiation protection, and environmental protection. Furthermore, it should also contribute to the promotion of the transfer of know-how between experts throughout the whole of Europe.

1944. RTARC: A COMPUTER CODE FOR RADIOLOGICAL SEVERE ACCIDENT CONSEQUENCE ASSESSMENT -- MODELS AND CODE DESCRIPTION. STUBNA, M.; KUSOVSKA, Z. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Slovakia)). Workshop on Decision Making Support for Off-site Emergency Management, Schloss Elmau (Germany), 25-30 October 1992, Radiation Protection Dosimetry (United Kingdom), Volume 50, Number 2-4, CONF-9210458, 1993, pp. 135-139.

Real-Time Accident Release Consequence (RTARC) is a computer code developed at the Nuclear Power Plants Research Institute, Trnava, Slovak Republic, to calculate and predict atmospheric transportation and off-site radiological consequences in the event of a nuclear accident or radiological emergency during the early phase. The code is used by nuclear facilities for basic emergency response planning and preparedness, real-time dose projection and dispersion calculations during an accident, and for post-accident analysis. The main objectives of the code are: (1) providing guidance for deploying and directing field measurement teams; (2) evaluating the consequences of assumed release mechanisms and rates; (3) evaluating the effectiveness of the protective measures; and (4) displaying data effectively in an emergency response facility. The code calculations include atmospheric transport and diffusion, dose assessment, evaluation

and display of the affected zones, evaluation of the early health effects, concentration and dose rate time dependence in the selected sites, etc. The simulation of the protective measures (sheltering, iodine administration) is involved.

1945. SMALL, SIMPLE BUT USEFUL: THE SSI APPROACH TO A REAL-TIME SYSTEM FOR DECISION MAKING SUPPORT. BAEVERSTAM, U. (Swedish Radiation Protection Inst., Stockholm (Sweden)). Workshop on Decision Making Support for Off-site Emergency Management, Schloss Elmau (Germany), 25-30 October 1992, Radiation Protection Dosimetry (United Kingdom), Volume 50, Number 2-4, CONF-9210458, 1993, pp. 93-97.

In case of a nuclear accident or a threat of a release, the Swedish Radiation Protection Institute (SSI) is responsible for advising and informing the Government, other authorities and the public. The institute's experts are supported by a newly developed, small computerized system. Some components of the system are: a simple model for atmospheric dispersion and dose predictions; databases including maps, nuclides, instruments and facilities to store and handle measured values; on-line connection to nationwide system of automatic measuring stations; a number of data display facilities; and computer based handbooks. Most software for the system is written for the MS Windows environment.

1946. NUCLEAR POWER AND THE PUBLIC. CASTELL, L. (Technische Univ. Muenchen, Garching (Germany)). Workshop on Decision Making Support for Off-site Emergency Management, Schloss Elmau (Germany), 25-30 October 1992, Radiation Protection Dosimetry (United Kingdom), Volume 50, Number 2-4, CONF-9210458, 1993, pp. 91-92.

A change in the politics of national governments concerning information on radiation from nuclear power stations is proposed. It includes a close cooperation with those citizens' initiatives, which have established an early warning system for radioactive contamination. Today the whole population should be informed in detail how to behave in case of a possible nuclear accident. This could avoid a likely panic with enormous casualties in case of a major breakdown of a nuclear reactor in the vicinity of a large town. Information on the size, the equipment, and the scientific standards of the initiatives are given.

1947. TECDO-STATUS AND RECENT DEVELOPMENTS. RIEDEL, U.; HOEPFNER, K.A. (Gesellschaft fuer Anlagen-und Reaktorsicherheit (GRS) mbH, Koeln (Germany)). Workshop on Information Management in Nuclear Safety, Radiation Protection and Environmental Protection (WINRE-3), 14-15 October 1992, GRS-96, CONF-9210460, January 1993, pp. 187-193 (292 p).

The purpose of the closed, though company-wide accessible, information retrieval system, TECDO, is to provide central electronic storage for all technical documents that have any importance to the safety evaluation of nuclear power plants and other nuclear facilities. This information material is made easily accessible to all installations of the GRS throughout Germany, and also to the BMU in Bonn, through the local and wide area networks (WAN/LAN) that connect these installations. In this role as the central information retrieval system of the GRS, TECDO must provide considerable end-user friendliness such that even the occasional user is quickly supplied with comprehensive information without each time requiring a crash course on the how-to of PC operation.

1948. OPERATION OF FINNISH NUCLEAR POWER PLANTS. Edited by TOSSAVAINEN, K. (Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland)), STUK-B-YTO-112, December 1993 (24 p).

Quarterly reports on the operation of Finnish nuclear power plants describe events and observations related to nuclear and radiation safety which the Finnish Centre for Radiation and Nuclear Safety considers safety significant. Safety-enhancing plant modifications and general matters relating to the use of nuclear energy are also reported. A summary of the radiation safety of plant personnel and the environment, and tabulated data on the plants' production and their load factors are also given. At the Loviisa 1 plant unit one of two specially-backed AC busbars was lost during the second quarter of 1993. A ca. 30 minute voltage break caused malfunctions in the plant unit's electrical equipment and rendered inoperable certain components important to safety. The event is rated on the International Nuclear Event Scale (INES) at level 1. In inspections carried out at TVO II during the annual maintenance outage, the number of cracks detected in control rod structural material was higher than usual. When cracks occur, part of boron carbide, the power regulating medium in control rods, may wash into the reactor water and control rod shutdown capability may be impaired. The event is rated on the INES at level 1. Other events in the second quarter of 1993 had no bearing on nuclear or radiation safety.

1949. AVK - A DOCUMENTATION SYSTEM FOR RADIOACTIVE WASTE. GRUENDLER, D. (Institut fuer Sicherheitstechnologie (IST) GmbH, Koeln (Germany)); WURTINGER, W. (Gesellschaft fuer Anlagen-und Reaktorsicherheit (GRS) mbH, Koeln (Germany)); SCHLESINGER, H. (Gesellschaft fuer Nuklear-Service (GNS) mbH, Essen (Germany)). WINRE '92 3rd Workshop on Information Management in Nuclear Safety, Radiation Protection, and Environmental Protection, 14-15 October 1992, GRS-96, CONF-9210460, 1993, pp. 139-146 (292 p).

The program AVK is a decentralized data base system for bookkeeping of radioactive wastes from German nuclear power plants. It keeps track of radioactive wastes from their origin to their disposal in a final repository. AVK ensures that the exact location and the state of treatment of any nuclear waste can be accurately determined at any time required.

1950. ENGINEERING AND SAFETY ASPECTS OF THE DECOMMISSIONING AND DISMANTLING OF NUCLEAR INSTALLATIONS. THOMAS, W. (Gesellschaft fuer Anlagen-und Reaktorsicherheit (GRS) mbH, Garching (Germany)). Decommissioning and Dismantling of Nuclear Installations. Edited by PELZER, N., Regional Meeting of the German Section of the International Nuclear Law Association: Decommissioning and Removal of Nuclear Facilities, CONF-920755, 2-3 July 1992, in German, pp. 29-49 (326 p).

It is possible with the available know-how and technology to decommission even large nuclear power plants. The current decommissioning activities have proven the suitability and feasibility of all processes involved, which applies to scheduled decommissioning activities according to a licensed programme. The experience gained so far shows: Safety of personnel is safeguarded. Clearing the fuel from the site significantly reduces the site risk or potential hazards to the environment, radiological protection of the population is safeguarded. During the period of safe enclosure, the collective dose to be expected reduces to approximately half the initial dose. The radioactive waste arisings remain practically the same. From the total waste volume of a nuclear power plant of more than 150.000 tonnes, only about 3000 tonnes have to be managed as radioactive wastes. This is about 2% of the total material; all other wastes are suitable for recycling. The relevant radioactivity measuring processes can be reliably done even in the case of large quantities of material. Decommissioning according to a specified programme after an accident has happened in the facility can only be done if the high-level radioactive fuel can be com-

pletely removed from the site. This not being feasible requires the entire reactor together with the radioactive inventory to be mothballed, and decommissioning work is postponed indefinitely.

1951. IMPOSITION AND ENFORCEMENT OF DECOMMISSIONING REQUIREMENTS IN THE U.K. - A PROSPECTIVE VIEW.

GRAZEBROOK, D. (U.K. Atomic Energy Authority, Peaslake (United Kingdom)). Edited by PELZER, N., Regional Meeting of the German Section of the International Nuclear Law Association: Decommissioning and Dismantling of Nuclear Installations, Schwerin (Germany), 2-3 July 1992, CONF-920755, 1993, pp. 67-78 (326 p.)

The author reviews the structure and content of existing U.K. legislation applicable to nuclear installations and examines how policy decisions about decommissioning may be accommodated therein. Planning legislation in relation to nuclear electricity generating stations and other nuclear installations is discussed with some reference to the proceedings at recent public enquiries. Environmental law governing the keeping and dispersal of radioactive substances is considered. The combined effect of the Nuclear Installations Act 1965 and the Health and Safety at Work Act 1974 on the implementation of decommissioning plans with particular reference to the protection of the work force and the public is summarized and explained.

1952. APPLICATIONS OF ALARA CRITERIA FOR EXTERNAL WORKERS AND CONTRACTORS. CAMPO, E. DEL; CASANOVA, T.; Radio-protection (Spain), Volume 2, 1993, in Spanish, pp. 10-16.

The ICRP recommendations address for 3 sectors: Nuclear Industry, Nuclear Medicine Facilities, and Public in general. These recommendations focus on professional exposed workers. In another way the study of NRPB addresses 5 sectors: nuclear industry, health, general industry, natural radiation sources and specialized training. This article analyzes the ALARA applications to contractors and external workers in Spanish Nuclear Power Plants.

1953. THE USE OF MOBILE DOSE RATE MEASURING STATIONS FOR EMISSION MONITORING IN THE VICINITY OF NUCLEAR POWER PLANT. KIRCHHOFF, K.; SALFELD, H.C. (Niederschsisches Landesamt Fuer Immissionschutz, Hannover (Germany)). Eighth Experts Meeting on Environmental Radioactivity Monitoring: Technical and Organizational Means for an Optimised Measurement of Ambient Radioactivity

the Environment of Nuclear Facility, Berlin (Germany), 24-26 October 1990, INIS-mf-14199, CONF-9010555, 1991, in German, pp. 347-354 (461 p).

Mobile ambient dose rate measuring instruments (radio measuring probes) shall be applied in special situations, (e.g., after undue release of radioactive material), for monitoring of the ambient dose rate in the environment of nuclear facilities and at other places to be monitored if necessity arises, at short notice and for short periods. They shall replace the ambient dose rate measuring rings which were installed in some federal lands in accordance with the KFU guideline. Unlike the concept of the measuring rings which uses measuring instruments operated permanently at every nuclear facility, the concept described in the lecture relies on mobile measuring instruments which are operated in response to actual needs, at the place and time required. It is therefore not necessary to continuously operate the measuring instruments in the field, so that the operating costs can be reduced considerably. In the Land of Lower Saxony, there are six nuclear facilities to be monitored, which at present are covered by the existing warning service measuring network, so that a number of twenty radio measuring probes in the first phase are considered to be sufficient.

1954. NUCLEAR SURVEILLANCE ON NUCLEAR POWER PLANTS IN POLAND. PART 2. REGULATION OF THE SECOND NUCLEAR POWER PLANT. PAWLAK, A. (National Atomic Energy Agency, Warsaw (Poland)). Bezpieczenstwo Jadrowe i Ochrona Radiologiczna (Poland), Number 3, 1990, in Polish, pp. 11-14.

The article describes licensing process of the NPP "Warta" on the stage of its localization. The Nuclear Surveillances activities focussed on such choice of the localization which would fulfill nuclear safety and radiological protection requirements are discussed in detail.

1955. WESTERN AID PROGRAMS FOR EAST EUROPEAN NUCLEAR REACTORS. VAN SEUREN, J.R., (Business Unit Nuclear Energy, Netherlands Energy Research Foundation, Petten (Netherlands)). Ingenieur (The Hague, Netherlands), Volume 105, Number 11, November 1993, in Dutch, pp. 12-17.

Western organizations in the European Community and of the G7 countries set up aid programs to give financial and technical support to Eastern Europe to improve the safety of their nuclear power plants and reactors. Attention is paid to the safety of those

plants, the contents of the bilateral and multilateral aid programs (Technical Assistance Commonwealth of Independent States or TACIS, and the Poland and Hungary Assistance to the Reconstruction of the Economy or PHARE) the amount of money involved, and how the programs can be carried out.

1956. CALCULATION OF THE ANNUAL RADIATION DOSE TO THE POPULATION IN THE VICINITY OF NUCLEAR INSTALLATIONS DUE TO LIQUID EFFLUENTS. GANS, I. (Inst. fuer Wasser, Boden und Lufthygiene, Bundesgesundheitsamt, Berlin (Germany)). Eighth Experts Meeting on Environmental Radioactivity Monitoring: Technical and Organizational Means for an Optimised Measurement of Ambient Radioactivity in the Environment of Nuclear Facilities, Berlin (Germany), 24-26 October 1990, INIS-mf-14199, CONF-9010555, 1991, in German, pp. 116-123 (461 p).

Since 1974, assessments of radiation exposure due to the emission of radioactive substances with liquid effluents have been done by the Institut fuer Wasser-, Boden- und Lufthygiene of the Federal Health Office and data have been published in the annual reports in the series "Umweltradioaktivitaet und Strahlenbelastung." The paper explains the radioecological models of ABG and AVV as far as they relate to the wastewater pathway, as well as the required modifications. Individual aspects of computation are explained referring to the dose calculations for 1989.

1957. CALCULATION OF THE ANNUAL RADIATION DOSE TO THE POPULATION IN THE VICINITY OF NUCLEAR INSTALLATIONS DUE TO AIRBORNE RADIOACTIVITY. WILDERMUTH, H.; WALTER, H.; HAUBELT, R. Eighth Experts Meeting on Environmental Radioactivity Monitoring: Technical and Organizational Means for an Optimised Measurement of Ambient Radioactivity in the Environment of Nuclear Facilities, Berlin (Germany), 24-26 October 1990, INIS-mf-14199, CONF-9010555, 1991, in German, pp. 107-115 (461 p).

The annual radiation exposure of the population in the environment of nuclear facilities due to the emission of radioactive material is depending on many variables and therefore can be determined only with considerable effort. Reports therefore publish maximum values of radiation exposure which are possible, but only under the condition of simultaneous occurrence of various, unfavorable conditions. It is essential in this context that the dose values are on the safe side, so that the radiation exposure is not underestimated. This is achieved by the radiation

exposure being calculated for the reference person, as required by the Radiation Protection Ordinance. Examples are explained.

1958. CALIBRATION OF RADIATION MONITORS AT NUCLEAR POWER PLANTS. BOUDREAU, L. (Louisiana Laissez-Faire, Inc., Metairie, LA); MILLER, A.D. (Pedro Point Technology, Inc., Pacifica, CA); NAUGHTON, M.D. (Tarawest Technologies, San Jose, CA). Electric Power Research Institute, Palo Alto, CA, EPRI-TR-102644, March 1994 (57 p).

This work was performed to provide guidance to the utilities in the primary and secondary calibration of the radiation monitoring systems (RMS) installed in nuclear power plants. These systems are installed in nuclear power plants to monitor ongoing processes, identify changing radiation fields, predict and limit personnel radiation exposures and measure and control discharge of radioactive materials to the environment. RMS are checked and calibrated on a continuing basis to ensure their precision and accuracy. This report discusses various approaches towards primary and secondary calibrations of the RMS equipment in light of accepted practices at typical power plants and recent interpretations of regulatory guidance. Detailed calibration techniques and overall system responses, trends, and practices are discussed. Industry, utility, and regulatory sources were contacted to create an overall consensus of the most reasonable approaches to optimizing the performance of this equipment.

1959. COMPUTER AIDED DATA PROCESSING FOR EXPOSURE CONTROL AT TAPS. SAWANT, R.V.; ADTANI, M.M.; SADAGOPAN, R.; DATTA, D. (Bhabha Atomic Research Centre, Bombay (India)). Bulletin of Radiation Protection (India), Volume 14, Number 3-4, July-December 1991, pp. 17-18.

At TAPS 1200 radiation workers are monitored on a monthly basis. Computer-aided data processing is helpful to control the personnel exposures in nuclear power plants where quickness, reliability and accuracy are involved. A new algorithm DABTAP (Computer Data Base Code for TAPS) was developed for the analysis of voluminous dose data and has been made operational on IBM PC/XT and SN-23 computer. Statistics reports are printed. Dose analysis is also done by this code which helps to keep individual's dose equivalents within limits and also for arranging planned exposures with selective radiation workers quickly. The same software with little modification can be used in other power reactors for personnel monitoring.

1960. IMPORTANCE OF NUCLEAR POWER PLANT TECHNOLOGY AND MANPOWER TRAINING. SRI RAM, K. (Indian Institute of Technology, Kanpur (India)). 20th Annual IARP Conference on Radiation Protection, Kanpur (India), 24-26 February 1993, Bulletin of Radiation Protection (India), Volume 16, Number 1-2, CONF-9302170, January-June 1993, pp. 9-14.

Over the past fifty years the design of nuclear plants has been constantly reviewed, improved from the radiation exposure to public and plant integrity and safety. Recently forgiving or inherently safe reactor plant design concepts are proposed and the concept of modular design is envisaged to cut down the delays in licensing procedures and construction time. Attention is also being focused on the human factors to avoid the type of severe accidents that have plagued the nuclear power plants. This paper looks at the impact of these developments on nuclear industry and radiation protection.

1961. THE NORDIC PROGRAMME FOR NUCLEAR SAFETY 1990-1993: STATUS REPORT FOR THE FIRST HALF OF 1993. Nordisk Kernesikkerhedsforskning, Roskilde (Denmark), NKS-93-9, August 1993 (45 p).

The report contains summaries written by leaders of the various projects carried out under the Nordic programme for nuclear safety during the first half-year of 1993. The programme covers spreading prognoses and consequences, strategy and methods for management and exchange of data for decision-makers, the evaluation and harmonizing of countermeasures and use of intervention levels, the basis for public information, Nordic emergency exercises, the reestablishment of radioactive contaminated areas, criteria for classification of radioactive materials, decommissioning of uranium-cleaning plants, storage of information, removal and disposal of contaminated soil from fields, influence of climatological and geological processes on long-term storage of radioactive wastes, training, quality assurance, aquatic radioecology, agriculture's radioecology, natural and semi-natural terrestrial ecosystems, reactor safety and personnel preparedness, safety evaluation, severe accidents and design and safety features of nuclear installations in countries which are neighbors to the Nordic lands. Budgets of expenditures for the various project groups are presented.

1962. OPERATIONAL HEALTH PHYSICS. Edited by SHLEIEN, B. In: The Health Physics and Radiological Health Handbook, Scinta, Inc., 1992, pp. 397-484 (742 p).

This chapter emphasizes the practical everyday good work practices in various aspects of health physics. The breadth of operational health physics is such that the Chapter is organized into sections on: Section 1. Laboratory Operation and Good Work Practices; Section 2. Nuclear Power Plants; Section 3. Atmospheric Dispersion and Environmental Monitoring; Section 4. Medical/Accelerator/X-Ray Diffraction; Section 5. Emergencies. Included are pertinent data related to reactor source terms, atmospheric dispersion, radiation surveys, contamination guidance and release levels and surface decontamination techniques.

1963. FIRST ALARA SUCCESS AT GOLFECH. PUJOL, P. (Centre Nuclaire de Production d'Electricité, 82 - Golfech (France)). Radioprotection (Bulletin de la Societe Francaise de Radioprotection) (France), Volume 28, Number 4, October-December 1993, in French, pp. 423-430.

Since 1991, Electricité de France nuclear power plants have started the implementation of a policy of radiation protection optimization. At the Golfech nuclear power station, one of the 20 French nuclear sites, an ALARA procedure was immediately set up and the results obtained during unit 1 first outage (an inspection representing over 400 000 hours' work) were most encouraging. The paper explains how - under the impetus of the management and ALARA committee - the procedure worked towards excellent results thanks to every actors' mobilization and motivation.

1964. FUEL INTEGRITY AND DOSE CONTROL. GUPTA, V.K.; SUNNY, S. (Atomic Energy Regulatory Board, Bombay (India)). Annual IARP Conference on Radiation Protection, Kanpur (India), 24-26 February 1993, Bulletin of Radiation Protection (India), Volume 16, Number 1-2, CONF-9302170, January-June 1993, pp. 116-119.

Radiation exposure of personnel in nuclear power plants can be reduced by source control, through use of materials of construction which have low cobalt content and improving the integrity of fuel. Pressurized Heavy Water Reactor design and operating philosophy are ideally suited to control the fission product inventory in the coolant by on power removal of failed fuel. A study of the radiological parameters, collected routinely as well as through specific measurements for the last eight years (1985-92) has been analyzed. It is seen that improved fuel performance has definite effect on reducing the collective external exposure of maintenance personnel whereas it does not affect the collective exposure of operating personnel. It is, therefore, necessary to investigate if the level of exposure of operating personnel is optimal.

1965. RADIATION-HYGIENIC PROBLEMS OF NUCLEAR POWER FACILITIES SHUT-DOWN. NOVOZHILOV, G.N.; ZHOLUS, B.I.; PETROV, O.I.; GREBEN'KOV, S.V.; ALFEROV, A.P.; ROMANOVICH, I.K. Voenno-Meditsinskii Zhurnal (Russian Federation), Volume 3, March 1993, in Russian, pp. 41-43.

Radiation-hygienic problems are discussed of the nuclear power plants (NPP) decommissioning: NPP power units, research and test reactors, ship nuclear power plants (at submarines, ice-breakers, research and transport ships). Attention is paid to the choice of optimum variant of the NPP decommissioning. Three variants of the nuclear reactor decommissioning are available: shutdown for 30-50 years with further total dismantling; partial dismantling with further limited use of the NPP equipment and site for non-nuclear purposes; total dismantling just after the reactor shutdown with the use of site after the proper treatment. Methods of the dismantling are also considered. Special attention is paid to the transportable NPP decommissioning. Problems of the waste disposal are discussed as well as radiation doses to personnel and population. Environmental impacts are also under consideration.

1966. RADIATION SAFETY. INNOVATION FROM SEIBERSDORF REGISTERS RADIOACTIVE HAZARD POTENTIAL. SCHMITZER, C. (Oesterrichisches Forschungszentrum Seibersdorf GmbH (Austria)). Austria Innovative (Austria), Volume 3, October 1993, in German, pp. 15-16.

The principal objective of radiation protection is to maintain safety standards with respect to radiation exposure. Well known nuclear accidents have shown that hazard potentials have to be carefully evaluated, even without nuclear power plants on Austrian territory. The Austrian Research Centre has designed and developed a radiation survey meter based on an analysis of user requirements. This cooperation with potential users and "smart solutions" in many technical areas have helped to create a device, which has found wide acceptance due to its high quality, simple operation, and excellent performance.

1967. LOCAL OPINION - THE IMPACT OF TWO VISITOR CENTRE STUDIES AT OLKI-LUOTO. AEMMAELAE, V.M. (Teollisuuden Voima Oy (Finland)). Nuclear Energy Agency, 75 - Paris, International Seminar on Visitor Centres at Nuclear Facility Sites, Madrid (Spain), 2-5 November 1992, CONF-9211298, 1993, pp. 273-283 (288 p).

Teollisuuden Voima Oy (TVO) has recently commissioned two opinion polls about attitudes towards

nuclear power. The target group of the first research was teachers in the nearby community. The subject of the poll was attitudes towards nuclear power and the impact of a visit. The second research handles the company image of TVO target groups being local elected officials, press, teachers and local representatives of trade organizations. The aim of these two studies was to measure the impact of the company's information and visits activities to the attitudes.

1968. THE ROLE OF VISITORS CENTRES AT NUCLEAR FACILITY SITES. ANDERIZ CEBRIAN, D. Nuclear Energy Agency, 75 - Paris, International Seminar on Visitor Centres at Nuclear Facility Sites, Madrid (Spain), 2-5 November 1992, CONF-9211298, 1993, pp. 263-272 (288 p).

The Nuclear Safety Council is the agency within the Spanish State entrusted with nuclear safety and radiological protection. Its information activities are explained. The future creation of an information centre is being considered as part of its technical divulgation programme in matters of public information.

1969. STRATEGIES FOR PROMOTING VISITS TO INFORMATION CENTRES. THE SANTA MARIA DE GARONA EXPERIENCE. CORNADO, A. Nuclear Energy Agency, 75 - Paris, International Seminar on Visitor Centres at Nuclear Facility Sites, Madrid (Spain), 2-5 November 1992, CONF-9211298, 1993, pp. 239-249 (288 p).

The information centre went into operation in May 1992. The experience accumulated over the months in which the Information Centre has been in operation have taught all of us actively involved a lot of lessons: coherence between the image of the Information Centre and that of the company itself; the message transmitted, clear and not aimed at any obvious target or objective; the basic importance of the team of people as regards the attention given to the visits; finally, attempt to establish an efficient communication.

1970. VISITOR CENTRE AT NUCLEAR FACILITY SITE OF LA HAGUE. MARIE-SAINTE, E.; JOZEAU-MARIGNE, M. (Compagnie Generale Des Matieres Nucleaires (Cogema), Velizy-Villacoublay (France)). Nuclear Energy Agency, 75 - Paris, International Seminar on Visitor Centers at Nuclear Facility Sites, Madrid (Spain), 2-5 November 1992, CONF-9211298, 1993, in French, pp. 159-166 (288 p).

Cogema, a french fuel reprocessing plant, reprocesses spent fuel issued from french nuclear power plants,

but also Japanese, German, Swiss, Belgian, Dutch ones. Since 1976, Cogema has reprocessed more than 5000 tons of spent fuel, about 85% of spent fuel in the world with a market economy. Since 1976, Cogema has a department which is in charge of visits of the firm. Five persons, communication assistants in charge of relations with the public organize all year long, visits on the site. A visitors' centre has been built in 1974 by the CEA (Commissariat a l'Energie Atomique). It is opened to the public six months by year, from 1st of April until 30 of September, seven days a week. The visitors' centre is situated out of the factory enclosure, so everybody can come in without formality. Entrance is free. Four floors to explain what is fuel cycle, reprocessing, environment surveillance, radiation protection, dosimetry, panels with elementary notions of nuclear physics (atom, fission, reactor working), use of atom in medicine and non nuclear industry, a whole of general information related to nuclear historical record, fuel cycle, and particularly activities of La Hague.

1971. CHINON MUSEUM: SO AS NOT TO LOSE THE BALL. POULAIN, E. (Electricité de France, Chinon (France)). Nuclear Energy Agency, 75 - Paris, International Seminar on Visitor Centres at Nuclear Facility Sites, Madrid (Spain), 2-5 November 1992, CONF-9211298, 1993, pp. 143-146 (288 p).

Of all the french nuclear power plants, Chinon is the most frequented, with an average of 45,000 visitors per year. After going through the Public Information Centre, visitors can see the nuclear museum (the first commercial power plant built in France). The exhibition makes it possible to more fully understand the museum and appreciate the strategy adopted to enhance the quality of the visits.

1972. CONCEPTUAL DESIGN AND EQUIPMENT OF VISITOR CENTRES. HUETTINGER, K., Nuclear Energy Agency, 75 - Paris, International Seminar on Visitor Centres at Nuclear Facility Sites, Madrid (Spain), 2-5 November 1992, CONF-9211298, 1993, pp. 121-135 (288 p).

Discussing the needs to be met by a visitor centre, the author develops the strategies to be adopted and defines the items to be included in the information program. The procedure in preparing the layout and design are explained and the media available to provide various levels of information are listed. Principles of selecting and mixing the media are discussed and the functions of the various sections of the centre described. Also included are examples of the costs and time requirements for the establishment

of a typical centre. The importance of regular maintenance and updating is emphasized.

1973. COMPUTER VISION MAPPING SYSTEM. CHATTERJEE, M.; UNEMORI, A.; THANGAM, N.; JAIN, D. (ASD International Inc.); HENDERSON, T. (Utah Univ., Salt Lake City, UT). British Nuclear Energy Society, London (United Kingdom), 2nd International Conference on Remote Techniques for Nuclear Plants, Stratford-upon-Avon (United Kingdom), 10-13 May 1993, Thomas Telford Services Ltd, CONF-930575, 1993, pp. 348-351 (372 p).

This paper describes a system capable of accurately mapping the pipe layout (including the associated components) in an existing nuclear power plant. The system processes the images taken by a laser range finder and creates a 3D model of the existing pipe system. Accurate mapping of the geometry, location, and orientation of pipe routes as well as components will permit both the generation of the 3D CAD database and validation of as-built plants with pre-existing CAD databases.

1974. LONG-TERM SAFETY OF NUCLEAR POWER PLANTS. TURNER, J., *Newsletter NEA* (France), Volume 11, Number 2, 1993, pp. 19-22.

Nuclear Power Plants are getting older. How to maintain and, where possible, improve their safety when compared with the requirements set for modern power reactor systems, are questions that have been asked by both operators and regulators for some years. It seems an appropriate time and it is the purpose of this article to review how, at an international level, these questions are being addressed.

1975. NUCLEAR SAFETY REVIEW, 1993. International Atomic Energy Agency, Vienna (Austria), IAEA, STI/PUB-937, September 1993 (107 p).

The Nuclear Safety Review 1993 describes events in the areas of radiation protection and nuclear safety during the previous year. Short summaries are given of important developments in a number of individual countries together with a summary description of the work programmes of some international organizations operating in these fields and of areas in which the IAEA is involved. Discussion of three topical issues, as viewed by authors outside the IAEA, are also presented: the problem for the nuclear regulator of the acceptability of existing nuclear power plants with safety deficiencies; the ongoing discussions on the international conventions relating to legal liability resulting from nuclear accidents; and a detailed

review of current knowledge on the induction of cancers through exposure to radiation.

1976. ON NEW EVOLUTION IN DEVELOPMENT OF BASIC TECHNOLOGY OF ATOMIC ENERGY. Atomic Energy Commission, Tokyo (Japan), *Genshiryoku Linkai Geppo* (Journal of Atomic Energy Commission) (Japan), September 1993, in Japanese, pp. 4-16.

In 1988, the expert committee on the promotion of basic technology organized in the Atomic Energy Commission presented the report and showed concretely the subjects of research and development to be promoted in four fields of material technology, artificial intelligence technology, laser technology and the technology for evaluating and reducing radiation risks for atomic energy, and the measures of efficiently promoting the technical development. The research and development achieved the steady results following this report. The creation of radiation resistant materials, the development of knowledge base system and robot technology, the development of the laser technology required for atomic energy, and the technology for evaluating and reducing radiation risks and so on have been carried out. As the measures for efficiently promoting the technical development, the promotion of the active interchange of researches, the intentional rearing of creative men, the positive development of international interchange, the introduction of the new evaluation of research and the promotion of spread of the results of research have been carried out. The state of execution and the new development measures of the development of the basic technology are reported.

1977. OCCUPATIONAL DOSE REDUCTION AT DEPARTMENT OF ENERGY CONTRACTOR FACILITIES: BIBLIOGRAPHY OF SELECTED READINGS IN RADIATION PROTECTION AND ALARA, VOLUME 5. DIONNE, B.J.; SULLIVAN, S.G.; BAUM, J.W. (Brookhaven National Laboratory, Upton, NY). U.S. DOE Assistant Secretary for Environment, Safety, and Health, Washington, DC, DOE/EH-0364T, BNL-43228-Vol. 5, January 1994 (102 p).

Promoting the exchange of information related to implementation of the As Low as Reasonably Achievable (ALARA) philosophy is a continuing objective for the Department of Energy (DOE). This report was prepared by the Brookhaven National Laboratory (BNL) ALARA Center for the DOE Office of Health. It contains the fifth in a series of bibliographies on dose reduction at DOE facilities. The BNL ALARA Center was originally established in 1983 under the sponsorship of the Nuclear Regulatory Commission to

monitor dose-reduction research and ALARA activities at nuclear power plants. This effort was expanded in 1988 by the DOE's Office of Environment, Safety and Health, to include DOE nuclear facilities. This bibliography contains abstracts relating to various aspects of ALARA program implementation and dose-reduction activities, with a specific focus on DOE facilities. Abstracts included in this bibliography were selected from proceedings of technical meetings, journals, research reports, searches of the DOE Energy, Science and Technology Database (in general, the citation and abstract information is presented as obtained from this database), and reprints of published articles provided by the authors. Facility types and activities covered in the scope of this report include: radioactive waste, uranium enrichment, fuel fabrication, spent fuel storage and reprocessing, facility decommissioning, hot laboratories, tritium production, research, test and production reactors, weapons fabrication and testing, fusion, uranium and plutonium processing, radiography, and accelerators. Information on improved shielding design, decontamination, containments, robotics, source prevention and control, job planning, improved operational and design techniques, as well as on other topics, has been included. In addition, DOE/EH reports not included in previous volumes of the bibliography are in this volume (abstracts 611 to 684). This volume (Volume 5 of the series) contains 217 abstracts.

1978. ALLOWANCE FOR SEVERE ACCIDENTS IN DESIGN. GROS, G.; CORNILLE, Y.; JALOUNEIX, J. (CEA Centre D'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). ANP '92: International Conference on Design and Safety of Advanced Nuclear Power Plants, 25-29 October 1992, Compiled by OKA, Y.; KOSHIZUKA, S. (Tokyo Univ. (Japan)), Atomic Energy Society of Japan, Tokyo (Japan), CONF-921003, 1992, pp. 22.2/1-22.2/6 (2182 p).

In the paper "Safety of Future Reactors in France," the basic safety principles for future PWRs including the design provisions for severe accidents were presented. The application of the principle of defense in depth is the central concept. The general safety objectives for future French PWRs are summarized as the significant reduction of the probability of core meltdown and the scale of release of radioactive substance in accidents as compared to present plants and the exclusion of the excessive release to environment. When a probabilistic approach is used, the definition of the targets to be set for these events which are desirable to be precluded by design provisions must be made case by case, and such design provisions are discussed in this paper. The investigation of the design criteria for reactor containment and

other radioactivity-confining systems is based on the identification of the relation between core meltdown and possible containment failure. The event sequences that induce both core meltdown and containment failure, or that culminate in sudden vessel failure and core meltdown, high pressure and low pressure core meltdown and so on are discussed. The effect of future PWR design on severe accident management is considered.

1979. POST-IRRADIATION EXAMINATION FACILITY FOR POWER REACTOR FUEL AT KAERI. KIM, E.-K.; LEE, K.-S.; RO, S.-G. (Korea Atomic Energy Research Inst., Taejeon (Republic of Korea)). Proceedings of the JAERI-KAERI Joint Seminar on Post Irradiation Examination, Japan Atomic Energy Research Inst., Tokyo (Japan), 9-10 November 1992, JAERI-M-93-016, CONF-9211283, February 1993, pp. 17-24 (298 p).

The post irradiation examination facility (PIEF) at Korea Atomic Energy research Institute (KAERI) consists of three pools, four heavy concrete cells, and two lead cells. It provides adequate support services of post irradiation examination (PIE) for nuclear power reactor fuels as well as for experiments associated with reactor safety studies, and fuel design and fabrication improvements. Capability of the PIEF includes in-pool nondestructive examination, in-cell nondestructive examination, metallographic examination and chemical composition analyses of irradiated nuclear fuels. PIE facility was put into service for nuclear power plant fuel from 1987.

1980. STRENGTHENING RADIATION AND NUCLEAR SAFETY INFRASTRUCTURES IN COUNTRIES OF THE FORMER USSR. (United Nations Development Programme, International Atomic Energy Agency, Vienna (Austria)). Forum on Strengthening Radiation and Nuclear Safety Infrastructures in Countries of the Former USSR, 4-7 May 1993, IAEA, CONF-9305322, STI/PUB-939, September 1993 (143 p).

A Joint Secretariat of the United Nations Development Programme and the International Atomic Energy Agency convened a Forum for information exchange of radiation and nuclear safety infrastructures of the former USSR. These proceedings reflect the discussions at the forum.

1981. RADIATION PROTECTION FOR NUCLEAR POWER PLANTS WITH LIGHT WATER REACTORS, STATE OF THE ART AND POTENTIAL FOR IMPROVEMENTS. HOCK, R. Nuclear Energy Agency, 75 - Paris, Workshop on Radiation Protection Toward the Turn of the Century,

Paris (France), 11-13 January 1993, Organization for Economic Co-Operation and Development, CONF-930181, 1993, pp. 213-229 (319 p).

Operating nuclear power plants of the most recent design feature a very low collective radiation exposure of plant personnel and very low releases of radioactive substances to the environment. Further improvements must therefore concentrate on the elimination of design features which have become less effective because of changes in other relevant plant parameters. Future plants are likely to incorporate additional protection against low-probability, large-consequence types of accidents. The methodology used to verify the adequacy of such additional equipment may be similar to that used in designing for protection against so-called design basis accidents. However, because of their lower probability of occurrence, more realistic values for the relevant parameters should be allowed in such evaluations. The upper bounds which are considered to demonstrate adequacy of protection must also be adjusted for the same reason.

1982. A MODEL NATIONAL EMERGENCY RESPONSE PLAN FOR RADIOLOGICAL ACCIDENTS. International Atomic Energy Agency, Vienna (Austria), IAEA-TECDOC-718, September 1993 (38 p).

The IAEA has supported several projects for the development of a national response plan for radiological emergencies. As a results, the IAEA has developed a model National Emergency Response Plan for Radiological Accidents (RAD PLAN), particularly for countries that have no nuclear power plants. This plan can be adapted for use by countries interested in developing their own national radiological emergency response plan, and the IAEA will supply the latest version of the RAD PLAN on computer diskette upon request.

1983. FUTURE ISSUES IN RADIATION PROTECTION: A CANADIAN PERSPECTIVE. HAYNES, M.J. (Ontario Hydro, Whitby, Ontario (Canada)). Radiation Protection on the Threshold of the 21 Century, Nuclear Energy Agency, 75-Paris (France), Workshop on Radiation Protection Toward the Turn of the Century, Paris (France), 11-13 January 1993, Organization for Economic Co-Operation and Development, CONF-930181, 1993, pp. 161-174 (319 p).

Radiation protection has always been a key effectiveness area in Ontario Hydro's nuclear power program. The overall collective and individual dose performance continues to be amongst the best in the world.

However, several important issues are emerging and will continue to impact the way in which the radiation protection program is managed. These include proposed reductions in regulatory dose limits based on ICRP 60, worker and public perception of an increased level of radiation risk, an increased presence of organized labour in the formulation of radiation protection policy, our philosophy of self protection coming under challenge and the impact of heavily audited radiation protection practices and programs. Each of these issues will be discussed further in this paper. The Ontario Hydro ALARA program is briefly covered although it is considered not to be a future issue but rather a principle which has been incorporated into the design and operation of our stations for many years.

1984. NONSTOCHASTIC SKIN EFFECTS FROM DISCRETE RADIOACTIVE PARTICLES EMITTING HIGH-ENERGY SPECTRA BETA RAYS. REECE, W.D. (Texas A & M University, College Station, TX); DURHAM, J.S.; MERWIN, S.E.; MOELLER, M.P. (Battelle Pacific Northwest Laboratory, Richland, WA); OWEN, D.E. (ENCORE Technical Resources, Inc., Middletown, PA). Electric Power Research Inst., Palo Alto, CA, EPRI-TR-102658, October 1993 (63 p).

Among the more contentious radiation protection issues in recent years has been the debate over the risk to nuclear power plant workers from beta radiation-emitting discrete radioactive particles (or DRPs). DRPs -- sometimes called "hot particles" are small, usually microscopic, radioactive particles that can adhere to the skin and protective clothing of plant workers and potentially produce high radiation doses to very small areas of the skin. In response to regulations that don't account for DRPs, nuclear power plants are expending considerable financial and personnel resources to monitor workers for DRPs and to prevent the spread of DRPs within the plant. In the process, power plant workers are incurring additional whole body radiation exposure. Concern over DRP exposures is based on the knowledge that various types of nonstochastic skin injuries can result from sufficiently high beta radiation doses. While the effects for large-area irradiations (several square centimeters and larger) are generally well understood, the effects for doses to very small areas are less clear. The evidence, however, is clear that biological injury dose thresholds for DRP irradiations are much larger than the dose limits prescribed in existing regulations for large-area skin exposures. One concern is that nuclear power plant efforts to comply with the current skin protection standard causes workers to receive unnecessary whole-body radiation exposure. In addition, applying the existing skin protection stan-

dards to DRP exposures focuses radiation protection resources on very low risk hazards, and is an inappropriate use of the available radiation protection resources.

1985. ACHIEVEMENTS OF RADIATION PROTECTION IN NUCLEAR POWER - KEY FACTORS RELEVANT FOR DOSE REDUCTION. PFEFFER, W. (Gesellschaft Fuer Reaktorsicherheit MbH (GRS), Koeln (Germany)). Radiation Protection on the Threshold of the 21 Century, Nuclear Energy Agency, Paris (France), Workshop on Radiation Protection Toward the Turn of the Century, Paris (France), 11-13 January 1993, Organization for Economic Co-Operation and Development, CONF-930181, 1993, pp. 69-97 (319 p).

Many efforts have been taken to reduce the radiological exposure of the public and of the personnel which is caused by the production of nuclear power. Key factors contributing to the dose reduction are addressed in the paper ranging from design of the plant, operating experience, work management and training of the personnel to reduction techniques implemented to reduce the releases of the plants. Some data are presented to point out the improvements gained and to show the effect of certain factors. Improvements to be aimed at in the future regarding harmonization and information transfer in an international frame are addressed.

1986. HIGH ENERGY PHOTON RESPONSE OF DIFFERENT ENVIRONMENTAL TLDs. SAEZ-VERGARA, J.C.; GOMEX-ROS, J.M.; DELGADO, A. (Centro De Investigaciones Energeticas, Medioambientales y Technologicas (CIEMAT), Madrid (SPAIN)). 10th International Conference on Solid State Dosimetry, 13-17 July 1992, Radiation Protection Dosimetry (United Kingdom), Volume 47, Number 1-4, CONF-920702, 1993, pp. 327-330.

The presence of high energy photons (4-7 Me) around nuclear power plants and high energy accelerators is important during operation. Environmental monitoring frequently uses passive TL measurements for the assessment of the radiological impact of these facilities. However, due to the presence of this energetic photon radiation component, the design of environmental TLDs must be reconsidered, in order to provide charged particle equilibrium. The energy dependence of phosphors (LiF:Mg,Ti, Li₂B₄O₇:Cu, CaSO₄:Tm) in different irradiation conditions has been measured in the range 0.6-6.5 Me. Irradiations using 6 Me photons were performed in the calibration facility recently established at PTB (Germany). These data also seem to indicate that it could be necessary to apply specific corrections to the TLD readouts to

account for these high energies and the convenience of the use of a discriminant TL dosimeter with special dose calculation algorithms for this radiation. These algorithms are usually based on element ratios and can be impractical in field readouts. However, this is not a serious limitation since the maximum error should not exceed $\pm 10\%$.

1987. DEVELOPMENT OF A GENERAL-PURPOSE MOBILE ROBOT FOR USE IN NUCLEAR POWER PLANTS. MARTINEZ, A.; YAGUE, M.A.; LINARES, F., Revista de la Sociedad Nuclear Espanola (Spain), Volume 295, 1993, pp. 47-51.

In recent years, the Space Division of Construcciones Aeronauticas (CASA) and Equipos Nucleares (ENSA) have participated in several national and international robotics programs in the respective space and nuclear areas. In mid-1992, they decided to jointly undertake the development of a mobile inspection and maintenance robot for Nuclear Power Plants. The success of such a multidisciplinary project was ensured by the way both companies complement each other and by their previous development. Work was begun on the feasibility study and specifications, for which technical meetings were held with personnel from the Medical and Health Physics Association of the utilities (AMYS) and several Nuclear Power Plants. The result of these conversations was a preliminary system design along with the specifications with which the system must comply. With these results, a report and job plan were prepared for construction of two prototypes and submitted to the INI (National Institute of Industry Shareholder of both CASA and ENSA), which decided to finance this second Phase of Development by charging it to the Group's Research Development Fund.

1988. UNESA PARTICIPATION IN INTERNATIONAL R & D PROJECTS IN THE FIELD OF NUCLEAR SAFETY. PUGA, J., Revista de la Sociedad Nuclear Espanola (Spain), Volume 126, 1993, pp. 39-41.

The participation of the Spanish Electricity Sector, in the framework of UNESA, in international efforts to carry out nuclear safety research projects has been successful for the fulfillment of the original objectives. The direct involvement in the development of the work of technical staff from the utilities and the nuclear power plants has proven to be an efficient way to transfer technology and valuable results to the final users. UNESA looks forward to continuing this way of participation in R&D projects in the nuclear safety area as part of the general involvement of the

Spanish Electricity Sector in the international nuclear scene.

1989. THE PRESENCE IN THE PROGRAMS FOR IMPROVING NUCLEAR SAFETY IN THE EASTERN EUROPEAN COUNTRIES. GONZALEZ DE UBIERTA, A., Revista de la Sociedad Nuclear Espanola (Spain), Volume 126, 1993, pp. 35-37.

The program of the improvement of nuclear safety in Eastern Europe offers both the Electricity Sector and the Spanish Nuclear Industry an opportunity to apply their wide technological capabilities and to contribute to strengthening of the nuclear option, which is perceived as being of fundamental importance to ensure the supply of electrical energy that will be demanded by the industrialized societies in the medium and long term.

1990. PREPARING FOR THE NEXT CHERNOBYL. COUGHLAN, S., IEEE Review (United Kingdom), Volume 39, Number 5, 16 September 1993, pp. 207-210.

Some fifty-six nuclear power plants in eastern Europe and the former Soviet Union are, by western standards, in a dangerous condition. Although a programme of refurbishment and decommissioning is underway this is a long-term task. In the meantime it is hoped to set up an early warning system of nuclear incidents for Eastern Europe and the west. Under the European Commission programme of technical assistance to the CIS, a feasibility study has been carried out for a radiation incident monitoring system for Ukraine and Belarus. This could provide early warning of the likelihood of radioactive fallout. The study was to provide a costed, phased, high-level design for a monitoring system. The results are summarized. A full technical design of a pilot system is now underway.

1991. CONTROL OF NUCLEAR FUEL AND OTHER MATERIALS REQUIRED IN THE OPERATION OF NUCLEAR POWER PLANTS. Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland), STUK/YVL-GUIDE-6.1, 1993 (12 p).

The control of nuclear fuel and other nuclear materials in Finland is based on the Finnish nuclear energy and radiation protection legislation, regulations and the decisions of the Council of State as well as Finland's international treaties concerning nuclear energy field. The regulatory authority of the control is the Finnish Centre for Radiation and Nuclear Safety (STUK). The guide summarizes the general

requirements for the nuclear material control of the Finnish nuclear power plants. Detailed regulations are presented in the relevant (series 6) YVL guides.

1992. AECB STAFF ANNUAL REPORT OF BRUCE B NGS FOR THE YEAR 1991. Atomic Energy Control Board, Ottawa, Ontario (Canada), INFO-0432, November 1992 (34 p).

In this account of Bruce NGS B station operation during the year 1991 AECB staff have pointed out non-compliances with the operating license, which have been few in number and minor in degree of seriousness. There were no exposures of workers to radiation in excess of regulatory limits, but there were contraventions of the ALARA principle. Releases of radioactive material to the environment have been well below the target levels. The performance of the four special safety systems has been good, except for the containment system. A review of the significant event reports and the causes of the events has revealed a lack of a system by which operations and maintenance work could be verified to have been carried out as intended. In operations and maintenance the backlog of work to be done to regularize temporary changes to equipment (removal of jumpers), to carry out preventive maintenance (call-ups), and to make repairs (deficiency reports) has increased from that of the previous year. On the other hand, the station has reduced the number of temporary operating instructions (operating memos) to half of what it was last year. The fretting of steam generator tubes reported last year has not become worse. Nevertheless, inspections continue and modifications to the tube supports are underway. Overall plant chemistry has been acceptable. An Ontario Hydro assessment of the station found the station management's expectations for maintaining the margin of safety in the plant had not been properly communicated to all levels of station staff. The station is now attempting to correct this. Infractions of work protection procedures, which were the subject of many significant events, have led to changes in the procedures and resulted in a major training effort. AECB staff believe that Ontario Hydro has continued to operate Bruce NGS B in a safe manner, but have pointed out areas where improvement is required.

1993. QUALITY ASSURANCE OF NUCLEAR POWER PLANTS - AN IMPORTANT FACTOR FOR NUCLEAR SAFETY AND RADIATION PROTECTION. YANEV, Y.; MIL'OVSKI, V. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria)), 2nd Conference on Metrology Assurance of Nuclear Energy: From Theory to Practical Applications, Varna (Bulgaria), 30 May-1 June 1993, CONF-9305325, 1993, in Bulgarian (5 p).

The nuclear technology may have some undesirable effects on society with the long term storage and deposition of long lived radioactive wastes as well as with some nonproliferation issues. One of the most important factors influencing the safety of a nuclear power plant is the correct and reliable functioning of the control and safety systems including all I $\approx$ C equipment inside the plant and in the controlled environment outside the plant. In fact during normal operation these systems substitute the operator's control of the NPP and give time to the operators to perform the necessary calculations and take the proper measures to ensure the desired operational status. In this respect it is particularly important that all these systems and instrumentation are properly qualified so that all the information regarding the reliability, operability, seismic protection etc., can be correct and the algorithms installed in the safety systems can function properly and effectively. A special concern is the proper qualification of the radiation protection equipment because this directly influences the health of the operating personnel. The report presents some important requirements concerning quality assurance and qualification of I $\approx$ C systems in the Kozloduy NPP, as well as the way this is supervised in Bulgaria.

1994. THE OPERATIONAL PRACTICE OF AN ENVIRONMENTAL PROTECTION REPRESENTATIVE IN A WELTER OF REGULATIONS. BEISING, R. (Energie-Versorgung Schwaben AG, Tuttgrat (Germany)). VGB Kraftwerkstechnik (Germany), Volume 73, Number 12, December 1993, in German, pp. 1050-1054.

At Energie-Versorgung Schwaben AG (Schwabia Power Supply Company), the environmental protection representative is directly responsible to the management board and has undertaken the statutory function of an operational representative responsible for water, emission and radiation protection, waste and dangerous substances. In the power station and operating management departments, so-called environmental assistants undertake tasks covering different aspects of the environment. By means of concrete examples from operational practice, the paper indicates how the task is performed in view of the growing flood of regulations.

1995. DISPOSAL OF REACTOR WASTE. Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland), STUK/YVL-GUIDE-8.1, 1992 (9 p).

In Finland the licensing procedure for the radioactive waste disposal is presented in the Nuclear Energy Act (990/87) and Degree (161/88). The general safety

regulations are defined in the Decisions of the Council of State concerning disposal facilities. In the guide the provisions of these regulations are specified. The guide is applied to the planning, construction, operation, and the post-operational phase of a disposal facility for the reactor waste to be located in the bedrock of a nuclear power plant site. The criteria for radiation protection, performance of barriers, safety analyses, investigations of the host rock, documentation and post-closure surveillance is included. Also some specifications of the licensing procedures are given.

1996. OCCUPATIONAL RADIATION EXPOSURE AT COMMERCIAL NUCLEAR POWER REACTORS AND OTHER FACILITIES 1992. RADDATZ, C.T. (U.S. Nuclear Regulatory Commission, Division of Regulatory Applications, Washington, DC); HAGEMEYER, D. (Science Applications International Corp., Oak Ridge, TN), Nuclear Regulatory Commission, Washington, DC, NUREG-0713-Vol. 14, December 1993 (295 p).

This report summarizes the occupational radiation exposure information that has been reported to the NRC's Radiation Exposure Information Reporting System (REIRS) by nuclear power facilities and certain other categories of NRC licensees during the years 1969 through 1992. The bulk of the data presented in the report was obtained from annual radiation exposure reports submitted in accordance with the requirements of 10CFR20.407 and the technical specifications of nuclear power plants. Data on workers terminating their employment at certain NRC licensed facilities were obtained from reports submitted pursuant to 10CFR20.408. The 1992 annual reports submitted by about 364 licensees indicated that approximately 204,365 individuals were monitored, 183,927 of whom were monitored by nuclear power facilities. They incurred an average individual dose of 0.16 rem (cSv) and an average measurable dose of about 0.30 (cSv). Termination radiation exposure reports were analyzed to reveal that about 74,566 individuals completed their employment with one or more of the 364 covered licensees during 1992. Some 71,846 of these individuals terminated from power reactor facilities, and about 9,724 of them were considered to be transient workers who received an average dose of 0.50 rem (cSv).

1997. ALARA: AS LOW AS REASONABLY ACHIEVABLE RADIATION DOSES IN INDUSTRY. Edited by LEWINS, J.D. (Cambridge University (United Kingdom)). Symposium on ALARA: Ionizing Radiation Levels in the Nuclear Industry, London (United Kingdom), 21 September 1990,

Research Studies Press Ltd., CONF-900976, 1991 (224 p).

The Institution of Nuclear Engineers, with the support of other national and international societies, organised a one-day meeting to continue its initiative in education and training in ALARA. The meeting was well attended by industry and academia and the papers prepared for this workshop, together with the record of discussion, form the matter of this book. Papers include discussion of recent international developments, application of the ALARP principle by the U.K. Nuclear Installations Inspectorate, achievements in nuclear power plant design and operation, experience in the U.K. nuclear fuel cycle, design of Sizewell 'B' PWR, education and training for ALARA, and the emergency reception of radiation casualties.

1998. COBALT REDUCTION GUIDELINES, REVISION 1. Electric Power Research Inst., Palo Alto, CA, EPRI-TR-103296, December 1993 (73 p).

This report, which updates and supersedes an earlier report (EPRI NP-6737) on the same subject, describes methods for establishing a program to identify nuclear power plant valves with high-cobalt hardfacing that are potential significant contributors to the cobalt inventory that is irradiated in the reactor core. The resulting radioactive cobalt isotope, cobalt-60, is a major contributor to plant radiation levels and therefore occupational doses received by plant operational and maintenance personnel. A methodology to determine whether hardfacing is actually required on specific valves is also described as is the physical, mechanical and wear properties of high-cobalt and potential replacement cobalt-free hardfacing and trim alloys. Discussions are presented of the general and specific design requirements for valve hardfacing in nuclear service. Current world-wide nuclear utility experience with cobalt-free hardfacing alloys is described. The regulatory and industry code issues related to replacing and/or changing valve hardfacing materials are discussed. The actions and responsibilities of utility management in implementing an effective cobalt-reduction program are also delineated.

1999. ENFORCEMENT ACTIONS: SIGNIFICANT ACTIONS RESOLVED. Office of Enforcement, Nuclear Regulatory Commission, Washington, DC, NUREG-0940-Vol. 12-No. 3, December 1993 (588 p).

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (July-September 1993) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to

these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

2000. SUMMARY OF COMMENTS RECEIVED FROM WORKSHOPS ON RADIOLOGICAL CRITERIA FOR DECOMMISSIONING. CAPLIN, J.; PAGE, G.; SMITH, D.; WIBLIN, C. (Advanced Systems Technology, Inc., Atlanta, GA), Nuclear Regulatory Commission, Washington, DC., NUREG/CR-6156, January 1994 (229 p).

The Nuclear Regulatory Commission (NRC) is conducting an enhanced participatory rulemaking to establish radiological criteria for site cleanup and decommissioning of NRC-licensed facilities. Open public meetings were held during 1993 in Chicago, IL, San Francisco, CA, Boston, MA, Dallas, TX, Philadelphia, PA, Atlanta, GA, and Washington, DC. Interested parties were invited to provide input on the rulemaking issues before the NRC staff develops a draft proposed rule. This report summarizes 3,635 comments categorized from transcripts of the seven workshops and 1,677 comments from 100 NRC docketed letters from individuals and organizations. No analysis or response to the comments is included. The comments reflect a broad spectrum of viewpoints on the issues related to radiological criteria for site cleanup and decommissioning. The NRC also held public meetings on the scope of the Generic Environmental Impact Statement (GEIS) during July 1993. The GEIS meetings were held in Washington, DC, San Francisco, CA, Oklahoma City, OK, and Cleveland, OH. Related comments from these meetings were reviewed and comments which differed substantially from those from the workshops are also summarized in the body of the report. A summary of the comments from the GEIS scoping meetings is included as an Appendix.

2001. NEW ICRP RECOMMENDATIONS : ITS IMPLICATIONS FOR THE PRACTICE OF RADIATION SAFETY. MURTHY, M.S.S.; DHOND, R.V. (Bhabha Atomic Research Centre, Bombay (India)). 19th Annual IARP Conference on Radiation Protection, Bombay (India), 3 March 1992, Bulletin of Radiation Protection (India), Volume 15, Number 1, CONF-9203289, January-March 1992, pp. 3-5.

Trends in the average and collective doses for medical, industrial and nuclear power plant workers over the past few years, have been analyzed in view of the new ICRP recommendations. It is seen that at the

current level the average risk in certain parts of nuclear fuel cycle and industrial radiography would be a significant fraction of the risk at the dose limit of 20 mSv, unless conscious efforts are made to further reduce the average doses in these areas. Similarly, conforming to the new limits may require some degree of dose-sharing which in turn may lead to increased collective dose. This is demonstrated in the case of nuclear power plant workers.

2002. AN AUGMENTED AUDIT PROGRAM FOR ASSURING RADIATION SAFETY DURING RADIOGRAPHIC EXAMINATION OPERATIONS. JERVEY, R.A. JR.; PAPIN, P.J., (San Onofre Nuclear Generating Station, San Clemente, CA). Health Physics, Volume 65, Number 3, September 1993, pp. 322-327.

Auditing a gamma radiography program is required as part of the authorizing license. Checklists and cursory reviews are the typical approach to addressing program requirements. A more proactive approach is recommended. The audit program described was prepared for a specific set of operating conditions but can be applied to any given program. Improvements in the effectiveness of the radiography safety program can be made with additional examination and emphasis on direct observation of licensed activities.

2003. MEASURING AND MONITORING OF GASEOUS RELEASES AND AEROSOL-BOUND RADIOACTIVE MATERIAL. Part 1 of Measuring and Monitoring of Radioactive Material Released Together with the Stack Exhaust Air in Regular Operation, Bundesanzeiger (Germany), Volume 45, Number 211a, 9 November 1993, in German, pp. 3-14 (319 p).

This part of the standard is to be applied to devices for stationary nuclear power plants with LWR's and HTR's during regular operation. Their duties are (a) balancing of the radioactive material released with the stack exhaust air as a basis for the assessment of the radiological consequences; (b) automatic release of signals if limits are exceeded; (c) contributing to meeting the requirements of paragraph 46, section 1, number 3 of the Radiation Protection Ordinance.

2004. ADVANCES IN CANADIAN REGULATORY PRACTICE. WADDINGTON, J.G. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Proceedings of the 32nd Annual Conference of the Canadian Nuclear Association. Canadian Nuclear Association, Toronto, Ontario (Canada), 7-10 June 1992, INIS-mf-13764, CONF-9206428, 1992, pp. 351-369 (449 p).

The paper deals with new and revised licensing guides on: new dose limits, dosimetry, safety analysis, reliability, fault tree analysis, reporting requirements, human factors, software, the ALARA principle, backfitting, and the licensing process.

2005. EFFECTS OF DOSE LIMITS REDUCTION ON THE ARGENTINE NUCLEAR POWER PLANTS. PALACIOS, E.; CURTI, A.; MASSERA, G.; SPANO, F.; BOUTET, L. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). *Health Physics*, Volume 65, Number 5, November 1993, pp. 532-534.

Occupational doses are evaluated in different stages of the fuel cycle and in the operation of nuclear power plants. Trends in individual dose distribution and collective doses are analyzed. The most contributive working conditions to collective dose are identified and the implications of dose limit reduction recommended by the ICRP in 1990 are assessed. It is concluded that no relevant difficulties should appear in accomplishing the new recommendations except for implementation at Atucha I, a nuclear power plant designed in the 1960s. Some options to reduce individual and collective doses in this plant are analyzed. The change of fuel channels by new ones free from cobalt is essential to get effective improvement of occupational exposures.

2006. RADIATION: RISKS AND REALITIES. Office of Air and Radiation. Environmental Protection Agency, Washington, DC, EPA-402/K-92/004, August 1993 (12 p).

Natural sources of radioactivity are all around us, and man-made radioactive materials are a vital part of medicine and industry. Exposure to some radiation, natural or man-made, is inevitable. The booklet discusses the major sources and uses of radiation, the risks from exposure, and how they can limit and reduce these risks.

2007. IPSN MONITORING CAPABILITIES AND INFORMATION NETWORKS IN ACCIDENTAL SITUATION. CALMET, D.; ROBEAU, D. CEA Centre d'Etudes de Fontenay-aux-Roses, 92, France, 3rd International Workshop on Decision Making Support for Off-site Emergency Management, Schloss-Elnau (Germany), 25 October 1992, CEA-CONF-11492, CONF-9210425, 1992 (8 p).

In 1989, a Radiological Transmission and Early Warning System (SYTAR) came into being in order to harmonize radioactivity surveillance methodologies and furthermore to trigger off an alert throughout the networks whenever an unusual degree of radioactivity

is detected. SYTAR is a remote permanent system linking up a national electronic access and the radiation protection services of nuclear facilities located on the mainland. The structure of the network are particularly presented in the framework of a drill organized on October 1991 in the south-east of France. During this drill, an accident was simulated on a ghost nuclear power plant located in the Cadarache Nuclear Center. A large number of samples were taken from filtered aerosols, soils, grass, milk, vegetables, food stuff; they were contaminated with Caesium 137 and Iodine 131 before to be sent to laboratories for measurements. The results of measurements were transmitted to the actors of the drill using SYTAR network. They permit to determine the exclusion area, the radiological impacts and counter-measures.

2008. ISOE-A TOOL FOR IMPLEMENTING ALARA IN NUCLEAR POWER PLANTS. VIKTORSSON, C. (Nuclear Energy Agency, 75-Paris (France)). ALARA: As Low as Reasonably Achievable Radiation Doses in Industry. Edited by LEWINS, J.D. (Cambridge University, United Kingdom). Symposium on ALARA: Ionizing Radiation Levels in the Nuclear Industry, London (United Kingdom), 21 September 1990, Research Studies Press Ltd., CONF-900976, 1991, pp. 190-196 (224 p).

The existence of an International Information System on Occupational Exposure (ISOE) would facilitate the ability of participants to get access to up-dated information on radiation protection matters including dose-saving methods, task-related doses, etc. The Pilot Project described was set up in order to apply on an experimental basis the scheme proposed for the ISOE System, and to demonstrate the feasibility of an interest in setting it up. It included the participation of nuclear electric utilities from eight countries. The Brookhaven National Laboratories (BNL) in the United States and the CEPN (Centre d'Etudes sur l'Evaluation de la Protection dans le Domaine Nucleaire) in France acted as Technical Centres, i.e., provided the technical services to the Pilot Project and developed the necessary computer software for data handling and management.

2009. ACHIEVEMENTS IN ALARP IN THE DESIGN OF NUCLEAR POWER STATIONS. MORTIN, S.J.; TAYLOR, R.H. (Nuclear Electric Plc., Bedminster Down (United Kingdom)). In: ALARA: As Low As Reasonably Achievable Radiation Doses In Industry. Edited by LEWINS, J.D. (Cambridge University, United Kingdom). Symposium on ALARA: Ionizing Radiation Levels in the Nuclear Industry, London (United Kingdom), 21

September 1990, Research Studies Press Ltd., CONF-900976, 1991, pp. 56-73 (224 p).

The requirement to reduce risks from operation of a nuclear power plant to "as low as reasonably practicable" is one of the fundamental principles of Nuclear Electric safety policy. However, it is not practicable to apply detailed ALARP considerations at each and every stage of the design process. Quantitative targets are therefore provided such that, if met, there is a high degree of assurance that the design is broadly ALARP. These targets have been reviewed in this paper and despite some remaining difficulties and uncertainties in the quantification of ALARP, the current targets can clearly be seen to achieve ALARP, if not to go beyond it in some areas.

2010. SAFETY IN SPANISH NUCLEAR POWER PLANTS. La Seguridad en las Centrales Nucleares Españolas. Consejo de Seguridad Nuclear, Madrid (Spain), 1992, in Spanish (161 p).

This report issued by the Nuclear Safety Council analyzes the situation of Spanish nuclear power plants. The report elaborates on seven chapters: 1. Principles of Safety in Nuclear Power Plants; 2. Legal aspects of safety in Nuclear Power Plants; 3. Inspection and Control of NSC; 4. Specific Situation in each NPP; 5. Periodical safety evaluation; 6. Safety actualizations; 7. Radiation protection; 8. Conclusions

2011. 222 QUESTIONS ABOUT ENERGY. BARRACHINA GOMEZ, M.; CERROLAZA ASENJO, J.A.; GARCIA ALONSO, J.M.; IRANZO MARTIN, J.E.; LOPEZ PEREZ, B.; MINGUEZ PERRES, E.; MINGUEZ TORRES, E.; PASCUALENA CAMBRA, M.T.; POZA GALIANO, A. DE LA; SECADES ARIZ, I. Forum Atomico Espanol, Madrid (Spain), 1993, in Spanish (272 p).

The book presents with an easy language, questions about energy. The main topics are: Energy and energy sources; Energy and society; The energy in the world; Basic concepts of Nuclear Physics; Basic concepts of radiological protection; Electric power; Nuclear Fuel cycle; Environmental impact; Radioactive waste management; The risk in the electricity production; Standardization of Nuclear Safety; Economic aspects of electricity generation; Energy and Spanish economy.

2012. STEAM GENERATOR REPLACEMENT AT THE BEZNAU-1 NUCLEAR POWER PLANT. DAEMMIG, S.; SANDONA, E.; WEIDMANN, U. (Nordostschweizerische Kraftwerke Ag, Doettingen (Switzerland)); ROFFLER, J. SVA-Bulletin (Schweizerische Vereinigung fuer

Atomenergie) (Switzerland), Volume 35, Number 19, 1993, in German, pp. 15-21.

During the 1993 fuel change, the two steam generators of Beznau-1 were exchanged. In this report, manufacture of the steam generators by the firm Framatome, the preparatory work and the actual work in the exchange are described, and also the provisions for radiation protection and the planning measures as a prerequisite for successful execution.

2013. OPTIMIZATION AND COST OF RADIATION DETRIMENT ON USING EGYPTIAN ORDINARY AND HEAT RESISTANT CONCRETE AS SHIELDING MATERIALS FOR POWER REACTORS. KANY, A.M.I.; ELASSALY, F.M.; MEGAHID, R.M. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt)), Isotope and Radiation Research (Egypt), Volume 18, Number 2, 1986, pp. 85-92.

This paper discusses the derivation of shield materials to be used as nuclear power plants shields on the basis of ICRP, ALARA principles and cost benefit analysis. It is important to adopt a shielding design philosophy which whilst meeting the requirements of ICRP principles of dose limitation recognizes the practical constraints imposed by the complexity of large projects as power reactors. For each material, its relaxation length and cost per unit volume may be determined to assess the total marginal cost factor for complete shield. The methodology and calculations are presented involving the following: (a) Specification of defined Egyptian shield materials such as ordinary concrete (O.C.) and ilmenite limonite heat resistant concrete (I.L.H.R.C.) with their physical properties and their relaxation lengths; (b) Calculation of the measured dose rate for each type of concrete; and (c) Calculation of the optimum design dose rate and collective dose equivalent. Hence, the cost of radiation detriment can be assumed proportional to a plant life and the collective dose equivalent with a equal to alpha (α) which is represented by L.E. per man Sievert per m². In this case, the competent authority should specify alpha (α) values to be used in optimization of cost evaluation.

2014. GRAYSKY-A NEW GAMMA-RAY SKYSHINE CODE. WITTS, D.J.; TWARDOWSKI, T.; WATMOUGH, M.H. (British Nuclear Fuels Ltd., Cheshire (United Kingdom)). American Nuclear Society (ANS) Annual Meeting, San Diego, CA, 20-24 June 1993, Transactions of the American Nuclear Society, Volume 68, CONF-930601, 1993, pp. 391-392.

This paper describes a new prototype gamma-ray skyshine code GRAYSKY (Gamma-RAY SKYshine) that has been developed at BNFL, as part of an industrially based master of science course, to overcome the problems encountered with SKYSHINEII and RANKERN. GRAYSKY is a point kernel code based on the use of a skyshine response function. The scattering within source or shield materials is accounted for by the use of buildup factors. This is an approximate method of solution but one that has been shown to produce results that are acceptable for dose rate predictions on operating plants. The novel features of GRAYSKY are as follows: 1. The code is fully integrated with a semianalytical point kernel shielding code, currently under development at BNFL, which offers powerful solid-body modeling capabilities. 2. The geometry modeling also allows the skyshine response function to be used in a manner that accounts for the shielding of air-scattered radiation. 3. Skyshine buildup factors calculated using the skyshine response function have been used as well as dose buildup factors.

2015. ASSURING THE QUALITY OF PRACTICAL RADIATION PROTECTION. NEUBURGER, E.; SCHROEDER, H.J. ATW, Atomwirtschaft, Atomtechnik (Germany), Volume 38, Number 10, October 1993, in German, pp. 684-687.

There is no possibility in Germany to serve an apprenticeship in practical radiation protection in nuclear facilities. However, the scope of knowledge required for such activities is defined in a binding "Directive about Ensuring the Knowledge Required in Persons otherwise Engaged in the Operation of Nuclear Power Plants." That Directive by far exceeds the scope, in terms of safety, normally applied to a vocation or activity. The Directive implicitly contains three important provisions: Plant operators must ensure that radiation protection workers have all the knowledge they need to do their job safely; that radiation protection workers are autonomous, within certain limits, as a consequence of the depth of knowledge they have; that radiation protection workers are given formal advanced training possibilities. An examination to be taken by radiation protection workers before a Chamber of Industry and Commerce was introduced in 1982 in order to make available personnel trained in the whole range of possible activities as defined in the Directive referred to above. However, persons who have passed the exam before a Chamber of Commerce and Industry no longer automatically fulfill the criteria under the Directive after three years, but must undergo advanced training in a formal program.

2016. AIR SAMPLING IN THE WORKPLACE. HICKEY, E.E.; STOETZEL, G.A.; STROM, D.J.; CICOTTE, G.R. (Pacific Northwest Laboratory, Richland, WA); WIBLIN, C.M. (Advanced Systems Technology, Inc., Atlanta, GA); MC GUIRE, S.A. (Nuclear Regulatory Commission, Washington, DC), Nuclear Regulatory Commission, Washington, DC, NUREG-1400, September 1993 (89 p).

This report provides technical information on air sampling that will be useful for facilities following the recommendations in the NRC's Regulatory Guide 8.25, Revision 1, "Air Sampling in the Workplace." That guide addresses air sampling to meet the requirements in NRC's regulations on radiation protection, 10 CFR Part 20. This report describes how to determine the need for air sampling based on the amount of material in process modified by the type of material, release potential, and confinement of the material. The purposes of air sampling and how the purposes affect the types of air sampling provided are discussed. The report discusses how to locate air samplers to accurately determine the concentrations of airborne radioactive materials that workers will be exposed to. The need for and the methods of performing airflow pattern studies to improve the accuracy of air sampling results are included. The report presents and gives examples of several techniques that can be used to evaluate whether the airborne concentrations of material are representative of the air inhaled by workers. Methods to adjust derived air concentrations for particle size are described. Methods to calibrate for volume of air sampled and estimate the uncertainty in the volume of air sampled are described. Statistical tests for determining minimum detectable concentrations are presented. How to perform an annual evaluation of the adequacy of the air sampling is also discussed.

2017. CONSIDERATIONS ON POST-PRODUCTION OBLIGATIONS IN TERMS OF ATOMIC ENERGY LAW. REBENTISCH, M. Deutsches Verwaltungsblatt mit Verwaltungsarchiv (Germany), Volume 19, 1 October 1992, in German, pp. 1255-1261.

The article describes and evaluates the laws concerning the decommissioning and dismantling of nuclear power plants and offers suggestions for possible new regulations. The contribution examines fundamental legal aspects, the instrumentalization of post-production obligations in terms of atomic energy laws, especially the question as to how to bring the Atomic Energy Law into accord with the Federal Emission Control Law within the realm of decommissioning laws, licenses for safe confinement and

dismantling of a plant, and in addition questions on making financial provisions for decommissioning.

2018. OPERATION OF FINNISH NUCLEAR POWER PLANTS. Edited by TOSSAVAINEN, K. (Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland)), STUK-B-YTO-110, September 1993 (23 p).

Quarterly reports on the operation of Finnish nuclear power plants describe events and observations, relating to nuclear safety and radiation protection which the Finnish Centre for Radiation and Nuclear Safety considers safety significant. Safety-enhancing modifications at the nuclear power plants and issues relating to the use of nuclear energy which are of general interest are also reported. The reports include a summary of the radiation safety of plant personnel and the environment, as well as tabulated data on the production and load factors of the plants. In the first quarter of 1993, a primary feedwater system pipe break occurred at Loviisa 2, in a section of piping after a feedwater pump. The break was erosion-corrosion induced. Repairs and inspections interrupted power generation for seven days. On the International Nuclear Event Scale the event is classified as a level 2 incident. Other events in the first quarter of 1993 had no bearing on nuclear safety and radiation protection.

2019. UNDERWATER COATING REPAIR CUTS NUCLEAR MAINTENANCE COSTS. STUART, C.O. Power Engineering, Volume 97, Number 7, July 1993, pp. 31-34.

This article discusses the cleaning and recoating/repair of condensate tanks or other vessels in a nuclear power plant. The topics of the article include the safety and regulatory need for this system of repair, a description of the work done on the Brown's Ferry MK-1 suppression chamber, coating failure mechanisms, qualitative inspection, quantitative inspection, quantitative inspection results, spot repairs, and economic considerations.

2020. ENGINEERING PRACTICES TO MINIMIZE OCCUPATIONAL EXPOSURE IN NEW GENERATION NUCLEAR POWER PLANTS. ASAY, R.H. (Radiological and Chemical Technology, Inc., Santa Clara, CA). 204th American Chemical Society (ACS) National Meeting, Washington, DC, 23-28 August 1992, CONF-920815, 1992, pp. 23.

The concept of ALARA (as low as reasonably achievable) is now mandatory for operators of nuclear power generating plants. The first opportunity to implement ALARA practices for reducing occupa-

tional exposure is during the design and construction of plants and components for the primary systems. Component surface pretreatment has been shown to be very effective in reducing future deposition of activation (and fission) products on these surfaces. The Electric Power Research Institute, and others, have developed viable chemical and electrochemical surface treatment processes which have been used for replacement components in conventional plants. These processes have resulted in significant reductions in deposition of radioactive materials and reduced surface corrosion, and thus, reduced radiation levels from the primary system components. An even greater opportunity to apply these practices of surface pretreatment is present for new generation power stations while in the design stages.

2021. RADIATION DOSE REGISTRATION AND EPIDEMIOLOGICAL STUDY FOR WORKERS OF NUCLEAR INSTITUTIONS IN JAPAN. KUMATORI, T. (Radiation Effects Association, Chiyoda-Ku, Tokyo (Japan)). 8th Pacific Basin Nuclear Conference, Taipei (China), 12-16 April 1992, Transactions of the American Nuclear Society, Volume 65, CONF-920414, 1992, pp. 10.D.1-10.D.5.

The first nuclear reactor was operated in 1957 at Tokai-mura in Japan. Since then radiation dose of workers has been controlled by nuclear institutions according to the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors. However, many nuclear power plants and other nuclear facilities were built, resulting in the remarkable increase of workers in controlled areas. Further, periodical inspection and repair work at nuclear facilities were carried out by employees of subcontractors, who were engaged in such work at many different facilities, so that it was getting more and more difficult to obtain accurate information of radiation dose on these workers. In order to meet this situation, the "Radiation Dose Registration Center for Workers" (RADREC) was established in November 1977 within the "Radiation Effects Association" (REA), which was founded in September 1960 for the purpose of supporting the research on radiation effects and radiation protection. In January 1978, RADREC was designated by the Government as an organization to preserve the records on exposure of radiation workers, which was linked up with the registration system.

2022. THE ENHANCEMENT OF NUCLEAR SAFETY: BASIC PRINCIPLES AND APPROACHES TO ENSURE THE OPERATION SAFETY OF NPP'S IN KOREA. LEE, S.H. (Korea Institute Of Nuclear Safety, Science Town, Dae-Jeon (Democratic People's Republic of Korea)).

8th Pacific Basin Nuclear Conference, Taipei (China), 12-16 April 1992, Transactions of the American Nuclear Society, Volume 65, CONF-920414, 1992, pp. 2.G.1-2.G.4.

Nuclear safety of NPPs should receive the highest priority concerns in any mode of operation because various operational transients can develop into an accident of serious consequence. In most nuclear countries, two-tier approach is commonly adopted to assure the operational safety; (1) various operational and maintenance activities by the utility which has the primary responsibility for the safety of the facility, (2) surveillance and inspection by the government authority which officially confirms the nuclear safety to protect the public from the radiation hazards. The utility has to improve the economy of the plant operation and at the same time has to enhance the safety through the achievement of high quality and reliability in operation and maintenance. The regulatory body, in the meantime, confirms the operational safety through the safety review and inspection activities in the form of preoperational inspection, periodical inspection, daily inspection, special inspection, etc. This paper reviews the basic principles for operation and maintenance of NPP, and the fundamental framework of the roles and responsibilities of the utility and the regulatory body with a view to achieving the operational safety. Also discussed is the regulatory effort in Korea to verify the adequacy of the plant management.

2023. THE ENHANCEMENT OF NUCLEAR SAFETY: BASIC PRINCIPLES AND APPROACHES FOR ACTIVITIES OF OPERATION AND MAINTENANCE. MITSUO, S. (Chubu Electric Power Company Inc., Higashi-Ku Nagoya (Japan)). 8th Pacific Basin Nuclear Conference, Taipei (China), 12-16 April 1992, Transactions of the American Nuclear Society, Volume 65, CONF-920414, 1992, pp. 2.F.1-2.F.8.

The dual purposes of this presentation are to (I) report on the current situation of the safety of the operation and maintenance/repairs of operating nuclear power plants and the future tasks related to the continued safe operation of the same and (II) to give, as an example, the outline of the operation and maintenance/repairs information network currently planned at Chubu Electric Power Company, Inc.

2024. AEC ENHANCED SAFETY REQUIREMENTS FOR FUTURE NUCLEAR POWER PLANTS. HSIA, D.-Y.; WU, R.-Y. (Atomic Energy Council, Lung-Tan, Taoyuan (Taiwan)); CHIOU, S.-T. (Atomic Energy Council, Taipei (Taiwan)). 8th Pacific Basin Nuclear Conference, Taipei (China),

12-16 April 1992, Transactions of the American Nuclear Society, Volume 65, CONF-920414, 1992, pp. 2.E.1-2.E.7.

Achieving excellence in design is essential to the safe operation of a nuclear power plant. Many lessons have been learned as a result of Brown's Ferry incident and TMI-2 accident and from safety reviews, research results and operating experiences over the world through the years. Based on this information, the Atomic Energy Council (of the Republic of) sets safety requirements for our future nuclear plants as will be outlined in this paper. The Taiwan Power (TPC) is required to adapt advanced design and proven technology to meet these requirements. Specific requirements on EIA report, PSA, report, safety goal, radiation protection, radwaste production, plant reliability and maintenance programs etc, in addition to the more conventional requirements on design, construction, testing and quality assurance are discussed in detail.

2025. STATUS OF NUCLEAR SAFETY DEVELOPMENTS AND PROSPECTS FOR THE FUTURE. BIRKHOFE, A. (Gesellschaft/Director Fur Reaktorsicherheit, Forschungsgelaude (Germany)); LAVERIE, M. (Director for the Safety of Nuclear Installations, Paris (France)). 8th Pacific Basin Nuclear Conference, Taipei (China), 12-16 April 1992, Transactions of the American Nuclear Society, Volume 65, CONF-920414, 1992, pp. 2.A.1-2.A.5.

During the eighties, the emphasis on safety questions progressively shifted from design and construction of plants towards the operation of existing plants. Lessons learned from incidents and accidents in national or foreign plants, experience gained from the operation and maintenance of plants, research and ageing of installations were some of the issues on which, at that time, the nuclear community focused its attention and concern. At the same time, numerous actions, dedicated to the strengthening of defense-in-depth which consists of piling up enough dispositions (or defense lines) to be able to deal with situations even beyond the initial design of plants, were implemented. Despite all these technical precautions to reduce the risk to the public and the environment, the acceptance level decreased in some countries, due to the impact of TMI and Chernobyl, a certain misunderstanding between technicians and the public proceeding from a lack of openness and poor communication.

2026. OPERATION OF FINNISH NUCLEAR POWER PLANTS. Edited by TOSSAVAINEN, K. (Finnish Centre for Radiation and Nuclear Safety

(STUK), Helsinki (Finland)), STUK-B-YTO-109, June 1993 (28 p).

Quarterly reports on the operation of Finnish nuclear power plants describe events and observations, relating to nuclear and radiation safety, which the Finnish Centre for Radiation and Nuclear Safety considers significant. Also other events of general interest are reported. The reports also include a summary of the radiation safety of plant personnel and the environment, as well as tabulated data on the plants' production and load factors.

2027. THE ENVIRONMENTAL IMPACT OF NUCLEAR POWER. JONES, S.R.; WATSON, D.C.; WILKINSON, W.L. (British Nuclear Fuels plc, Risley (United Kingdom)). Energy and Environment (Brentwood) (United Kingdom), Volume 4, Number 2, 1993, pp. 174-192.

The main issues which give rise to public concern about the environmental impact of the nuclear industry are addressed and an attempt is made to place them in a proper perspective. The health effects of radiation exposure are outlined and the deviation of radiological protection standards is described. A summary of major accidental releases of radioactivity is given and routine discharges to the environment are examined in terms both of their local and global effects. Data on exposure of the general public to discharges from United Kingdom installations are included. Radioactive waste disposal and storage is presented in terms of waste from power plants, fuel processing and uranium mining. Decommissioning plans for nuclear power plants in the United Kingdom are summarized. The main conclusions drawn are that the effect of nuclear power generation on the global environment in normal operation is insignificant, that the local environmental impact of nuclear power plants, uranium mines and fuel processing plants is less than that of most other large industrial facilities, and that the safety record of reactors built to Western designs is extremely good. A comparative summary of the risks to life associated with electricity production from different power sources taking into account accidents and routine operation is provided. This shows that the uranium fuel cycle compares favorably with alternative power sources where available data permits an assessment to be made.

2028. NUCLEAR POWER PLANT OCCUPATIONAL EXPOSURES IN OECD COUNTRIES. 1969-1991. Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France), Organisation for Economic Co-Operation and Development, Paris (France), 1993 (78 p).

OECD Nuclear Energy Agency launched the idea of creating an international system for information exchange in the field of occupational exposure (ISOE). The System would allow the integration of experience gained in nuclear power plant operation in the various OECD countries for the purpose of facilitating operational dose management and optimization of radiation protection. This report puts the emphasis on basic performance indicators of relevance to radiation protection. Nuclear power plant operating experience in the ISOE database reaches 3199 reactor-years for a total of 283 reactors. In analyzing the data, the authors notice that the total collective dose cumulated in OECD countries since 1969 to 1991 reaches 7 580 man-Sv (1607 reactor-years), 2 638 man-Sv (1108 reactor-years) and 1 755 man-Sv (484 reactor-years) respectively in the North American, European and Asian regions. By the end of the eighties, a global decrease of the dosimetric results in all regions can be seen, returning to the initial figures of, on average, about 2 man-Sv per reactor and year; variation between average annual collective doses per reactor in the various countries are about to level out, but still variations up to a factor of 4 can be seen between the various OECD countries for light water reactors. If CANDU reactors are included the variation amounts to almost a factor of 6. For all regions and for all types of reactors, the oldest plants show in general higher average annual collective doses than more recent plants. Concerning the influence of the reactor size, it is more difficult to draw a conclusion: for PWRs, it seems to be a tendency of increasing collective doses with reactor size, whereas for BWRs and CANDUs there seems to be a decrease.

2029. CURRENT SITUATION OF NUCLEAR POWER DEVELOPMENT IN DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA. REPORT ON THE INVESTIGATION CONCERNING THE FUNDAMENTAL POLICY OF JAPAN FOR ATOMIC ENERGY SUCH AS LEGISLATION RELATING TO ATOMIC ENERGY IN 1992 FISCAL YEAR. (Japan Machinery Federation, Tokyo (Japan)), ETDE/JP-mf-94707417, March 1993, in Japanese, pp. 55-76 (76 p).

This paper summarizes nuclear power development in North Korea. In the premises of the nuclear power research center in Nyongbyon, the nuclear power plant Unit No. 1 with an output of 5 MWe is in operation as a test power reactor. The reactor is a Colder Hall reactor of natural uranium, graphite moderated carbon dioxide cooling type. Unit No. 2 with an output of 50 MWe is under construction with operation start-up scheduled for 1995. Other facilities include radiation chemistry facilities for experiment-

ing dissolution, extraction and purification of nuclear reactor fuels, forming and processing factories, and fuel storing facilities. The research center executes radiation chemistry and isotope processing, and has a pool-type IRT research reactor made in the Soviet. Other than the Nyongbyon area, a nuclear power plant with an output of 200 MWe is under construction in Techon, and three other units are being planned. The paper also introduces the Pyongyang nuclear research center, uranium ore concentrate pilot plant in Pakchon, uranium ore concentrate production plant in Pyongsan, and uranium mines. Descriptions are given on the institute of radiation protection, and agricultural and medical utilization of radioactive rays. The paper mentions issues of joining IAEA and performing the security measure treaty, and their background. With respect to the suspicion on plutonium use, IAEA needs to confirm whether the North Korean plan is limited to peaceful use.

2030. CHEMICAL AND CORROSION PROBLEMS IN CZECHOSLOVAK NUCLEAR POWER PLANTS. TURÝNA, R. (EGU - Power Research Inst. Prague Plc (Czech Republic)) KYSELA, J. (Nuclear Research Inst., Rezplc (Czech Republic)). *VGB Kraftwerkstechnik* (Germany), Volume 73, Number 4, April 1993, in German, pp. 389-393.

Up to 1978, when the first unit of Jaslovské Bohunice Nuclear Power Plant was commissioned, problems at nuclear power plants were known only from western literature. DE corrosion, caused by damage in the secondary circuit, is at the forefront of the statistics. Corrosion problems in the secondary circuit can be solved, for example, by exchanging chromium steel for austenitic steel and by treatment of the circulating water. A proposal for DE conservation has been formulated on the basis of corrosion investigations into the water regime used in the secondary circuit.

2031. APPLICATION OF GOAL PROGRAMMING TO DECISION PROBLEM ON OPTIMAL ALLOCATION OF RADIATION WORKERS. SA, S.; NARITA, M. (Hokkaido Univ., Sapporo (Japan)). *Hoken Butsuri* (Journal of Japan Health Physics Society) (Japan), Volume 28, Number 2, June 1993, pp. 161-166.

This paper is concerned with an optimal planning in a multiple objective decision-making problem of allocating radiation workers to workplaces associated with occupational exposure. The model problem is formulated with the application of goal programming which effectively followed up diverse and conflicting factors influencing the optimal decision. The formulation is based on the data simulating the typical

situations encountered at the operating facilities such as nuclear power plants where exposure control is critical to the management. Multiple goals set by the decision-maker/manager who has the operational responsibilities for radiological protection are illustrated in terms of work requirements, exposure constraints of the places, desired allocation of specific personnel and so on. Test results of the model are considered to indicate that the model structure and its solution process can provide the manager with a good set of analysis of his problems in implementing the optimization review of radiation protection during normal operation.

2032. OVERALL ASSESSMENT METHOD FOR THE EFFECTIVENESS OF A SYSTEM OF RADIATION PROTECTION. IZAWA, S.; KUMAZAWA, S. (Japan Atomic Energy Research Inst., Takai Research Establishment, Tokai, Ibaraki (Japan)). Proceedings of the International Conference on Radiation Effects and Protection, Japan Atomic Energy Research Inst., Mito (Japan), 18-20 March 1992, INIS-JP-008, CONF-9203223, 1992, pp. 455-462 (558 p).

An overall assessment of the effectiveness of an established system of radiation protection is to provide some possible improvement of the system and to confirm the adequacy of the system. The method of applying the hybrid lognormal dose distribution model to the overall assessment has been studied to measure the degree of overall reduction of individual doses and collective doses per practice in both radiation work control and regulatory activity. Four kinds of data of the research reactor JRR-2 and of the U.S. and Japanese nuclear power plants were analyzed by the method, on the effectiveness of both setting the control levels of individual dose and managing the collective doses per practice. It was found that the overall effectiveness of reduction of individual doses and collective doses per practice in radiation work as well as in regulatory activity can be measured by the hybrid scale, changing from the logarithmic scale to the linear scale according to the degree of control.

2033. EXPERIENCE OF DOSE REDUCTION AT PWR IN JAPAN. SATOH, T.; WADA, S. (Japan Atomic Power Co., Tokyo (Japan)). Proceedings of the International Conference on Radiation Effects and Protection, Japan Atomic Energy Research Inst., Mito (Japan), 18-20 March 1992, INIS-JP-008, CONF-9203223, 1992, pp. 452-454 (558 p).

In Japan, nineteen of PWR (Pressurized Water Reactor) commercial nuclear power plants are operation. The exposure dose is mostly caused in the periodical

inspection and the repair works. The efforts have been done to reduce occupational dose by various measures including automatic or remote control equipments, low cobalt content material adoption, proper chemical control of primary water, radiation shielding, mock-up training, and the Target Dose Management method. In recent years, the dose has been kept low level, because the execution of those dose reduction measures. In the case of PWR plants in 1990, the average collective dose per reactor was 1.73 man-Sv and the average individual dose was 1.58 mSv.

2034. IMPROVED EMERGENCY ELEVATED AIR RELEASE FOR SIMPLIFIED PWR. NAITOH, T. (Mitsubishi Atomic Power Industries, Inc., Tokyo (Japan)); BRUCE, R.A.; HIROTA, K.; TAJIRI, Y. ANP '92 International Conference on Design and Safety of Advanced Nuclear Power Plants. Compiled by OKA, Y.; KOSHIZUKA, S. (Tokyo Univ. (Japan)), Atomic Energy Society of Japan, Tokyo (Japan), 25-29 October 1992, CONF-921003, 1992, pp. 37.2/1-37.2/6 (2182 p).

In developing the application of the simplified PWR in Japan, one of the most important areas is to limit post-accident site boundary whole body dose. In addressing this, the concept of Emergency Passive Air Filtration System (EPAFS) and its feasibility is developed. The efficiency of charcoal filtering and the atmospheric diffusion effect of an elevated air release are important for dose reduction. The performance of these functions was evaluated by confirmatory testing. The test results confirmed a 99% efficiency of charcoal filter and an atmospheric diffusion effect higher than that of a conventional plant. The Emergency Passive Air Filtration System (EPAFS) and the atmospheric diffusion effect of elevated air release contribute to making the calculated post-accident site boundary whole body dose of simplified PWR as low as that of the conventional Japanese PWR plant.

2035. TRANSITIONING TO 12-HOUR SHIFTS. SUTER, P.S.; CERVASSI, S.M. Nuclear News, Volume 36, Number 3, March 1993, pp. 32-34.

In 1989, Yankee Rowe nuclear power station successfully implemented a 12-hour shift schedule for all shift workers (control room personnel, auxiliary operators, and radiation protection shift technicians) with many positive effects on morale, motivation, and performance. The transition from an 8-hour to a 12-hour shift schedule was initiated, organized, and promoted by the shift workers themselves after they had identified numerous inadequacies in the 8-hour

shift schedule. Preliminary and final implementation required several steps: (a) a survey of needs, (b) research of potential schedules, (c) cost/benefit analysis, (d) resolution of any union contract conflicts, (e) management approval, and (f) trial shift schedule periods.

2036. WNP-2'S PISARCIK: CHALLENGES IN RADIATION PROTECTION. Nuclear News, Volume 36, Number 3, March 1993, pp. 28-29.

The following Nuclear News interview, conducted by associate editor Gregg M. Taylor, is with David J. Pisarcik, radiation protection manager at the Washington Public Power Supply System's WNP-2 nuclear power plant. The unit is an 1100-MWe (net) GE boiling water reactor, and began commercial operation in December 1984.

2037. ROLES OF CONTAINMENT SEVERE ACCIDENT MANAGEMENT. SODA, K. (Japan Atomic Energy Research Inst., Tokai Research Establishment, Tokai, Ibaraki (Japan)). ANP '92 International Conference on Design and Safety of Advanced Nuclear Power Plants. Compiled by OKA, Y.; KOSHIZUKA, S. (Tokyo Univ. (Japan)). Atomic Energy Society of Japan, Tokyo (Japan), 25-29 October 1992, CONF-921003, 1992, pp. 23.1/1-23.1/5 (2182 p).

A reactor containment is the last physical barrier to protect the public and plant workers from unnecessary exposure to radioactivities in the case of severe accidents. Thus maintaining the integrity of the containment is of the primary importance to prevent release of radioactive materials to the environment. In order to further increase the level of the safety of nuclear power plants, various accident management measures have been proposed and adopted for the containment design. The present paper reviews the current status of the containment with accident management measures for the existing nuclear power plants and the advanced nuclear power plants.

2038. ANNUAL REPORT 1992-93. Department of Atomic Energy, Bombay (India), INIS-mf-13709, 1993 (123 p).

Activities of the various constituent units of the Department of Atomic Energy (DAE) and also of the institutions financially aided by DAE during the financial year 1992-93 are reported. The various constituent Units of DAE consist of research establishments, public sector undertakings and industrial organizations. These activities cover the gamut of nuclear fuel cycle, research and development in nuclear science and reactor technology, applications

of radiation and radioisotopes, radiation protection, research and development in front line areas such as robotics, lasers, parallel processing, etc. The activities are described under the headings : General Survey, Research and Development, Public Sector Undertakings, Industrial Organizations, Aided Institutions, Other Activities, and Services. Other activities of DAE include international relations, emergency planning, training, technology transfer, etc. Service activities include materials management, construction work, publicity and information work, etc. Some of the highlights of the year's work are: (1) Unit-1 of the Kakrapar Atomic Power Project (KAPP) attained criticality and was synchronized with the western grid; (2) Unit-2 of the Narora Atomic Power Station (NAPS) began commercial production; (3) the heavy water enrichment plant at Hazira was commissioned; (4) thorium bundles were used in KAPP-1 to achieve an efficient power flattening; (5) a thorium plant was commissioned at Chhatrapur, Orissa; and (6) the annual gross generation of electricity by nuclear power stations during 1992-93 is estimated to reach about 6600 MUs. The text is illustrated with a Number of colored photographs. A chart showing the organizational structure of atomic energy administration of the country and a map of India showing locations of various atomic energy establishments, spread all over the country are also given.

2039. MAIN APPROACHES TO CHOICE OF DECONTAMINATION METHODS IN CASE OF NUCLEAR POWER PLANT SHUTDOWN. TARASOV, V.M.; SYRKUS, M.N. *Ehnergeticheskoe Stroitel'stvo* (Russian Federation), Volume 1, January 1991, in Russian, pp. 61-64.

Selection criteria for optimal decontamination technology in case of nuclear power plant shutdown are considered. It is shown that technology evaluation from the viewpoint of observance of required precautionary measures is performed during the first stage of operation followed by analysis of process operational characteristics. The next stage relates to risk analysis of equipment, technological process and structure failures. The selection process is followed then according to criteria of decontamination duration, complexity level of control process and availability of qualified personnel, as well as complexity and composition of radioactive waste conditioning. Further follows decontamination technology evaluation from the viewpoint of its impact on personal health and environment. Cost-benefit ratio resulting from introduction of technologies under consideration are determined at the final stage.

2040. THE NORDIC PROGRAMME FOR NUCLEAR SAFETY 1990-1993. REPORT FOR

1993. Nordisk Kernesikkerhedsforskning, Roskilde (Denmark), NKS-93-2, April 1993 (67 p).

In 1993 the fourth Nordic Nuclear Safety Research programme will be concluded with final reports on all of the eighteen projects. Each report will contain the results of the work carried out which has taken four years to complete and, at the same time, give a more general survey of the Northern countries' competence within the fields of emergency readiness in situations of abnormal radiation, radioactive waste and its disposal, radioecology and nuclear reactor safety - accessibility of appropriate information. Some of the reports will be published in the form of reference books or in the form of databases of direct assistance to the authorities. A number of seminars will be held so that the results and professional level of the reports can be discussed. The coordinators' and project leaders' plans for these activities are presented with the amounts of money that project organizers have asked the Nordic Nuclear Safety Research programme to finance them with. During 1993 the plans for the programme starting in 1994 must be laid, and future researchers, project leaders, involved organizations and sponsors determined.

2041. THE NORDIC PROGRAMME FOR NUCLEAR SAFETY 1990-1993. REPORT FOR 1992. Nordisk Kernesikkerhedsforskning, Roskilde (Denmark), NKS-93-1, April 1993 (76 p).

The annual report contains the coordinators' summary of the results so far achieved by the in all 18 current projects in which 200 persons are taking part. In some cases the project leader's account is included. An overview is given of the programme's costs and orders during 1992 in relation to the subsidies given to the individual projects. The fields covered by these projects are emergency readiness in radiation situations which are not normal, nuclear wastes and their disposal, radioecology, reactor safety - knowledge readiness, and coordination efforts. An economical overview is given and English summaries of the projects presented at the summer meeting in 1992 are presented. A list of the names of the members of the Nordic Nuclear Safety Research members in the syndicate and reference groups is included in the publication, and a brief description is to be found of the institution's activities.

2042. SHIELDING DESIGN OF MRX (ADVANCED MARINE REACTOR X). YAMAJI, A.; IIDA, H.; KOBAYASHI, H.; SHIZAKA, Y.; SAKO, K.; (Japan Atomic Energy Research Inst., Tokai Research Establishment, Tokai, Ibaraki (Japan)); KAWASAKI, H.; OHUCHI, K. ANP '92 International Conference on Design and Safety of Advanced

Nuclear Power Plants. Compiled by OKA, Y.; KOSHIZUKA, S. (Tokyo Univ. (Japan)). Atomic Energy Society of Japan, Tokyo (Japan), 25-29 October 1992, CONF-921003, 1992, pp. P4.5/1-P4.5/7 (2182 p).

A marine reactor should be compact in size and light in weight because of its installation in narrow and limited space in ship. The concept developed for the MRX solves this problem to a significant extent by adoption of an integral type PWR and a water-filled containment vessel. As a result, this concept does not need the bulk shield outside the containment vessel. As compared with the existing marine reactors, the MRX becomes lighter in weight and more compact in size. For instance, the plant weight and the volume of containment vessel of MRX are about 0.5 and 0.7 of those of N.S. MUTSU, in spite of the power of MRX is 2.8 times as large as that of the MUTSU reactor.

2043. STATEMENT OF NUCLEAR INCIDENTS AT NUCLEAR INSTALLATIONS: SECOND QUARTER 1992. (Health and Safety Executive, London (United Kingdom)), INIS-GB-492, 30 September 1992 (3 p).

Two incidents are reported, neither of which gave rise to release of radioactivity. A treated water plant at the Trawsfynydd sewage plant overflowed. The radioactivity of the effluent was negligible but the discharge route was not authorized one and has therefore reported to the Health and Safety Executive: Float switches in the level control system have been modified as a result of the incident. At Hunterston-B nuclear power plant a fire in one of the reactors occurred during routine maintenance. No nuclear material was involved and no one was injured. However the reactor will be checked before being allowed to return to power.

2044. DESIGN OPTIONS FOR FUTURE ADVANCED HTR. KUGELER, K. (Inst. Fuer Sicherheitsforschung Und Reaktortechnik, Forschungszentrum Juelich GmbH (Germany)). Compiled by OKA, Y.; KOSHIZUKA, S. (Tokyo Univ. (Japan)). Atomic Energy Society of Japan, Tokyo (Japan), ANP '92: International Conference on Design and Safety of Advanced Nuclear Power Plants, Tokyo (Japan), 25-29 October 1992, Atomic Energy Society of Japan, CONF-921003, 1992, pp. 7.3/1-7.3/8. (2182 p).

Nuclear Energy has to be used probably world-wide in a wide scale. But then it will be necessary to introduce this form of energy into the heat market and above all to realize a new quality of safety. In

addition to this it is absolutely necessary to develop a catastrophe-free nuclear energy. Furthermore a safe final deposit of burnt fuel elements is demanded. It is also necessary to avoid the misuse of fissile material. Besides these safety oriented demands progressive reactor concepts have to satisfy the demands upon high availability, of maintainability and reparability as well as careful consideration of uranium resources and economic competitiveness. The HTR already fulfills many of these demands to a great extend. In this paper it is reported about the latest developments and further possibilities of improvement. Also necessary proofs are discussed in regard to some of the mentioned points.

2045. JOURNAL OF THE CITIZEN AMBASSADOR PROGRAM: NUCLEAR PROTECTION DELEGATION TO RUSSIA AND UKRAINE. CHRISTIANSEN, H.D. (U.S. DOE Idaho Operations Office, Idaho Falls, ID), DOE/FTR-93016213, 29 June 1993 (125 p).

This document provides details of the activities of the Citizen Ambassador Program Nuclear Protection Delegation which convened August 3, 1992 in New York City. Biographical information is provided for the delegation members.

2046. OCCUPATIONAL DOSE REDUCTION AT NUCLEAR POWER PLANTS: ANNOTATED BIBLIOGRAPHY OF SELECTED READINGS IN RADIATION PROTECTION AND ALARA. KAURIN, D.G.; KHAN, T.A.; SULLIVAN, S.G.; BAUM, J.W. (Brookhaven National Lab., Upton, NY). Division of Regulatory Applications, Nuclear Regulatory Commission, Washington, DC, NUREG/CR-3469-Vol.7, BNL-NUREG-51708-Vol.7, July 1993 (98 p).

The ALARA Center at Brookhaven National Laboratory publishes a series of bibliographies of selected readings in radiation protection and ALARA in the continuing effort to collect and disseminate information on radiation dose reduction at nuclear power plants. This is volume 7 of the series. The abstracts in this bibliography were selected from proceedings of technical meetings and conferences, journals, research reports, and searches of the Energy Science and Technology database of the U.S. Department of Energy. The subject material of these abstracts relates to radiation protection and dose reduction, and ranges from use of robotics to operational health physics, to water chemistry. Material on the design, planning, and management of nuclear power stations is included, as well as information on decommissioning and safe storage efforts. Volume 7 contains 293 abstracts, an author index, and a subject index. The

author index is specific for this volume. The subject index is cumulative and lists all abstract numbers from volumes 1 to 7. The numbers in boldface indicate the abstracts in this volume; the numbers not in boldface represent abstracts in previous volumes.

2047. OCCUPATIONAL EXPOSURES AND DOSE REDUCTION IN JAPAN. OSHINO, M. (Japan Atomic Energy Research Inst., Tokai Research Establishment, Tokai, Ibaraki (Japan)). Proceedings of the International Conference on Radiation Effects and Protection, Japan Atomic Energy Research Inst., Mito (Japan), 18-20 March 1992, INIS-JP-008, CONF-9203223, 1992, pp. 306-312.

Occupational exposure to ionizing radiation in Japan is governed by a series of regulations. Based on ICRP Publication 26, these regulations were revised in 1989. Assessment of occupational exposure is essential to assure the status of radiation protection or workers in various occupations, to identify the possible improvements of regulations and to revise regulations as necessary. This paper presents a brief review of the categories of Japanese radiation workers, a review of occupational exposure for the year 1990, a summary of trends for the period of 1976 to 1990 and a perspective of future Japanese occupational exposure as related to ICRP Publication 60. In general the dose distribution of monitored workers has been a hybrid-lognormal distribution rather than a lognormal distribution. This reflects the strengthened higher individual dose controls. In the 1990s the number of monitored workers in Japan will increase but there is the potential to attain both a reduction of collective dose and a reduction of the number of workers exposed to more than 20 mSv.

2048. IMPROVEMENT IN WATER-CHEMICAL REGIME OF PRIMARY CIRCUIT COOLANT AT NPP WITH BWR AND PWR. Compiled by RUMYANTSEV, V.V. Atomnaya Tekhnika za Rubezhom (Russian Federation), Volume 1, January 1992, in Russian, pp. 11-13.

The experience of the USA and France in the optimization of water chemistry of primary circuit coolant at NPPs with BWRs and PWRs is considered in view of decreasing radiation doses of the personnel due to radioactive depositions and in view of reducing equipment corrosion. It is shown that the most optimal conditions are achieved through additions of zinc (5-10 µg/kg) into BWR coolant and via increase of pH value up to 7.2 under restriction of lithium concentration at 2.2 µg/kg level in PWR coolant.

2049. RISK AND DOSE ASSESSMENT METHODS IN GAMMA KNIFE QA. BANKS, W.W.;

JONES, E.D. (Lawrence Livermore National Lab., CA); RATHBUN, P. (Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission, Washington, DC) Lawrence Livermore National Lab., CA, 20th Water Reactor Safety Information Meeting, Bethesda, MD, 21-23 October 1992, UCRL-JC-111219, CONF-921007-34, October 1992 (12 p).

Traditional methods used in assessing risk in nuclear power plants may be inappropriate to use in assessing medical radiation risks. The typical philosophy used in assessing nuclear reactor risks is machine dominated with only secondary attention paid to the human component, and only after critical machine failure events have been identified. In assessing the risk of a misadministrative radiation dose to patients, the primary source of failures seems to stem overwhelmingly, from the actions of people and only secondarily from machine mode failures. In essence, certain medical misadministrations are dominated by human events not machine failures. Radiological medical devices such as the Leksell Gamma Knife are very simple in design, have few moving parts, and are relatively free from the risks of wear when compared with a nuclear power plant. Since there are major technical differences between a gamma knife and a nuclear power plant, one must select a particular risk assessment method which is sensitive to these system differences and tailored to the unique medical aspects of the phenomena under study. These differences also generate major shifts in the philosophy and assumptions which drive the risk assessment (Machine-centered vs Person-centered) method. We were prompted by these basic differences to develop a person-centered approach to risk assessment which would reflect these basic philosophical and technological differences, have the necessary resolution in its metrics, and be highly reliable (repeatable). The risk approach chosen by the Livermore investigative team has been called the "Relative Risk Profile Method" and has been described in detail by Banks and Paramore (1983).

2050. THE SWISS NUCLEAR INSTALLATIONS ANNUAL REPORT 1992. Bundesamt fuer Energiewirtschaft, Wuerenlingen (Switzerland). Abt. fuer die Sicherheit der Kernanlagen. HSK-AN-2580, KSA-AN-1754, June 1993 (86 p).

This report concerns the safety of the Swiss nuclear installations in the period of 1992. Surveillance of these installations with regard to nuclear safety, including radiation protection, is among the tasks of the Swiss Federal Nuclear Safety Inspectorate (HSK). In Switzerland five nuclear power plants are operational: Beznau I and II, Muehleberg, Goesgen, and

Leibstadt. Research reactors of thermal capacities below 10 MWth are operational at the Paul Scherrer Institute (PSI), at the Swiss Federal Institute of Technology Lausanne and at the University of Basle. Further subject to HSK's supervision are all activities at PSI involving nuclear fuel or ionizing radiation, the shut down experimental reactor of Lucens, the exploration in Switzerland of final disposal facilities for radwaste and the interim radwaste storage facilities. The present report first deals with the nuclear power plants and covers, in individual sections, the aspects of installation safety, radiation protection as well as personnel and organization, and the resulting overall impression from the point of view of HSK (chapters 1-4). In chapter 5, the corresponding information is given for the research installations. Chapter 6 on radwaste disposal is dedicated to the waste treatment, waste from reprocessing, interim storage and exploration by the NAGRA. In chapter 7, the status of emergency planning in the nuclear power plants' vicinity is reported. Certificates issued for the transport of radioactive materials are dealt with in chapter 8. Finally chapter 9 goes into some general questions relating to the safety of nuclear installations, and in particular covers important events in nuclear installations abroad. In all, the operation of the Swiss nuclear installations in the period of 1992 is rated safe by HSK.

2051. NUCLEAR POWER INDUSTRY 1991: ACTIVITY DISCHARGE, OCCUPATIONAL EXPOSURES. Swedish Radiation Protection Inst., Stockholm (Sweden), SSI-92-15, September 1992, in Swedish (33 p).

A compilation of data of radioactivity discharges and personnel monitoring at Swedish nuclear facilities.

2052. ADVANCES IN CANADIAN REGULATORY PRACTICE. PAPER NO. INFO-0439. WADDINGTON, J.G. (Atomic Energy Control Board, Ottawa, ON (Canada)), MIC-93-03717, 1993 (20 p).

The new General Amendments to the Regulations, new recommendations on dose limits, developments in techniques and safety thinking, and aging of plant are all contributing to the need for a significant number of new regulatory documents on a wide range of topics. This paper highlights initiatives taken in response to these pressures, giving a brief background to the initiative and, where possible, outlining some of the ideas in the document being written. The paper covers licensing guides on new dose limits, dosimetry, safety analysis, reliability, fault tree analysis, reporting requirements, human factors,

software, the ALARA principle, backfitting, and the licensing process.

2053. BWR/5 FULL-SYSTEM DECONTAMINATION FEASIBILITY STUDY. BEAMAN, T.A. (Niagara Technical Consultants, Niagara Falls, NY). Electric Power Research Inst., Palo Alto, CA, EPRI-TR-102332, May 1993 (63 p).

Full-system BWR decontamination using the LOMI (low-oxidation-state metal-ion) process can feasibly, cost effectively be applied to BWR/5 models. This report describes an EPRI evaluation of LOMI application at Commonwealth Edison's LaSalle County Station, a BWR/5 plant. Eight key areas were evaluated in terms of full-system decontamination, including: application parameters, long-term materials performance, system interactions, additional equipment requirements, radwaste issues, recontamination, economics, and licensing considerations. This study of LOMI process applicability was based on earlier successful application at Commonwealth Edison's Quad Cities BWR/3 (EPRI report TR-100049).

2054. THE INTERNATIONALIZATION OF NUCLEAR SAFETY. ROSEN, M. (International Atomic Energy Agency, Division of Nuclear Safety, Vienna (Austria)). The IAEA Safety Programme. Proceedings of the 27th Annual Conference of The Canadian Nuclear Association, Saint John (Canada), 14-17 June 1987, INIS-mf-13673, CONF-8706423, 1987, pp. 147-152 (398 p).

The IAEA has published "Regulations for the Safe Transport of Nuclear Materials," the "Nuclear Safety Standards" for nuclear power plants, and "Basic Safety Standards for Radiation Protection." By 1986 the emphasis of the IAEA safety program had shifted to implementation, with inception of the "Incident Reporting System," the "Operational Safety Review Team" (OSART), and "Radiation Protection Advisory Teams" (RAPATs). By 1986, OSART had made 14 visits to various countries, and RAPATs had visited 17 countries.

2055. SHIPMENT OF SPENT FUEL IN STORAGE CANISTERS. ROSA, J.M.; HEDGEWICK, P.D.; MCINNES, I.D.; MCCONAGHY, W.J. (Pacific Nuclear Fuel Services, Inc., San Jose, CA). Electric Power Research Inst., Palo Alto, CA, EPRI-TR-102462, June 1993 (90 p).

Spent fuel is being stored in canisters in Independent Spent Fuel Storage Installations (ISFSI) at two nuclear power plants. Canistered storage systems have been submitted to NRC for approval for ISFSI at four additional plants. It is desirable that the canisters be

compatible with the requirements for shipment of spent fuel under 10CFR71. Compared to unloading the canisters and reloading fuel into a shipping cask, shipment of intact canisters offers the possibility of substantial savings to the utility of cost and occupational exposure. It also offers increased safety margins against radionuclide release during transport to the repository or the MRS. In order for a storage canister to be compatible with shipping regulations, it must be compatible with a licensed shipping cask. Although a suitable cask does not exist presently, a scoping analysis shows that it is feasible to design a rail cask that will accept the largest canister design now planned. To be shippable, the storage canister must be shown to retain its structural integrity during the storage term of at least 20 years. Of the potential damage mechanisms caused by prolonged storage in a high radiation field at moderately elevated temperature, only corrosion is of significant interest. It is found that the dry storage environment will prevent nucleation and growth of defects in stainless steels due to IGSCC, and that a properly selected and applied coating can provide general corrosion protection to carbon steel canisters. Economic and ALARA benefits to the utility of intact canister shipment include avoided costs of opening and downloading a canister and disposal of the canister. Benefits to the DOE include a faster turnaround time for the cask at the reactor since dewatering and decontamination of the cask are avoided.

2056. GNS SPENT FUEL CASK EXPERIENCE. WEH, R. (Gesellschaft Fuer Nuklear-Service mbH, Hannover (Germany)). *JNMM* (Journal of the Institute of Nuclear Materials Management), Volume 21, Number 3, May 1993, pp. 37-41.

The Gesellschaft fuer Nuklear-Service mbH (GNS), which is owned by German utilities, is responsible for the management of spent fuel and nuclear waste on behalf of the German utilities operating nuclear power plants. This paper describes the spent reactor fuel and waste shipping and/or storage casks that GNS manufacturers for nuclear facilities in Germany, and worldwide. So far more than 30 different casks have been produced in quantities ranging from one to several hundred of each type. GNS participates in the German Support Program to assist the International Atomic Energy Agency (IAEA) in developing verification procedures for dry storage casks containing spent fuel. This activity is also summarized.

2057. BETA DOSE RATES AND BETA PARTIAL BODY DOSES AT TWO GERMAN NUCLEAR POWER PLANTS. HEINZELMANN, M. (Forschungszentrum Juelich GmbH (Germany)); HALLFARTH, G.; WELTE, U. (Kernkraftwerk

Kruemmel GmbH (KKK), Hamburg (Germany)); REGULLA, D. (Gsf-Forschungszentrum Fuer Umwelt Und Gesundheit GmbH, Neuherberg (Germany)); SCHNEPEL, G.H. (Bundesamt Fuer Strahlenschutz, Bonn (Germany)). *Radiation Protection Dosimetry* (United Kingdom), Volume 46, Number 2, 1993, pp. 89-96.

The beta dose rate, the shielding of beta radiation by protective clothing and the personnel doses caused by beta radiation during special activities were measured at two German nuclear power plants, one with a pressurized water reactor and the other with a boiling water reactor. Measurements were performed during refuelling outage and, in the case of the boiling water reactor, also during plant operation. Beta area dose rates of up to 440 mSv.h⁻¹ were determined, the beta dose rates being up to a factor of 40 times the gamma dose rates. In most cases, low energy beta radiation was involved, which is largely shielded by protective clothing. In addition, however, radiation fields with high energy beta radiation were also detected (¹²⁴Sb). The skin doses produced by beta radiation during various activities were not sufficiently high to require monitoring with a partial-body dosimeter in accordance with the German Radiation Protection Ordinance.

2058. INEL FACT FINDING MISSION TO RUSSIA, UKRAINE, AND EASTERN EUROPE REGARDING NUCLEAR SAFETY. BICKEL, J.H.; MODRO, S.M. (EG&G Idaho, Inc., Idaho Falls, ID). DOE/FTR-93011934, 1993 (42 p).

This report discusses travel to Russia, Ukraine, and Eastern Europe regarding nuclear safety. In order to obtain better information regarding nuclear safety technical assistance needs in these countries. A series of technical meetings were arranged between the INEL and various organizations in these countries. The trip was partially funded by the IAEA Division of Nuclear Safety (Bickel at VNIIAES) and from internal INEL funds.

2059. QUALITY ASSURANCE OF RADIATION MONITORING PERFORMED AT THE SWEDISH NUCLEAR INDUSTRY. DISCHARGE OF LIQUID WASTES 1990. Swedish Radiation Protection Inst., Stockholm (Sweden), SSI-92-21, December 1992, in Swedish (34 p).

The Swedish nuclear power plants have own administration of some radiation monitoring. These monitoring programs are quality controlled by the Swedish Radiation Protection Institute (SSI). The report presents the results of the quality control 1990. The following were controlled: Interlaboratory compari-

sons of measurements of gamma emitting nuclides in water; Discharge of liquid wastes; Discharge of plutonium.

2060. QUALITY ASSURANCE OF RADIATION MONITORING PERFORMED OF THE SWEDISH NUCLEAR INDUSTRY. DISCHARGES OF LIQUID WASTES 1989. Swedish Radiation Protection Inst., Stockholm (Sweden), SSI-92-19, November 1992, in Swedish (33 p).

The Swedish nuclear power plants have own administration of some radiation monitoring. These monitoring programs are quality controlled by the Swedish Radiation Protection Institute (SSI). The report presents the results of the quality control 1989. The following were controlled: Interlaboratory comparisons of Sr-90 measurements discharge of liquid wastes 1989; Discharge of plutonium 1988.

2061. OPERATION OF FINNISH NUCLEAR POWER PLANTS. Edited by TOSSAVAINEN, K. (Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland)), STUK-B-YTO-101, December 1992 (28 p).

The Finnish nuclear power plant units Loviisa 1 and 2 as well TVO I and II were in operation for almost the whole second quarter of 1992. Longer breaks in production were caused by the annual maintenance of the TVO plant units. The load factor was 87.4%. At TVO I it was detected during the annual maintenance outage when removing nuclear fuel assemblies from the reactor that one assembly had been loaded into the reactor in an incorrect manner during the previous year's annual maintenance: the assembly was slightly higher than the other assemblies. The water cooling the nuclear fuel partly by-passed the fuel assembly and the coolant flow proper passing through the assembly was below design. The fuel assembly's cooling had been sufficient during the whole operating cycle but could have essentially deteriorated during certain transients with the danger of consequent damage to some fuel rods. On the International Nuclear Event Scale the event is classified as level 1. Other events in this quarter which are classified on the International Nuclear Event Scale were level 0/below scale on the scale.

2062. A RAPID WAY TO PROCESS BONNER SPHERES DATA. AROUA, A.; GRECESCU, M.; LERCH, P.; VALLEY, J.-F. (Inst. For Applied Radiophysics, Lausanne (Switzerland)); PRETRE, S. (Swiss Nuclear Safety Inspectorate, Villigen-Hsk (Switzerland)). Radiation Protection Dosimetry (United Kingdom), Volume 46, Number 1, 1993, pp. 45-48.

The Bonner spheres neutron spectrometer is well suited for radiation protection measurements at nuclear facilities because of its energy range and its high neutron sensitivity. The processing of the measured data requires the use of unfolding codes that often run on large computers which makes it difficult to obtain on-site the spectrometric and dosimetric results. In this paper, the use is suggested, in a preliminary stage, of a spectral index to characterize the neutron spectrum, and to compute the dosimetric quantities as a combination of the readings given by three spheres only. The terms of the combination are first established using synthetic spectra. The method is then evaluated in 26 realistic spectra measured around isotopic sources and inside nuclear power plants.

2063. TERMINOLOGICAL DICTIONARY OF ELECTRICAL POWER INDUSTRY IN RANGE OF GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRIC ENERGY. BIERNACKI, T.; CEGLA, S.; CISZEWSKI, W. Praca Zbiorowa, Stowarzyszenie Elektrykow Polskich, Warsaw (Poland), Power System Computer Centre, August 1990, in Polish (475 p).

The dictionary contains about 5,000 terms about conventional and nuclear power plants, energy sources, transmission lines, automation, power systems, environment protection, statistics etc. Each term is given with definition and its equivalents in English, French, German and Russian. Indexes of Polish, English, French, German and Russian terms are provided at the back of dictionary.

2064. R&D FOR DECOMMISSIONING IN THE EUROPEAN COMMUNITIES. PRESENT ACTIVITIES AND FUTURE TASKS. SIMON, R.; HUBER, B. (Commission of The European Communities, Charleroi (Belgium)). Decommissioning Policies For Nuclear Facilities. Nuclear Energy Agency, 75 - Paris (France), 2-4 October 1991, Nuclear Energy Agency of the OECD, CONF-9110141, 1992, pp. 35-44 (402 p).

Since 1979, the European Community (EC) has been conducting three successive R&D programmes in the field of decommissioning of nuclear installations with the main objective of reinforcing the scientific and technical basis of decommissioning with a view to strengthening the safety and protection aspects. The current programme covers: six R&D projects concerning building integrity, decontamination, dismantling, treatment of waste materials, remote-controlled manipulator systems, estimation of radioactive wastes; identification of guidelines related to application of ALARA principle on decommissioning, and the

technical elements of a Community policy; testing of new techniques in practice, particularly in the four pilot dismantling projects.

2065. POWER STATION WASTES - PRACTICAL MEANS. WESTON, J. (Nuclear Electric PLC, Hinkley Point Power Station (United Kingdom)). 1991 Summer School on Radioactive Waste Management, Decommissioning and Clean-up. IBC Technical Services Ltd., London (United Kingdom), Summer Session on Nuclear Power Reactor Safety and Thermal Power Reactors, Cambridge, MA, 8-12 July 1991, CONF-9107107, 1991 (316 p).

The aim of this paper is to give an insight into some of the practical problems that beset a typical power station Health Physicist striving to meet the demands of best practice in relation to the control of radioactive discharges and disposals. It is important to recognize that the requirements of various groups must be considered when dealing with this subject and conflicts can exist between groups and even within one group. For example the requirements of the Regulators, the requirements of the Company, the requirements of other bodies and the requirements of the public must all be taken into account.

2066. SYSTEM FOR KEEPING ATMOSPHERIC PRESSURE IN NUCLEAR FACILITY AND ITS PERIPHERAL EQUIPMENTS. MATSUMOTO, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)). Japan Atomic Energy Research Inst., Tokyo (Japan), JAERI-M-93-025, February 1993, in Japanese (76 p).

The design to keep radioactive materials in the facility and not to make them spread inside the facility and into the environments is an essential issue in the construction of nuclear facilities. One reason of the contamination is due to the diffusion with air flow, therefore, negative pressure for the ambients has been utilized to keep gaseous radioactivities inside the facility of interest. The pressure difference is not so large, though, the atmospheric pressure level of the contaminated and possibly contaminated areas are always kept to be lower than those of the ambient one to prevent the dissemination of radioactivity from the defined area. The technique using negative pressure, at present, is employed widely in nuclear facilities, and the basic system is the same as that of JRR-1 built as the first nuclear facility in Japan. In the present work, the conventional system with negative pressure was reexamined on the state-of-art of the regulations for the nuclear facilities, and consequently some shortages of the system has been found. Thus, an advanced system with an excellent performance keeping the negative pressure has been

developed to cover the shortage. In this report, the new system is introduced with a couple of comments, acquired from the author's experience, to the design and the maintenance of the composite equipments of the system.

2067. ASSESSMENT OF THE EFFECTIVE DOSE EQUIVALENT FOR EXTERNAL PHOTON RADIATION. REECE, W.D.; POSTON, J.W.; XU, X.G. (Texas A&M University, College Station, TX). Electric Power Research Inst., Palo Alto, CA, EPRI-TR-101909-Vol.1, February 1993 (69 p).

Beginning in January 1994, U.S. nuclear power plants must change the way that they determine the radiation exposure to their workforce. At that time, revisions to Title 10 Part 20 of the Code of Federal Regulations will be in force requiring licensees to evaluate worker radiation exposure using a risk-based methodology termed the "effective dose equivalent." A research project was undertaken to improve upon the conservative method presently used for assessing effective dose equivalent. In this project effective dose equivalent was calculated using a mathematical model of the human body, and tracking photon interactions for a wide variety of radiation source geometries using Monte Carlo computer code simulations. Algorithms were then developed to relate measurements of the photon flux on the surface of the body (as measured by dosimeters) to effective dose equivalent. This report (Volume I of a two-part study) describes: the concept of effective dose equivalent, the evolution of the concept and its incorporation into regulations, the variations in human organ susceptibility to radiation, the mathematical modeling and calculational techniques used, the results of effective dose equivalent calculations for a broad range of photon energies and radiation source geometries. The study determined that for beam radiation sources the highest effective dose equivalent occurs for beams striking the front of the torso. Beams striking the rear of the torso produce the next highest effective dose equivalent, with effective dose equivalent falling significantly as one departs from these two orientations. For point sources, the highest effective dose equivalent occurs when the sources are in contact with the body on the front of the torso. For females the highest effective dose equivalent occurs when the source is on the sternum, for males when it is on the gonads.

2068. FACTS AND FIGURES ON NUCLEAR ENERGY. Deutsches Atomforum e.V., Bonn (Germany), Inforum Verl., January 1993, in German (78 p).

The leaflet presents updated full-text, graphical and factual information in energy demand and supply, in nuclear power plants and reactor types, latest developments in radiological protection, and reactor safety engineering, and on waste management.

2069. TECHNIQUES FOR CONTROLLING RADIATION EXPOSURE. OCKEN, H.; WOOD, C.J. *Nuclear News*, Volume 36, Number 2, February 1993, pp. 43-47.

The U.S. nuclear power industry has been remarkably successful in reducing worker radiation exposure over the past 10 years. There has been more than a fourfold reduction in person-rem per MW-year of electric power generated: from 1.8 person-rem in 1980 to only 0.4 person-rem in 1991. Despite this substantial improvement, challenges for the industry remain. Individual exposure limits have been tightened in the 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, and there will be more requirements for special maintenance work as plants age, suggesting that vigorous efforts will be required to meet the 1995 industry goals for unit median collective exposure. No one method will suffice, but implementing suitable combinations from this compendium will help utilities to achieve their exposure goals. Radiation reduction is generally cost-effective: Outages are shorter, staffing requirements are reduced, and work quality is improved. Despite up-front costs, the benefits over the following one to three years typically outweigh the expenses.

2070. TOWARDS A NEW RADIATION PROTECTION ORGANIZATION. LARSSON, T.; PERSSON, G.; ULVDAND, T.; EDVARSON, K.; HELLMAN, R. (Foersvarets Forskningsanstalt, Umeaa (Sweden). Huvudavdelning foer ABC-Skydd). FOA-C-40304-4.3, text in Swedish with English abstracts, January 1993 (34 p).

Work has been initiated to create a new protection organization for warning and mapping in radioactive fall-out situations in Sweden. The organization should be the same in peace, crises and war and be able to deal with fall-out, both from accidents in nuclear power stations and nuclear weapons explosions. The two present organizations, one for peace and one for war, will be substituted by this common organization. The report describes the first steps in the work. A description of the two present organizations is made and they are compared for two different fall-out levels. This comparison is evaluated and some proposals are made for the local and regional organizations level.

2071. NUCLEAR POWER PLANT SAFETY UNDER MILITARY THREATS. STRITAR, A.; MAVKO, B. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). TOPFORM '92: The Safe and Reliable Operation Of LWR NPPs. Vol. II. European Nuclear Society (ENS), Bern (Switzerland), Czech Nuclear Society, Prague (Czech Republic), Slovak Nuclear Society, Bratislava (Slovakia), TOPFORM '92: The Safe and Reliable Operation Of LWR NPPs. Vol. II. East-West Topical Meeting: The Safe and Reliable Operation of Light Water Reactor NPPs, Prague (Czechoslovakia), 18-21 October 1992, INIS-mf-13503, CONF-921068, January 1993, pp. 166-169 (245 p).

The Krsko nuclear power plant in Slovenia was probably the first in the world that found itself in the middle of a war region. A number of preventive measures performed during and immediately after the war in summer 1991 by the plant personnel as well as some of related activities of the Reactor Engineering Division of the 'Jozef Stefan' Institute are described. All efforts were aimed at the minimization of the possible public radiological consequences during a military attack. The critical safety functions in such conditions were checked. Concern was further devoted to maintenance of the core cooling in the core and to integrity of the spent fuel pit. The cold shutdown mode was found to be the most appropriate option. After selecting the cold shutdown mode as a most suitable operational state of the plant, further studies of the vulnerability were done. In addition to possible direct damage to structures, that would cause release of radioactivity, two important subjects were considered: AC and DC power supply and the ultimate heat sink. A quick analysis during the crisis has shown that the consequences of a military attack against the plant by jet fighters could be serious, but with the proper preventive measures and preparedness the environmental consequences could be minimized.

2072. MEASURES TAKEN TO IMPROVE NUCLEAR SAFETY ON EDF PWRs IN OPERATION. KUS, J.P. (Electricité de France CNIPE, Lyon (France)); NORVEZ, G. (Electricité de France CLI, Lyon (France)). TOPFORM '92: The Safe and Reliable Operation Of LWR NPPs. Vol. II. East-West Topical Meeting: The Safe and Reliable Operation of Light Water Reactor NPPs, Prague (Czechoslovakia), 18-21 October 1992, INIS-mf-13503, CONF-921068, January 1993, pp. 135-141 (245 p).

In parallel with its major nuclear programme (56 PWR units in service or under construction), France has developed an original philosophy in the field of Nuclear Safety. This comprehensive philosophy

ensures a fine balance and coordination between design and operation, it provides a methodology to design, construct and operate a safe nuclear plant. Actual experience is then continuously compared to the initial expectation and the methodology refined whenever necessary. This methodology is fully applied to the new 1400 MWe plant series presently under construction. The essential elements are also backfitted into all previous units, thereby giving them an equivalent level of safety. The French PWR park can therefore be considered as very homogeneous with regard to its safety level, regarding both its design and operation.

2073. EXAMINATION OF BIOLOGICAL SHIELDING OF NUCLEAR PLANTS OR HOT CELLS. POINBOEUF, PH. (CEA Centre D'Etudes De Cadarache, 13-Saint-Paul-Lez-Durance (France)). Decommission and Demolition 1922. Edited by WHYTE, I.L. (Inst. of Science and Technology, Manchester University (United Kingdom)). 3rd International Conference on Decommissioning Off-shore, Onshore Demolition and Nuclear Works, Manchester (United Kingdom), 25-26 March 1992, Thomas Telford Ltd., CONF-9203239, 1992, pp. 77-78.

The inspection of biological shields is necessary to check the quality of the materials used to protect against gamma radiation effects and protects the operators. This technique is frequently utilized in hot laboratories or in nuclear power plants before further operations can be undertaken. This paper describes the method of testing and some different checks made in hot laboratories.

2074. EMERGENCY PLANNING IN NUCLEAR POWER PLANTS IN INDIA. MURTHY, L.G.K.; SAH, B.M.L. (Nuclear Power Corporation, Bombay (India). Directorate of Health and Safety). Industrial Safety Chronicle (India), Volume 23, Number 1, April-June 1992, pp. 52-56.

As a measure of abundant caution, detailed planning is done for the handling of both the in-plant and on-site/off-site emergency situations likely to arise in nuclear power plants. The basis for the emergency response preparedness for the accidents involving large-scale releases of radioactive materials is presented in this paper. This philosophy to be adopted for the introduction of counter-measures in plant and public domain is kept in line with the recommendations of the International Commission on Radiological Protection (ICRP) and International Atomic Energy Agency (IAEA). The roles of the different plant and off-site authorities/agencies and plant personnel for carrying out the emergency actions/functions in an

orderly manner are clearly detailed and the various orientation and training/retraining and qualification of all key-agencies and personnel and periodic checks of the availability of the emergency facilities and equipments, are outlined. The emergency plan reviews and revisions are carried out periodically on the basis of the results of the past experience. The evaluation of adequate level of preparedness is also done by conducting the emergency drills and in-plant/site and off-site emergency exercises and post-exercise reviews/critiques. The possibilities of emergency situations arising out of accidents involving the release of toxic materials from the heavy water production plant located near a nuclear plant have also been considered in the emergency plan. The experience obtained by carrying out the on-site and off-site emergency exercises at the different nuclear power plants has given a reasonable level of confidence that it would be possible to implement the countermeasures as demanded by the emergency situations in the nuclear power plants.

2075. SAFETY ASPECTS IN NUCLEAR POWER PLANTS. SARMA, M.S.R.; KAPOOR, R.K. (Operating Plants Safety Division, Atomic Energy Regulatory Board, Bombay (India). APRC '91: Prevention and Control of Hazards in Nuclear Industry, New Delhi (India), 28-30 August 1991, Industrial Safety Chronicle (India), Volume 23, Number 1, CONF-9108242, Apr-June 1992, pp. 42-51.

Nuclear power, like any other power source, has some hazards and some risks associated in its various phases and aspects such as construction, operation, maintenance and waste disposal. Several methods based on both engineering and administrative procedures are employed to create multiple safety barriers. Each such safety barrier, by itself, provides a high level of protection against release of radiation or radioactive materials. Rules and regulations are drawn up to ensure that the minimum acceptable standards of quality are enforced in the course of design, fabrication and maintenance of all safety related equipment. The mainstay of the stage of nuclear power programme in India, is based on the Pressurized Heavy Water Reactor (PHWR). Safety aspects of Indian nuclear plants are analyzed and presented.

2076. TRAVEL TO LYON, FRANCE IN REVIEWING ANALYSES OF MORTALITY AMONG POPULATIONS OF NUCLEAR INDUSTRY WORKERS IN THE U.S., U.K. AND CANADA. FRY, S.A. (Oak Ridge Inst. for Science and Education, Oak Ridge, TN), DOE/FTR-93011543, 1993 (12 p).

The present meeting was intended as the final one of the Study Group established in 1988 under the aegis of IARC, Lyon, France to conduct combined analyses of cancer mortality among nuclear industry and workers in three countries. The work at LKRC has been supported by organizations in the countries represented, including DOE and the National Institute of Environmental and Health Sciences. Study group members from the epidemiology groups contributing previously analyzed data for site-specific populations of nuclear industry workers in the United States (Hanford, Oak Ridge National Laboratory, Rocky Flats), United Kingdom and Canada, met to review and discuss the data, methods, analytic approaches, the results and their preliminary interpretation, and draft documents describing the study and its findings. Specific topics discussed included issues relating to the radiation dosimetry used in the analyses, interpretation of the findings for cancer mortality overall and mortality due to all and specific types of leukemias, and other specific cancer types of a priori interest; the results of the analyses and cancer risk estimates obtained with respect to the type of radiation and the dose uncertainties. Decisions were made regarding the form and publication of referenceable reports that will be prepared to document the study and the results obtained. Questions of the interim confidentiality of the results and the need for prepublication briefings of management and workers were addressed. Also discussed was the need for further analyses involving the present combined populations alone, together with other candidate cohorts, e.g., Savannah River, Los Alamos National Laboratory, by specific exposure groups, e.g., plutonium, uranium, or in combination with nuclear power plant employee populations. Reference is made to IARC's plans for research in the areas of ionizing radiation including radon, and electromagnetic fields.

2077. RADIATION PROTECTION IN NUCLEAR POWER PLANTS: FUTURE PERSPECTIVES. BERTRON, L. (Electricité de France, 75 - Paris (France)). *Revue Generale Nucleaire* (France), Volume 6, November-December 1992, in French, pp. 526-527.

The author presents the future perspectives of the radiation protection in EDF nuclear power stations and the actions that must be undertaken in order to improve it.

2078. TECHNIQUES OF RADIATION MONITORING AND MEASUREMENT IN AND AROUND NUCLEAR POWER PLANTS. FLORANCE, D. (Electricité de France, 75 - Paris (France)). *Revue Generale Nucleaire* (France), Volume 6, November-December 1992, in French, pp. 517-525.

This article takes stock of techniques and instrumentations that are used at EDF for the radioactivity measurement, external exposure measurement, personnel dosimetry, dose equivalent measurement, measurement connected with contamination, for the area control inside nuclear power stations and for the environment monitoring. This article also presents the actual development.

2079. INTERVENING ENTERPRISES. DOLLO, R.; ROLLIN, P. (Electricité de France, 75 - Paris (France)). *Revue Generale Nucleaire* (France), Volume 6, November-December 1992, in French, pp. 512-516.

The authors explain the actions that have been undertaken by EDF in order to insure the same protection level at outer workers as its own workers: quality of training and of dosimetric follow-up.

2080. REFERENCE VALUES OF THE WORKERS' COLLECTIVE DOSE UNIT FOR THE IMPLEMENTATION OF "ALARA" POLICY IN EDF NUCLEAR POWER PLANTS. BERTHET, A.; BRISSAUD, A. (Electricité de France, 69 - Villeurbanne (France)); BOUSSARD, P. (Department of Radioprotection, Electricité de France, 93 - Saint-Denis (France)); LOCHARD, J.; LEFAURE, C. (Centre d' Etude Sur L'Evaluation de la Protection Dans Le Domaine Nucleaire, 92 - FON (France)). *Radioprotection (Bulletin de la Societe Francaise de Radioprotection)* (France), Volume 27, Number 4, October-December 1992, in French, pp. 411-421.

Implementing the ALARA principle at the design, operation and maintenance stages of EDF's PWRs aims at ensuring a coherent management of individual and collective exposures. The objective of such a policy is, as recommended by ICRP 60, to keep exposures (number of individuals exposed and levels of exposure) as low as reasonably achievable, with an equitable distribution taking into consideration economical and social aspects. This leads EDF to adopt, among other tools, a system of reference monetary values for the unit of collective dose averted. After having recalled the ethical issue associated with such an approach as well as the international consensus on the dose-risk relationship for low doses, the model adopted, integrating risk aversion considerations, is presented. Its main characteristic is a rapid increase of the monetary values with the level of annual individual doses coming close to the regulatory limits. This model will be used as a decision-aiding tool for the evaluation and comparison of alternative protection actions within the optimization process of workers' exposure.

2081. THE PROGRAM OF THE ALARA CENTER AT BROOKHAVEN NATIONAL LABORATORY. KHAN, T.A.; BAUM, J.W. (Brookhaven National Lab., Upton, NY). Advanced Workshop on Occupational and Environmental Radiation Protection, Boston, MA, 10-14 May 1993, BNL-NUREG-48552, CONF-9305129-1 (14 p).

In 1984 the Brookhaven National Laboratory was asked by the Nuclear Regulatory Commission to set up a Center to monitor dose-reduction efforts in the U.S. and abroad and to focus the industry's attention on ALARA. The paper summarizes the main work of the ALARA Center between 1984 and 1992. The Center maintains nine data bases for the NRC and the Nuclear Power Industry. These databases are constantly updated and access to them is provided through a personal computer and a modem and by periodic publications in the form of a newsletter and NUREG reports. Also described briefly are eight other projects related to dose-reduction at nuclear power plants that the Center has carried out for the NRC. Among these are projects that analyze the cost-effectiveness of engineering modifications, look at worldwide activities at dose reduction and compare U.S. and foreign dose experience, examine high-dose worker groups and high-dose jobs, develop optimum techniques to control contamination at nuclear plants, and look at the doses being received by men and women in all sectors of the nuclear industry.

2082. ISOE - A TOOL FOR IMPLEMENTING ALARA IN NUCLEAR POWER PLANTS. VIKTORSSON, C. (Nuclear Energy Agency, 75 - Paris (France)). Work Management to Reduce Occupational Doses. Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993, pp. 295-308 (342 p)

The OECD Nuclear Energy Agency launched in 1988 the idea of creating an international system for information exchange in the field of occupational exposure. The system would allow the integration of experience gained in nuclear power plant operation in the OECD Countries for the purpose of facilitating operational dose management and optimization of radiation protection. This idea led to the official launching of the ISOE on the occasion of the first meeting of its Steering Group, on 18th November 1991 in Paris. This paper describes the principal features of the ISOE, discusses the role of past experience in ALARA and gives, finally, an update of the participation in the System.

2083. BNL ALARA CENTER EXPERIENCE WITH AN INFORMATION EXCHANGE SYSTEM ON DOSE CONTROL AT NUCLEAR POWER PLANTS. BAUM, J.W.; KHAN, T.A. (Brookhaven National Laboratory, Upton, NY). Work Management to Reduce Occupational Doses. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993, pp. 270-282 (342 p).

The essential elements of an international information exchange system on dose control at nuclear power plants are summarized. Information was collected from literature abstracting services, by attending technical meetings, by circulating data collection forms, and through personal contacts. Data are assembled in various databases and periodically disseminated to several hundred interested participants through a variety of publications and at technical meetings. Immediate on-line access to the data is available to participants with modems, commercially available communications software, and a password that is provided by the Brookhaven National Laboratory (BNL) ALARA Center to authorized users of the system. Since January 1992, rapid access also has been provided to persons with fax machines. Some information is available for 'polling' the BNL system at any time, and other data can be installed for polling on request. Most information disseminated to date has been through publications; however, new protocols, simplified by the ALARA Center staff, and the convenience of fax machines are likely to make the earlier availability of information through these mechanisms increasingly important.

2084. CONCLUSIONS AND RECOMMENDATIONS. WORK MANAGEMENT TO REDUCE OCCUPATIONAL DOSES. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993, pp. 313-323 (342 p).

This summary contains the results of the workshop, namely the principal means of achieving an active approach towards occupational dose reduction. Examples from nuclear installations illustrate the achievements reached in practice. Finally, this summary includes a set of recommendations from the workshop participants. The major conclusion of the meeting was that from the evidence presented, ALARA has now moved from the theoretical to the

practical level. Although there are differences in detail, the overall approaches adopted within the nuclear industry to the practical implementation of the ALARA principle are remarkably similar. It requires firm management involvement and the use of appropriate dosimetric and other tools.

2085. STUDY ON THE DOSE REDUCTION TECHNIQUES APPLIED IN SPANISH NUCLEAR POWER PLANTS. AMOR, I.; O'DONNELL, P. (Uranium Inst., London (United Kingdom)); CASTELO, J.; CARMENA, P. Work Management to Reduce Occupational Doses. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993, pp. 309-310 (342 p).

The utility organization (UNESA-AMYS) and the nuclear regulatory body (CSN) together are studying the conditions for dose reduction in power plants in order to facilitate the implementation of ALARA and make it as efficient as possible. This paper outlines some features of this study.

2086. ATTITUDE, AWARENESS AND MANAGEMENT ORGANIZATION FOR EFFECTIVE RADIATION PROTECTION - SWISS EXPERIENCE. BLASER, W.; JESCHKI, W. Work Management to Reduce Occupational Doses. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993, pp. 49-59 (342 p).

First some information is given on the nuclear power plant Leibstadt (KKL) and the Swiss Nuclear Safety Authority (HSK). The radiation protection rules are explained which have been set up to facilitate the implementation of the ALARA-principle. Measures are discussed which should help to reduce dose rates at work places. Then it is shown that these measures are most effective when the right attitude and awareness to effective radiation protection is present with the staff including contractor personnel and when this attitude is supported by the management.

2087. WORK MANAGEMENT TO REDUCE OCCUPATIONAL DOSES. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February

1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993 (342 p).

This NEA Workshop concerned occupational radiation protection in nuclear installations, with emphasis on power reactors and reprocessing plants. The objectives of the meeting were - to exchange views on, and discuss experience from, the application of various measures related to work management; - to identify components of work management which seem particularly successful and worth developing further; - to draw conclusions on the state-of-the-art and to identify evolving trends in work management; - to make recommendations for further work in this area. A concluding session was held at the end of the meeting to discuss and agree on conclusions and recommendations as emerged from the presentations and discussions.

2088. JOB-RELATED DOSES IN LIGHT WATER REACTORS. SCHNUER, K. (Commission of the European Communities, Luxembourg (Luxembourg)). Work Management to Reduce Occupational Doses. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993, pp. 283-294 (342 p).

The Treaty of 1957 establishing the European Atomic Energy Community, (EURATOM) was an essential prerequisite for the development of a strong nuclear industry in Europe. Among other things the Treaty provides that the Community shall lay down Basic Safety Standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation and ensure that they are applied. Following adoption of the Council Directive of 1980, the European Commission defined the basic principles of Justification, Optimization and Limitation to be applied in order to ensure the greatest possible protection of workers and the general public. Subsequently the Commission took initiatives in order to find ways of implementing these three basic principles in practical radiation protection. In 1980 the Commission in close collaboration with the leading nuclear power station operators, set up its own system of 'occupational radiation dose statistics from light water reactors operating in Western Europe'. This was designed for PWRs and BWRs, and the Commission benefited from the experience of neighboring non-EC countries such as Sweden, Finland, Switzerland and Spain (not yet a member) operating nuclear power stations made by different manufacturers. The paper provides some general information on developments and trends in collective

and individual doses to workers in nuclear power stations, based on a unique European databank of approximately 1000 operating reactor years.

2089. DOSE REDUCTION MANAGEMENT AND PRACTICE AT NUCLEAR POWER PLANTS IN JAPC. KUNIHIO, M. Work Management to Reduce Occupational Doses. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic Co-Operation and Development, CONF-920287, 1993, pp. 144-151 (342 p).

Operation of commercial nuclear power plants in Japan was originated in Tokai Power Station of JAPC in 1966. Number of nuclear power plants in Japan has grown from 21 units in 1978 to 41 units in 1991. Meanwhile, the annual collective dose, once increased approximately to 131 man-Sv in 1978, thereafter decreased approximately to 82 man-Sv regardless of the increasing number of reactor in operation. The annual collective dose per reactor in 1990 was approximately 2.4 man-Sv for BWR and approximately 1.7 man-Sv for PWR.

2090. NEUTRON SPECTROMETRY AND DOSIMETRY MEASUREMENTS MADE AT NUCLEAR POWER STATIONS WITH DERIVED DOSEMETER RESPONSES. DELAFIELD, H.J.; PERKS, C.A. (AEA Environment and Energy, Harwell (United Kingdom)). 7th Symposium on Neutron Dosimetry, Berlin (Germany), 14-18 October 1991, Radiation Protection Dosimetry (United Kingdom), Volume 44, Number 1-4, CONF-911029, 1992, pp. 227-232.

Neutron spectrometry measurements have been made in the working environments of three U.K. Nuclear Electric Magnox power stations, and of a PWR at Gosgen, Switzerland, using a high resolution spectrometry system based on high sensitivity cylindrical proton recoil counters and an alpha recoil counter. Multispheres were used to obtain dose equivalent information below the lower energy limit (~50 keV) of the recoil counter system. The derived $H^*(10)$ spectra show that, in general, the dose equivalent arises mainly from neutrons in two energy regions: thermal to 10 eV; and 10 keV to 1 Me, although in certain situations a major contribution may arise from thermal neutrons. Quality factors for the $H^*(10)$ dose equivalent are derived and compared with the proposed ICRP 60 (1990) radiation weighting factors. The measured spectra are also interpreted in terms of the response of several individual (personnel) dose-meters and survey instruments.

2091. INVESTIGATION OF THE NEUTRON FIELDS IN THE NUCLEAR POWER PLANTS AND OF THE INFLUENCE OF THEIR DIVERSITY ON THE DETERMINATION OF RADIOLOGICAL PROTECTION QUANTITIES. AROUA, A. (Ecole Polytechnique Federale, Lausanne (Switzerland)), 1991, Tesis #941 available from Bibliotheque Centrale de l'EPFL, CH-1015, Lausanne (France), in French (218 p).

A multisphere neutron spectrometer has been developed and used in order to characterize the neutron fields inside the Swiss nuclear power plants. Prior to the use of the Bonner spheres system, its response matrix has been determined. This has been evaluated by computation using the ANISN particles transport code and a recent condensed cross section library. The matrix has been then extended up to 400 Me. The adjustment of the calculated functions to the experimental calibration points, established in a previous work, has lead to coherent results. To determine the neutron spectrum from the spheres indications three unfolding codes, based on different mathematical algorithms, have been used in order to validate the obtained results. These codes have been tested by means of a variety of synthesised spectra. Both the spectrometric and dosimetric results of this test have been satisfactory. The sensitivity of the unfolding procedure to the measurement statistics and to the number of spheres used has been investigated. It has been established that with reasonable counting rates (a few thousands pulses) the spectrometric and dosimetric results are reliable. Moreover it is possible, in the case of the neutron fields encountered in the nuclear power plants, to reduce, when necessary, the number of spheres used without losing too much spectrometric information. The unfolding of the measurements performed in reference beams lead to neutron spectra in good agreement with ISO standard. The dosimetric values obtained match well with the reference values and this results validates both the unfolding procedure and the response matrix. The measurements performed in the nuclear power plants allowed the characterization of the radiation fields inside the containments.

2092. THE DEVELOPMENT AND APPLICATION OF REMOTE EQUIPMENT FOR DOSE REDUCTION IN COMMERCIAL NUCLEAR POWER STATIONS. BRITAIN, K.R. (Electric Power Research Institute, Charlotte, NC). Work Management to Reduce Occupational Doses. Nuclear Energy Agency, 75 - Paris (France), Nuclear Energy Agency (NEA) Workshop on Work Management in Occupational Dose Control, Paris (France), 4-6 February 1992, Organisation for Economic

Co-Operation and Development, CONF-920287, 1993, pp. 204-219 (342 p).

The Electric Power Research Institute has sponsored the development and application of remote and robotic equipment designed for commercial nuclear power stations. The primary goal of this research has been to demonstrate to the nuclear industry that remote and robotic equipment are a cost justifiable option to achieve improvements in dose reduction, worker safety and quality. The secondary goal is to stimulate commercialization of these technologies so they are readily available from the firms serving the nuclear industry.

2093. START-UP OF CHINESE NUCLEAR POWER AT QINSHAN. HE, H. (Qinshan Nuclear Power Company, Zhejiang Haiyan (China)). Hewuli Dongtai (Trends in Nuclear Physics) (China), Volume 9, Number 2, June 1992, in Chinese, pp. 38, 44-49.

Qinshan Nuclear Power Plant's (QSNPP) technological process and main equipment relative parameters are introduced. QSNPP can operate safely, of which, the safety and the relative safety facilities are mentioned. QSNPP's successful completion indicates the start-up of Chinese nuclear power.

2094. PROCEEDINGS OF THE 2ND WORKSHOP ON INFORMATION MANAGEMENT. Compiled by HOEPFNER, K.A. (Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany)). Second Workshop on Information Management in Nuclear Safety, Radiation Protection, and Environmental Protection - Status and Perspectives, Muenchen (Germany), 30-31 October 1991, GRS-90, CONF-9110481, March 1992 (297 p).

As a practical result of this workshop it is expected that the possibilities for the acquisition of information become more transparent. From the point of view of the authorities this would be of special interest in the field of safety evaluations, on the regulatory level, and for the work of the press and public relations. The wish has been fulfilled to invite to this workshop the information experts competent in the specialist area. This means that at the end of this workshop a qualified survey over existing information sources will be available. All this is of vital importance for effective information management of the topic areas of nuclear safety, radiation protection and environmental protection.

2095. RESULTS OF COMPARATIVE MEASUREMENTS. LAUTERBACH, U. (Physikalisch-technische Bundesanstalt, Braunschweig (Germany)). Proceedings of Quality Assurance of

Activity Measurements in Nuclear Medicine and Radiation Protection. Edited by RODLOFF, G.; DEBERTIN, K. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). PTB Seminar: Qualitaetssicherung von Aktivitaetsmessungen in Nuklearmedizin und Strahlenschutz, 25-26 November 1991, PTB-Ra-28, CONF-9111309, April 1992, in German, pp. 191-201 (239 p).

A total of 18 institutions in the Lower Saxon area (Federal authorities, university institutes, nuclear power plants, industrial laboratories, hospitals and medical practices) volunteered to participate in a study performed to gain a general impression of the properties of instruments that were commercially available at the time of the Chernobyl accident and actually used at the site. In this connection, comparative measurements were carried out using portable contamination meters, the results of which can hardly be described as satisfactory.

2096. MAINTENANCE PLANNING SUPPORT METHOD FOR NUCLEAR POWER PLANTS BASED ON COLLECTIVE DECISION MAKING. SHIMIZU, S.; SAKURAI, S.; TAKAOKA, K.; KANEMOTO, S.; FUKUTOMI, S. (Toshiba Corp., Kawasaki, Kanagawa (Japan)). Nippon Genshiryoku Gakkai-Shi (Journal of the Atomic Energy Society of Japan) (Japan), Volume 34, Number 8, August 1992, in Japanese, pp. 763-775.

Inspection and maintenance planning in nuclear power plants is conducted by decision making based on experts' collective consensus. However, since a great deal of time and effort is required to reach a consensus among expert judgments, the establishment of effective decision making methods is necessary. Therefore, the authors developed a method for supporting collective decision making, based on a combination of three types of decision making methods; the Characteristic Diagram method, Interpretative Structural Modeling method, and the Analytic Hierarchy Process method. The proposed method enables us to determine the evaluation criteria systematically for collective decision making, and also allows extracting collective decisions using simplified questionnaires. The proposed method can support reaching a consensus of groups effectively through the evaluation of collective decision structural models and their characteristics. In this paper, the effectiveness of the proposed method was demonstrated through its application to the decision making problem concerning whether or not the improved ultrasonic testing equipment should be adopted at nuclear power plants.

2097. FAREWELL TID-14844; HELLO SECY-92-127. LAHTI, G.P.; JOHNSON, W.J. (Sargent & Lundy, Chicago, IL). Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) International Meeting on Fifty Years of Controlled Nuclear Chain Reaction: Past, Present, and Future, Chicago, IL, 15-20 November 1992, Transactions of the American Nuclear Society, Volume 66, CONF-921102, 1992, pp. 406-407.

This year, 1992, marks the 50th anniversary of the first sustained nuclear reaction in the pile at the University of Chicago's Stagg Field. But it also marks the 30th anniversary of the publication of TID-14844, which has served as the design-basis source term for radiological assessments supporting the licensing of nuclear power plants in the United States since its inception. The conservative TID-14844 model assumes that 100% of the noble gases and 50% of the iodines are instantaneously released to the containment and are available for leakage to the environment. TID-14844 is formally embodied in the U.S. Nuclear Regulatory Commission's (NRC's) regulations in parts 10CFR100 (siting) and 10CFR50 (review of control room habitability, post-accident shielding and sampling systems). It is also embodied in a host of NRC Regulatory Guides and NUREG reports that address off-site consequences of releases of radioactivity, equipment qualification, and other post-accident radiological concerns. On April 20, 1992, the NRC staff presented to the NRC commissioners the draft "Revised Accident Source Terms for Light-Water Nuclear Power Plants." This effort is documented in SECY-92-127 and provides the first official position of the NRC in this matter.

2098. INCREASING THE EFFECTIVENESS OF INSTRUMENTATION AND CONTROL TRAINING PROGRAMS USING INTEGRATED TRAINING SETTINGS AND A SYSTEMATIC APPROACH TO TRAINING. MCMAHON, J.F.; RAKOS, N. (TEXAS UTILITIES, GLEN ROSE, TX). Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) International Meeting on Fifty Years of Controlled Nuclear Chain Reaction: Past, Present, and Future, Chicago, IL, 15-20 November 1992, Transactions of the American Nuclear Society, Volume 66, CONF-921102, 1992, pp. 11-12.

The performance of plant maintenance-related tasks assigned to instrumentation and control (I&C) technicians can be broken down into physical skills required to do the task; resident knowledge of how to do the task; effect of maintenance on plant operating conditions; interactions with other plant organizations

such as operations, radiation protection, and quality control; and knowledge of consequences of miss-action. A technician who has learned about the task in formal classroom presentations has not had the advantage of integrating that knowledge with the requisite physical and communication skills; hence, the first time these distinct and vital parts of the task equation are put together is on the job, during initial task performance. On-the-job training provides for the integration of skills and knowledge; however, this form of training is limited by plant conditions, availability of supporting players, and training experience levels of the personnel conducting the exercise. For licensed operations personnel, most nuclear utilities use formal classroom and a full-scope control room simulator to achieve the integration of skills and knowledge in a controlled training environment. TU Electric has taken that same approach into maintenance areas by including identical plant equipment in a laboratory setting for the large portion of training received by maintenance personnel at its Comanche Peak steam electric station. The policy of determining training needs and defining the scope of training by using the systematic approach to training has been highly effective and provided training at a reasonable cost (approximately \$18.00/student contact hour).

2099. RADIATION PROTECTION WORK AT NUCLEAR POWER PLANTS. WALHLSTROEM, B. *ATS Ydintekniikka* (Finland), Volume 21, Number 3, 1992, in Finnish, pp. 4-6.

Some 3,000 persons work annually at Finnish nuclear power plants in such conditions that their exposure to ionizing radiation must be monitored. About half of them receive doses exceeding the recording limit. Even though the individual doses normally are low they represent together 3/4 of the annual collective radiation dose of all occupationally exposed Finnish workers. The long time average for annual collective dose is 0.8 manSv/reactor unit. Also practical radiation protection field work is described in the article.

2100. NUCLEAR ENERGY IN SWEDEN 1991. Compiled by BORG, A.; SOKOLOWSKI, E. (Nuclear Training and Safety Center, Nykoeping (Sweden)); LINDHOLM, I. (Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden)); WIKDAHL, C.E. (Energiforum AB (Sweden)). Production, Costs, Environment, *Bakgrund* (Sweden), Volume 1, 1991, in Swedish, pp. 1-4.

Statistics on power production in Swedish nuclear power plants 1991 are analyzed and commented. The total generation was 73.5 TWh, which represents 51.6% of all electric energy produced. Mean costs for the production amounted to less than 3 U.S.

cents/kWh, including fuel, capital, personnel and other operational costs, as well as insurance premiums and reservations for future waste management. The operational safety was satisfactory, but incident during reactor stops for refuelling and maintenance, have made utilities and authorities aware of the need to ameliorate working routines and safety culture. The emissions of radioactive substance to the environment were far below the limits set by the Institute of Radiation Protection.

2101. SAFETY INDICES (SET OF INDICES USED BY THE STATE SURVEILLANCE OVER NUCLEAR SAFETY, CZECHOSLOVAK ATOMIC ENERGY COMMISSION, TO EVALUATE THE OPERATING SAFETY OF NUCLEAR POWER PLANTS IN CZECHOSLOVAKIA, AND RESULTS OF EVALUATION FOR THE PERIOD OF 1991 TO JUNE 1992). REHACEK, R. (Ceskoslovenska Komise Pro Atomovou Energii, Prague (Czechoslovakia)). No. 5, INIS-mf-13492, 1992, in Czech, English translation available from Nuclear Information Center, 156 16 Prague-Zbraslav, Czech Republic, at USD 10. per typewritten page (64 p).

Fields of operation of nuclear power plants are identified to which the set of safety indices can be applied. The choice was made with regard to the State Surveillance needs and requirements and to the feasibility of obtaining a sufficient volume of objective data. Examined were significant events (unscheduled emergency shutdowns, violation of the safe operation limits and conditions, etc.), function of the safety systems and their operability, hermeticity of barriers, reliability of fuel, radiation protection, and environmental protection (specific activity of radioactive releases). The results obtained serve as a source of information on the trends in the nuclear power plant operation, for the identification of weak spots in the plant operation, for determining the aims of inspection activities and as a document in support of decisions made and requirements imposed.

2102. CONSEJO DE SEGURIDAD NUCLEAR: THE SPANISH SAFETY AUTHORITY. GONZALEZ, E. (Consejo de Seguridad Nuclear, Madrid (Spain)). *Nuclear Europe Worldscan* (Switzerland), Number 13, Volume 1-2, 1993, pp. 16-17.

The Spanish Authority in Nuclear Safety and Radiological Protection was created by special law in 1981. The Consejo de Seguridad Nuclear (CNS) was established independent of the Government and reporting direct to Congress. This five-member commission is responsible for assisting the Government and other institutions in safety matters, with the

authority to impose safety conditions on all activities related to radioactive materials, and particularly on the nuclear power plants.

2103. LEGAL SOURCES COVERING RADIATION PROTECTION IN THE EC COUNTRIES, EFTA AND THE USA. BISCHOF, W. (Inst. fuer Voelkerrecht, Goettingen Univ. (Germany)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. B-5.1-B-5.13 (270 p).

This paper covers the following subjects: Areas of application of the Radiation Protection Law, international legal basis, constitutional law and radiation protection, standard addresses, principles, monitoring regulations, in-company radiation protection organisation, law and technology, individual regulation areas.

2104. OPTIMIZED RADIATION PROTECTION. JESCHKI, W.; PRETRE, S. (Bundesamt Fuer Energiewirtschaft, Wuerenlingen (Switzerland)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. F-1.1-F-1.10 (270 p).

The new ICRP recommendations will be incorporated into the Swiss Radiation Protection Laws. An investigation is being made to what extent the new strict dose limit values influence practical radiation protection in the Swiss nuclear power industry. An interpretation of the optimised radiation protection is presented from today's point of view.

2105. RADIATION PROTECTION TECHNOLOGY IN NUCLEAR POWER STATIONS, PART II. STRUCTURAL, TECHNICAL AND ORGANISATION MEASURES FOR THE REDUCTION OF THE PERSONNEL DOSES IN PARTICULAR DURING REVISIONS, BY WAY OF THE GKN I EXAMPLE. BENTELE, W. (Gemeinschaftskernkraftwerk Neckar GmbH, Neckarwestheim (Germany)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. D-3.1-D-3.9 (270 p).

Based on the GKN I example, a pressurized water reactor with a capacity of 850 MW, which went into operation in 1976, a quantification is to be established to what extent dose reduction is obtained by the use of fast removable cassette insulation, the mechanisation of WKP, the decontamination of plant sections, the filling of vessels as well as well thought out planning, including training courses on inactive models.

2106. TECHNICAL AND ADMINISTRATIVE MEASURES FOR MINIMISING THE RADIATION EXPOSURE IN A LARGE NUCLEAR POWER PLANT. BERGEMANN, L.; EICKELPASCH, N.; LASCH, M. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen/guenzburg (Germany)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. D-2.1-D-2.11 (270 p).

The nuclear power station in Gundremmingen is a twin plant with two boiling water reactors each with an electrical capacity of 1310 MW. The plants went into operation in 1984. In the years of operation the dose exposure of the personnel (own and external personnel) did not indicate any systematic upward trend in the two blocks. It ranges around 60% of the annual dose typical for BWR's and settles at approx. 600 mSv during a typical revision.

2107. METHODS FOR THE DECONTAMINATION OF PERSONNEL RECOMMENDED BY A COMPANY DOCTOR ON THE BASIS OF RECENT RESEARCH RESULTS. HEINEMANN, G. (Kernkraftwerk Stade (Germany)). Measures to Be Taken in Cases of Radioactive Contamination of the Skin. Recommendation of the Commission of Radiological Protection (SSK). Manuscripts of the Experts' Discussion of the Committee for Medicine and Radiological Protection of the SSK. Compiled by GUMPRECHT, D.; KINDT, A. (Bundesamt fuer Strahlenschutz, Geschäftsstelle Der Strahlenschutzkommission, Bonn (Germany)); KEMMER, W.; JOHNKE, G. (Bundesministerium fuer Umwelt, Naturschutz Und Reaktorsicherheit, Bonn (Germany)), Volume 18, G. Fischer, 1992, in German, pp. 121-129 (149 p).

There is no single panacea for all kinds of contamination and, thus, no standard procedure to be uniformly adopted in the decontamination of individuals. This means that methods of personnel decontamination vary according to the different working conditions encountered in research laboratories and units for the

production of nuclear fuel and radionuclides on the one hand and nuclear power plants on the other hand. Some knowledge of the chemical properties of contaminating materials appears indispensable, but is mostly found wanting. A suitable method of personnel decontamination can by no means be defined as one that ensures the cleaning of contaminations from the skin surface. All decontamination measures, even the less aggressive ones, may result in incorporation. An intact skin offers the best protection against incorporation. It must be borne in mind that most contaminations occurring in nuclear power plants are of minor importance as regards dose. The damage to the affected individual from aggressive methods of removal will be much greater than that from any radioactivity remaining in the corneal layer.

2108. THE EFFECT OF SMALL RADIATION DOSES. KELLERER, A.M. (Strahlenbiologisches Inst., Muenchen Univ. (Germany)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. A-1.1-A-1.17 (270 p).

After having taken a look back at the notable change in the attitude towards the risks of small radiation doses, the subject of possible health risks, e.g., genetic damage, radiation induced tumors and prenatal damage which will most probably occur even when exposed to low doses, is discussed. As the main risks of low radiation doses are of a carcinogenic nature the assessment of risks is being investigated based on the example of a comprehensive Japanese study. Having seen a depiction of the main findings the dose dependency for solid tumors and leukemia will be considered. In an examination going beyond the ICRP analysis the currently employed risk assessments are critically discussed.

2109. DOSE OPTIMISATION IN NUCLEAR POWER STATIONS. BLASER, W. (Kernkraftwerk Leibstadt AG, Leibstadt (Switzerland)); JESCHKI, W. (Abt. fuer Die Sicherheit Der Kernanlagen, Bundesamt fuer Energiewirtschaft, Wuerenlingen (Switzerland)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. D-1.1-D-1.21 (270 p).

Some information will be provided concerning the nuclear power station in Leibstadt and the instructions of the responsible authorities. Subsequently more

details will be gone into in clarifying investigations of the technical radiation protection situation and the resulting package of measures. The shutdown in 1988 clearly showed that with technical radiation protection measures alone the radiation which the operating personnel is exposed to, cannot be kept low enough. Today it can be established that the efforts made to date achieved the desired effect.

2110. DOSIMETRY SYSTEMS IN NUCLEAR POWER STATIONS. WEIDMANN, U. (Kernkraftwerk Beznau, Nordostschweizerische Kraftwerke Ag, Doettingen (Switzerland)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. C-4.1-C-4.7 (270 p).

In the following paper the necessity of the use of electronic dosimetry systems in nuclear power stations is presented, also encompassing the tasks which this type of systems has to fulfill. Based on examples the construction principles and the application possibilities of a PC supported system are described.

2111. EXPERIENCE IN THE APPLICATION OF THE DOSIMETRY REGULATION. VALLEY, J.F. (Inst. De Radiophysique Appliquee, Lausanne (Switzerland)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in French and in German, pp. C-3.1-C-3.21 (270 p).

In Switzerland a group of experts in dosimetry of the Swiss Commission for Radiation Protection has laid down the proceedings for personal dosimetry. A regulation specifies the recognition conditions for the dosimetry positions and the requirements regarding the measuring system. Comparative measurements performed each year ensure the quality of the service.

2112. CENTRAL DOSE REGISTRATION IN SWITZERLAND. MOSER, M. (Bundesamt Fuer Gesundheitswesen (BAG), Bern (Switzerland)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. C-1.1-C-1.7 (270 p).

In 1990 the Central Swiss Dose Register of the Federal Health Office took up its activities. The following publication describes the organisation of dosimetry applicable to persons in Switzerland together with a brief history of dose registration, the central dose register and its applications.

2113. CANADA. ATOMIC ENERGY CONTROL BOARD: ANNUAL REPORT, 1991-1992. Atomic Energy Control Board, Ottawa, Ontario (Canada), MIC-92-07503, SSC-CC-171-1992, 1992 (121 p).

The Board's mission is to ensure that the use of nuclear energy in Canada does not pose undue risk to health, safety, security and the environment. The annual report of the Board presents information on regulatory requirements; nuclear facilities, from uranium mines to nuclear power plants and related operations; regulation of nuclear materials; radioactive waste management; compliance monitoring; research; non-proliferation, safeguards and security; international activities, and public information. A financial statement is also included

2114. NUCLEAR INDIA: A DREAM GONE SOUR. SMITH, H. (Chameleon TV (United Kingdom)); CUTLER, J. (Yorkshire TV (United Kingdom)). Safe Energy (United Kingdom), Volume 91, Oct-November 1992, pp. 8-9.

India has the fastest growing nuclear programme in the world. Initially American and Canadian technology was used and reactors built to western designs. Now, however, India is self sufficient over all the fuel cycle from uranium mining to waste processing. Reactors are built to Indian design. This article, based on information collected for a television programme shown in the U.K. in September 1992, claims that workers in the nuclear industry and people living near nuclear plant are knowingly exposed to very high radiation levels. This has resulted in many deaths and congenital abnormalities in children. The industry is surrounded by secrecy and no information is given to those who work in it; military stockpiling for nuclear weapons is suspected.

2115. AGING ASSESSMENT OF BWR CONTROL ROD DRIVE SYSTEMS. GREENE, R.H. (Oak Ridge National Lab., TN). Nuclear Safety, Volume 33, Number 1, January-March 1992, pp. 87-99.

This study for the Nuclear Plant Aging Research (NPAR) Program examines the aging phenomena associated with boiling-water-reactor (BWR) control rod drive mechanisms (CRDMs) and assesses the

merits of various methods of managing this aging. Information for this study was acquired from (1) the results of a special CRDM aging questionnaire distributed to each U.S. BWR utility, (2) a first-of-its-kind workshop held to discuss CRDM aging and maintenance concerns, (3) an analysis of Nuclear Plant Reliability Data System (NPRDS) failure cases attributed to the CRD system, and (4) personal information exchange with industry experts. Nearly 3,500 NPRDS failure reports have been analyzed to examine the prevailing failure trends for CRD system components. An investigation was conducted to summarize the occurrence frequency of these component failures, discovery methods, reported failure causes, their respective symptoms, and actions taken by utilities to restore component and system service. The results of this research have identified the predominant CRDM failure modes and causes. Recommendations are presented that identify actions utilities can implement to mitigate CRDM aging. An evaluation has been made of certain maintenance practices and tooling that have enabled some utilities to reduce as low as reasonably achievable (ALARA) exposures received from routine CRDM replacement and rebuilding activities.

2116. AECB STAFF ANNUAL REPORT OF BRUCE NGS 'B' FOR THE YEAR 1990. REPORT NO. INFO-0395. ANNUAL PUBLICATION. Atomic Energy Control Board, Ottawa, Ontario (Canada), MIC-92-06479, 1991(24 p).

The operation of the Bruce 'B' Nuclear Generating Station is monitored and licensing requirements are enforced by the AECB Bruce project staff, with appropriate support from other AECB personnel. The staff observes operation of the reactors, conducts audits, witnesses important activities, reviews station documentation and reports, and issues approvals where appropriate in accordance with license conditions. This report summarizes and records the conclusions of the AECB staff assessment of the operation of Bruce NGS 'B' during 1990.

2117. AECB STAFF ANNUAL REPORT OF BRUCE NGS 'A' FOR THE YEAR 1990. REPORT NO. INFO-0394. ANNUAL PUBLICATION. Atomic Energy Control Board, Ottawa, Ontario (Canada), MIC-92-06473, 1991 (27 p).

This report presents AECB project staff's review of major licensing issues and operational performance of the station during 1990, using Ontario Hydro reports and official correspondence and observations of AECB staff at the site. The report is limited to aspects of the station performance that AECB staff considers to have safety significance. The review

covers compliance, maintenance, testing, radiation protection, effluents and environmental monitoring, reactor process, control and fuel handling systems, performance of special safety and secondary systems, shutdown systems, emergency cooling injection, negative pressure containment, significant events, quality assurance, chemistry control, training, emergency drills, maintenance, management and security. Significant licensing matters include standards of operation and maintenance, and pressure tube integrity.

2118. AECB STAFF ANNUAL REPORT OF DARLINGTON NGS 'A' FOR THE YEAR 1990. REPORT NO. INFO-0396. ANNUAL PUBLICATION. Atomic Energy Control Board, Ottawa, Ontario (Canada), MIC-92-06472, 1991 (40 p).

This report presents AECB project staff's review of major licensing issues and operational performance of the station during 1990, using Ontario Hydro reports and official correspondence and observations of AECB staff at the site. The report is limited to aspects of the station performance that AECB staff considers to have safety significance. The review covers compliance, maintenance, radiation protection, effluents and environmental monitoring, major process systems, special safety systems, significant events, quality assurance, maintenance/operations, chemistry control, management, training, emergency drills, security and safeguards, inspections, testing and measures of performance. Significant licensing matters are included, as well as commissioning and construction activities.

2119. AECB STAFF ANNUAL REPORT OF PICKERING NGS FOR THE YEAR 1990. REPORT NO. INFO-0398. ANNUAL PUBLICATION. Atomic Energy Control Board, Ottawa, Ontario (Canada), MIC-92-06470, 1991 (56 p).

The operation of Pickering Nuclear Generation Station (NGS), A Units 1-4 and Pickering NGS B Units 5-8, is monitored to ensure compliance with licensing and safety requirements by the Atomic Energy Control Board (AECB) Pickering project office staff in cooperation with AECB staff in Ottawa. This report presents the AECB staff's review of major licensing issues and of the operational performance of Pickering NGS during 1990. The report is limited to those aspects that AECB staff considers to have particular safety significance, such as the process system, chemistry control, performance of safety systems, reportable significant events, measures of station performance, radiation protection, station effluents and environmental monitoring, audits and appraisals, training, emergency exercises and drills,

security exercises and drills, security, and maintenance and management.

2120. AECB STAFF ANNUAL REPORT ON POINT LEPREAU G.S. FOR THE YEAR 1990. REPORT NO. INFO-0399. ANNUAL PUBLICATION. Atomic Energy Control Board, Ottawa, Ontario (Canada), MIC-92-06469, 1991 (25 p).

Review by AECB staff of the operation of Point Lepreau Nuclear Generating Station during 1990. The review is based on information contained in the documents submitted by New Brunswick Power under the terms of the Operating License and on information gathered by AECB staff during routine site monitoring, inspections and audits. The review covers compliance, radiation protection, effluents and environmental monitoring, process systems, performance of special safety systems, significant events, quality assurance, maintenance, chemistry control, management, training, emergency exercises and drills, security and measures of performance. Significant licensing matters and activities include license renewal, containment leak rate testing, follow-up to the Chernobyl accident, steam and feedwater failures in the turbine hall, and safety in operations and maintenance.

2121. THE NEW SWISS RADIATION PROTECTION LAW. ZELLER, W. (Bundesamt fuer Gesundheitswesen (BAG), Bern (Switzerland)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. B-4.1-B-4.8 (270 p).

In 1991 the new Radiation Protection Law was passed by the Federal Council. This resulting in the necessity for a complete revision of the currently valid Radiation Protection Law. The draft elaborated by a working group will be presented.

2122. THE GERMAN RADIATION PROTECTION LAW. PEINSIPP, N. (Bundesministerium fuer Umwelt, Naturschutz Und Reaktorsicherheit, Bonn (Germany)). SVA Further Education Course: Radiation Protection in the Nuclear Power Plant - New Regulations and Measures, Winterthur (Switzerland), 2-4 November 1992, Schweizerische Vereinigung fuer Atomenergie (SVA), CONF-9211197, 1992, in German, pp. B-3.1-B-3.13 (270 p).

This paper covers the following subjects: the origins of the Radiation Protection Law, the meaning of the

EURATOM treaty and basic standard, amendments to the 1989 Radiation Protection Law, deviation from the EC law harmonization, content of the German Radiation Protection Law and the new ICRP 60 rules.

2123. IMPLICATION OF THE NEW ICRP RECOMMENDATIONS: INTERFACE WITH NUCLEAR SAFETY. GONZALEZ, A.J. (3294390 (IAEA)). International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions. Symposium on Implications of the New ICRP Recommendations on Radiological Protection Practices, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 69-81 (600 p).

Historically, the ICRP Recommendations mainly focused on the control of 'normal' exposure from 'practices,' i.e., on the control of doses from human activities that can increase the overall exposure to radiation wherever such exposures can be anticipated in advance and assumed to be delivered with virtual certainty and predictable magnitude. The 1990 ICRP Recommendations address for the first time the control of radiation exposures for which there is a potential, but not a certainty that they will occur. The treatment of these so called 'potential exposures' have produced an unavoidable contrast with criteria and concept historically used for the prevention and mitigation of accidents at nuclear power plants (i.e., with 'nuclear safety' criteria). A major implication of the new recommendations, therefore, is that they are triggering a closed interface between radiation protection and nuclear safety. This is the issue addressed in the paper.

2124. RADIATION PROTECTION GUIDES FOR ATOMIC PLANTS IN THE USSR. GOSUDARSKIJ, L.V.; FEDULOV, V.F.; SHRAMCHENKO, A.D. Ehnergeticheskoe Stroitel'stvo (USSR), Volume 4, April 1991, in Russian, pp. 75-77.

Basic standard technical documents in the field of atomic plant (AP) radiation safety in the USSR are considered. They comprise 'The Radiation Safety Standards' (RSS-76/87), 'The basic sanitary rules of working with radioactive substances and other sources of ionizing radiations' (B9R-72/87), 'Sanitary rules of design and operation of atomic plants' (SRAP-88), 'Requirements to atomic plant location,' 'General rules of atomic plant safety provisions' (GRS-88). It is shown that the practical realization of standard document requirements allows one to reduce the negative AP effect on the population in the vicinity and environment and on the whole solve the problem of AP radiation safety.

2125. APPLIED RADIATION BIOLOGY AND PROTECTION. GRANIER, R.; GAMBINI, D.-J. (Paris-5 Univ., 75 (France) Hospital Laennec, Paris (France)). Ellis Horwood, London (United Kingdom), 1990 (355 p).

This book grew out of a series of courses in radiobiology and radiation protection which were given to students in schools for radiology technicians, radiation safety officers and to medical students. Topics covered include the sources of ionizing radiation and their interactions with matter; the detection and measurement of ionizing radiation; dosimetry; the biological effects of ionizing radiation; the effects of ionizing radiation on the human body; natural radio-exposure; medical radio-exposure; industrial radio-exposure of electronuclear origin; radioexposure due to experimental nuclear explosions; radiation protection; and accidents with external and/or internal radio-exposure.

2126. THE OPTICAL CARD: THE FUTURE RADIOLOGIC CARD. IGLESIAS, A. (Ikusi (Spain)). International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions. Symposium on Implications of the New ICRP Recommendations on Radiological Protection Practices, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 453-457 (600 p).

The increasing volume of information used and the multiplication of the communications require increasingly faster and reliable supports in the minimum space. The Optical Card is the answer to those questions. In a wallet-sized card it is able to store up to 800 standard typewritten pages of information and it can be carried about anywhere in reliable and safety conditions (no erase possibility, nor influence of external agents). The possibility of incorporating a magnetic band in its reverse allows to use it in access and presence controls. Substituting profitably to paper records and attaching the possibilities of processing any kind of data (from alphanumerics to photographs, etc.), it is best solution to replace to the current radiologic card.

2127. ALARA IN SPANISH NUCLEAR POWER PLANTS. CANOVAS SIMO, J.; GONZALEZ TARDIU, F.J.; LIZONDO BLESIA, M. (Asociacion Nuclear ASCO (Spain)). International Conference on Implication of the New ICRP Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26 November 1991, CIEMAT, CONF-911105, 1992, in Spanish, pp. 23-37 (600 p).

It is described the individual doses that are received in the Radiation Protection Services of Spanish Nuclear Power Plants. Collective doses should be minimized incorporating the participation of Organizations that presently have no systematized ALARA procedures. Most of collective doses are produced by outages, therefore the paper focusses on radiation protection procedures to reduce doses there.

2128. OCCUPATIONAL EXPOSURE TREND AND THE RADIOLOGICAL PROTECTION OPTIMIZATION CRITERIA IN SPANISH NUCLEAR POWER PLANTS IN OPERATION: PRESENT AND FUTURE. O'DONNELL, P. International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 199-210 (600 p).

Occupational collective dose per reactor evolution in the operating nuclear power plants in Spain has shown in the last years a tendency to stability, within a range of values similar to the average of the OECD countries. On the other hand, the last ICRP's recommendations will support a further effort for utilities and external contractors in order to adapt to the new individual dose limits. The lecturer considers that Spain must not accommodate to the present situation and should continue developing the ALARA criteria in its nuclear power plants. In this presentation the main indicators to assess the present development level of this criteria are reviewed and the basis to improve the effectiveness of the practical application of it is proposed.

2129. IMPLEMENTATIONS OF NEW ICRP RECOMMENDATIONS IN THE OPERATION OF THE SPANISH NUCLEAR POWER PLANTS. SOLLET SANUDO, E. (Unesa (Spain)). International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, p. 198, 1-11 (600 p).

The International Commission on Radiological Protection (ICRP) has recently reviewed its basic recommendations including a strong reduction in the annual dose limit for exposed workers to ionizing radiation. New dose limits in occupational exposure will have a direct impact in all activities concerning radiation exposure. The likely effect on the nuclear industry of a major decrease in exposure limits is discussed and the approaches taken to minimize radiation exposures is presented. Changes to the philosophy of radiation protection that would allow

accommodation of lower limits are suggested. Improvements to dose tracking and dose monitoring techniques are discussed. Methods for reducing existing radiation fields and for preventing future radiation field increases are briefly reviewed. Additionally, actions taken in the Spanish nuclear industry to identify collective groups and tasks potentially affected by the reduced new recommended limits are presented.

2130. TASK RELATING IMPLEMENTATION OF 1990 RECOMMENDATION OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP). OSHIMA, S. (JAPAN). International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 189-198 (600 p).

The Japanese radiation protection laws esteem the recommendation of the ICRP. The optimized radiation protection countermeasures for workers are planned and practiced in all Japanese nuclear power stations. About 1% of the total numbers of workers exceed effective dose of 20 mSv/Y and 0.1% of them exceed effective dose of 100 mSv in 5 years. And then effective measures for reducing radiation dose are required for the high radiation dose received workers.

2131. CONSEQUENCES OF THE NEW ICRP RECOMMENDATIONS FOR RADIATION PROTECTION MANAGEMENT IN THE FRENCH NUCLEAR POWER GENERATING FACILITIES. STRICKER, L.; DOLLO, R. (FRANCE). International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 173-187 (600 p).

This document contains a review of the individual and collective dosimetry results of French nuclear power generating facilities. Analysis of these results and of the probable trends have led those in charge of operating these facilities to reinforce the radiation protection measures, essentially by broadening the scope of operations dosimetry and by progressively making the ALARA approach generally applicable in maintenance work. This should make it possible to comply with the values specified in the latest ICRP publications.

2132. ON THE DECOMMISSIONING OF NUCLEAR FACILITIES. DESPOTOVIC, R. (Ruder Boskovic Institute (Croatia)). International Conference on Implications of the New ICRP Recom-

mendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 19-22 (600 p).

The radiation protection and control must continue after end of the exploitation period of the nuclear facility NF and the radiation sources of high activity SHA. In Croatia and Slovenia there is one experimental reactor NER, one nuclear power plant NPP with a LL and ML radwaste storage RAWS, near the four biggest nuclear research centres there also in operation RAWS, and the exploitation of uranium ore is effected in one mine EU. The present status is characterized by 12 different open problems connected with SHA, NER, NPP, EU, and RAWS for which the general problems are pointed out, and are suggested actions for radiation protection of man and his environment.

2133. WITH A VIEW TO THE NEW ICRP DOSE LIMITS: THE OCCUPATIONAL DOSE DISTRIBUTION DURING 1987-1990 AT SWEDISH NUCLEAR POWER PLANTS. International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 221-228 (600 p).

With the intention to estimate the influence of the ICRP 60 dose limit for occupational exposure on radiation protection work at Swedish nuclear power plants, the yearly dose distribution within the work force during 1987-1990 was surveyed. During the period the average number of workers per year who received doses was 5 902 and 0,7% received doses in excess of 20 mSv. The average individual dose per year was 2,7 mSv and the average maximum individual dose was 30,8 mSv. The most exposed workers are they who are involved in radiation protection, mechanical maintenance, insulation, inspection and operation. They represent in average 64% of all the exposed work force. In average 2% of the workers belonging to these categories are receiving doses exceeding 15 mSv/year. The conclusion drawn is that there should be no great difficulty in meeting the new ICRP dose limits. Although there are reasons to be aware of that some individuals in certain categories of work need special attention.

2134. HIGH ENERGY PHOTON DETECTION WITH TLD AROUND NUCLEAR POWER PLANTS. SAEZ VERGARA, J.C. (Centro De Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain)). International Conference on Implications of the New ICRP

Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 409-425 (600 p).

High energy photons (4-6 Me) have been found in the neighborhood of some nuclear reactors, due to ^{16}N production and its decay. This radiation increases the low natural background, and the estimation of this contribution could be necessary. CIEMAT (IIB and IMA Institutes) is engaged in the CEC financed Project Measurement of environmental gamma doses.

One of the main goals of this Project is to achieve a sufficient level of accuracy in measurements of environmental gamma radiation, both with active (instant dose rate) and with passive (TL integrate dose) detectors. Within the activities of this Project, continuous measurements have been performed for two months with active and TL passive detectors around a British nuclear power plant. Two types of TL dosimeters were used: no discriminant, with tissue equivalent phosphor LiF:Mg,Ti and the dose assessment based in the numerical methods used in the simplified glow curve analysis program developed by IIB-CIEMAT; and discriminant, combination of two phosphors ($\text{CaSO}_4\text{:Tm}$ and $\text{Li}_2\text{B}_4\text{O}_7\text{:Cu}$) with very different photon energy response which allows dose assessment using an algorithm. This work shows the results obtained with both TLD systems. Evidences about the detection of an important component of high energy photons (>1.3 Me) in the field measurements around the nuclear power plant will be presented and discussed.

2135. OFFSHORE TELEROBOTIC EQUIPMENT SHOWS POTENTIAL FOR NUCLEAR USE. YEMINGTON, C.R. American Nuclear Society (ANS) Winter Meeting, Salamanca (Spain), 11-16 November 1990, Transactions of the American Nuclear Society, Volume 62, CONF-901101, 1990, pp. 603-604.

Because mobile robots offer considerable promise for use in nuclear power plants, they are the subject of developmental efforts at national laboratories, universities, and other institutions. This paper suggests that development potential can be foreseen by examining robotic systems now used in the offshore oil industry where they have completely replaced divers in deep water and offer cost advantages over divers in all but the shallowest waters.

2136. PRINCIPLES OF DESIGNING MOBILE ROBOTS FOR NUCLEAR APPLICATIONS: SOME SOVIET DEVELOPMENT PROJECTS. ADAMOV, E.O.; IVANOV, V.G.; MEIERAN, H.B. American Nuclear Society (ANS) Winter Meeting,

Washington, DC, 11-16 November 1990, Transactions of the American Nuclear Society, Volume 62, CONF-901101, 1990, pp. 601-602.

The I.V. Kurchatov Institute of Atomic Energy and the Research and Design Institute of Power Engineering, both designers of nuclear power plant systems and located in Moscow, USSR, have collectively recognized the positive merits of utilizing mobile robots in the nuclear industry. They have given authority to their subsidiary agency CENOTECH to mount an active campaign to program the development of new generations of mobile robots that will support routine and emergency situation operations in the nuclear industry. CENOTECH's rationale for design and performance requirements of mobile robot units to be utilized in the nuclear industry is presented in this paper. A description of design, performance requirements, and operational characteristics of four mobile robots that have been developed at CENOTECH within the past 3 yr is also presented: the 2-tracked KURSAR; the 4 hybrid-wheeled TELER; the 12-wheeled BUGGY with articulated platforms; and the 2-tracked SADKO.

2137. AN ADVANCED SEMIAUTONOMOUS ROBOTIC SYSTEM FOR HAZARDOUS RESPONSE WORK FOR DECONTAMINATION AND DECOMMISSIONING. CRANE, C.; TULENKO, J.F. (Univ. Of Florida, Gainesville). American Nuclear Society (ANS) Winter Meeting, Washington, DC, 11-16 November 1990, Transactions of the American Nuclear Society, Volume 62, CONF-901101, 1990, p. 601.

The articulated transporter/manipulator system (ATMS) under development by the University of Florida (UF) with Odetics Corporation as lead subcontractor will be able to manipulate through obstructed areas. Since 1987, the Advanced Technology Division of the U.S. Department of Energy has sponsored a university team composed of the UF, University of Michigan, University of Tennessee, and the University of Texas under the leadership of the Oak Ridge National Laboratory to pursue innovative robotics research leading to the development of advanced robotic systems. The UF has the task of developing the ATMS innovative transport system. As part of this task, UF has been focusing on developing horizontal and external navigation algorithms that carry out ongoing ATMS autonomous path planning. The flexibility of the ATMS is also being demonstrated as a surveillance/maintenance robot for the PRISM reactor. The ATMS has demonstrated that it can carry out autonomous planning responding both to obstacles and set operating levels. The ATMS also has demonstrated that it has sufficient

flexibility to serve in a surveillance/maintenance mode. Work is progressing on developing the hardware to deliver the mechanical capabilities demonstrated by simulated robotic system.

2138. DESIGN AND DEVELOPMENT OF A WALKING ROBOTIC VEHICLE. SHKOLNIK, N. American Nuclear Society (ANS) Winter Meeting, Washington, DC, 11-16 November 1990, Transactions of the American Nuclear Society, Volume 62, CONF-901101, 1990, pp. 600-601.

Quest Systems, Inc., sponsored by DARPA, is developing a low-cost, high-efficiency walking robotic vehicle (WRV). This vehicle will be targeted for a variety of applications in waste management, hazardous materials transport and handling, nuclear plant operations, maintenance and decontamination, security, mining, and other areas in industrial and military sectors. The purpose of the development is twofold. The first goal is to demonstrate that, in spite of common beliefs, legged locomotion can be as efficient as wheeled (at low velocities), which could make a walking vehicle a prime candidate for an autonomously operated platform. The second goal is to show that this type of vehicle can be built rather inexpensively (below \$100,000), which would allow it to compete on a cost/functionality basis with wheeled and tracked ones.

2139. ANNUAL REPORT 1990/91 OF THE GESELLSCHAFT FÜR REAKTORSICHERHEIT mbH (GRS). JAHRESBERICHT 1990/91. Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany), 1992, in German (79 p).

The annual report presents two major contributions from the safety engineering department IST, discussing the safety analyses made for nuclear power plant equipped with the Soviet WWR type reactors and the safety report on ultimate disposal of radioactive wastes at the Morsleben repository. These are followed by research reports, as e.g., PHEBUS-SFD experiment B9, the BRITE project, work performed for the INTRAVAL project, analyses on the transport of dangerous goods, on-the-job safety, and long-term safety of the Konrad repository.

2140. AN ALTERNATIVE ATMOSPHERIC DIFFUSION MODEL FOR CONTROL ROOM HABITABILITY ASSESSMENTS. RAMSDELL, J.V., JR. (Battelle Pacific Northwest Laboratories, Richland, WA). American Nuclear Society (ANS) Winter Meeting, Washington, DC, 11-16 November 1990, Transactions of the American Nuclear Society, Volume 62, CONF-901101, 1990, pp. 467-468.

The U.S. Nuclear Regulatory (NRC) staff uses procedures to evaluate control room designs for compliance with General Design Criterion 19 of the Code of Federal Regulations, Appendix A, 10 CFR Part 50. These procedures deal primarily with radiation protection. However, other hazardous materials, for example, chlorine, pose a potential threat to control room habitability. The NRC is considering changes in their current procedures to update methods and extend their applicability. Two changes to the current procedures are suggested: using a puff diffusion model to estimate concentrations at air intakes and using a new method to estimate diffusion coefficients.

2141. SEMIAUTOMATIC SPENT-FUEL-HANDLING MACHINE. STROMBERG, M. American Nuclear Society (ANS) Winter Meeting, Washington, DC, 11-16 November 1990, Transactions of the American Nuclear Society, Volume 62, CONF-901101, 1990, p. 585.

The technology for the total automation of the entire fuel handling operation, has been in existence for several years. The simplest form, or first phase of modernization, is the semiautomatic fuel handling positioning system. Several of these types of platforms are in existence today, and recently CIMCORP/Par systems completed a semiautomatic spent-fuel handling machine (SFHM) built for Calvert Cliffs, owned by Baltimore Gas and Electric. CIMCORP has provided a semiautomated spent nuclear fuel handling system consisting of the following: (1) newly designed refueling platform bridge and trolley; (2) CIMCORP CIMROC 4000 based automatic controls technology; (3) closed circuit TV surveillance of fuel grappling operations; and (4) direct replacement of the original system provided in 1971. All SFHM motions are driven under computer control, with fully automatic bridge and trolley traverse and manually activated hoisting and grappling. Position feedback for motion control and position indication is provided by resolvers. In operation, the technician selects machine destination on a touch screen and the control system automatically positions the bridge and trolley at the desired location. Future automation of fuel grappling and hoisting can be preformed with relatively few machine modifications.

2142. STATUS OF A STANDARD FOR NEUTRON SKYSHINE CALCULATION AND MEASUREMENT. WESTFALL, R.M.; WRIGHT, R.Q. (Oak Ridge National Lab., TN); GREENBORG, J. American Nuclear Society (ANS) Winter Meeting, Washington, DC, 11-16 November 1990, Transactions of the American Nuclear Society, Volume 62, CONF-901101, 1990, pp. 433-435.

An effort has been under way for several years to prepare a draft standard, ANS-6.6.2, Calculation and Measurement of Direct and Scattered Neutron Radiation from Contained Sources Due to Nuclear Power Operations. At the outset, the work group adopted a three-phase study involving one-dimensional analyses, a measurements program, and multi-dimensional analyses. Of particular interest are the neutron radiation levels associated with dry-fuel storage at reactor sites. The need for dry storage has been investigated for various scenarios of repository and monitored retrievable storage (MRS) facilities availability with the waste stream analysis model. The concern is with long-term integrated, low-level doses at long distances from a multiplicity of sources. To evaluate the conservatism associated with one-dimensional analyses, the work group has specified a series of simple problems. Sources as a function of fuel exposure were determined for a Westinghouse 17 x 17 pressurized water reactor assembly with the ORIGEN-S module of the SCALE system. The energy degradation of the 35 GWd/ton U sources was determined for two generic designs of dry-fuel storage casks.

2143. NUCLEAR SAFETY. MODERN POWER STATION PRACTICE: INCORPORATING MODERN POWER SYSTEM PRACTICE: NUCLEAR POWER GENERATION. Edited by MYERSCOUGH, P.B. (British Electricity International, London (United Kingdom)), Pergamon Press, 1992, pp. 484-570 (606 p).

This chapter is concerned with issues of nuclear safety arising out of power production at nuclear power stations and at other related nuclear installations in the United Kingdom. Details are given of regulatory control in the United Kingdom as it applies to nuclear installations, transport of radioactive materials and radioactive waste disposal. The other topics discussed are safety philosophy, radiological protection, the management of nuclear safety, emergency arrangements and decommissioning.

2144. CLEANUP AND DECOMMISSIONING OF A NUCLEAR REACTOR AFTER A SEVERE ACCIDENT. International Atomic Energy Agency, Vienna (Austria), IAEA Technical Report Series No. 346, IAEA, 1992 (59 p).

Although the development of commercial nuclear power plants has in general been associated with an excellent record of nuclear safety, the possibility of a severe accident resulting in major fuel and core damage cannot be excluded and such accidents have in fact already occurred. For over a decade, IAEA publications have provided technical guidance and

recommendations for post-accident planning to be considered by appropriate authorities. Guidance and recommendations have recently been published on the management of damaged nuclear fuel, sealing of the reactor building and related safety and performance assessment aspects. The present technical report on the cleanup and decommissioning of reactors which have undergone a severe accident represents a further publication in the series.

2145. PERSONAL DOSIMETRY IN NPP REFUELLING. CAMPAYO, J.M.; RODENAS, J.; VERDU, G. (Spain). International Conference on Implications of the New ICRP Recommendations on Radiation Protection Practices and Interventions, Salamanca (Spain), 26-29 November 1991, CIEMAT, CONF-911105, 1992, pp. 211-219 (600 p).

Doses received by people involved in the operation of Nuclear Power Plants may reach high values, sometimes near limits, particularly during the refuelling operation. With the new ICRP recommendations, the doses produced may exceed the limits that have been now established, hence the practice used must be revised and/or exposure times reduced. In this paper, personal dosimetry from the workers of a Service Company involved in the operation of several Nuclear Power Plants, has been analyzed in order to state the implications of the new ICRP recommendations. Doses higher than new limits will imply a revision of the refuelling policies, thus exposure time would be reduced, and perhaps more workers must be involved in the operation, at least in critical stages. Statistics over the collected data have been estimated and major remarks on possible changes in the practice have been summarized.

2146. RADIATION PROTECTION AT NUCLEAR POWER PLANTS. WAHLSTROEM, B. (Imatran Voima Oy, Vantaa (Finland)). ALARA (Finland), Volume 1, Number 3, 1992, in Finnish, pp. 20-22.

At the Finnish nuclear power plants, more than 3,000 people work in conditions that make it necessary to monitor their radiation doses. Most radiation exposure occurs during annual maintenance shutdowns. Radiation doses at the Finnish nuclear power plants have regularly been among the lowest in the world. Workers personal dose are, however, clearly higher than those occurring in other sectors of industry, medicine or research.

2147. NUCLEAR SECURITY: THEN AND NOW. WEINSTEIN, A.A. Nuclear News, Volume 35, Number 15, December 1992, pp. 38-40.

The evolution of computerized security systems at nuclear power plants has been driven by both the enhancements in computer technology and the changes in regulatory requirements over time. Technical advancements have simplified the essential nature of these systems in both real-time and data processing operations. Regulatory developments have caused a similar trend in simplification. This article addresses the computer and data acquisition portions of a security system and not the access control hardware, intrusion detection sensors, or surveillance equipment, other than to indicate how functional improvements in these areas have been achieved as systems have developed. The state of technology today includes the availability of fault-tolerant computers, the practice of networking multiple computers, and the standardization of real-time data network communications. These factors make two things possible in a plant security system. One is distributed processing, with rapid alarm annunciation (less than 1 second), essentially immediate response to access requests (less than 1 second), and an expeditious and comprehensive reporting capability. The other is permitting different plant operations (security, radiation protection, operator tours) to achieve economies by sharing the same network while using independent computers and avoiding operational conflicts.

2148. DECISION OF THE COUNCIL OF STATE ON THE GENERAL REGULATIONS FOR THE SAFETY OF NUCLEAR POWER PLANTS. Finland, INIS-XN-403, 14 February 1991 (6 p).

These Regulations contain limits for emissions of radioactive substances and radiation exposure as well as requirements for safe planning and use of nuclear power plants. They take into account recent international experience and research on risks associated with the use of nuclear power. The Regulations entered into force on 1 March 1991.

2149. OPERATION OF FINNISH NUCLEAR POWER PLANTS. Edited by TOSSAVAINEN, K. (Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland)), STUK-B-YTO-99, September 1992 (18 p).

The Finnish nuclear power plant units Loviisa 1 and 2 as well as TVO I and II were in operation for almost all the time in the first quarter of 1992. The load factor average was 99.8%. All events which are classified on the International Nuclear Event Scale were level 0/below scale on the Scale. Occupational radiation doses and releases of radioactive material off-site remained well below authorized limits. Only quantities of radioactive material insignificant to

radiation exposure, originating from the nuclear power plants, were detected in samples collected in the vicinity of the nuclear power plants.

2150. NUCLEAR POWER PLANT. YOTSUYANAGI, T. (Toshiba Corp., Kawasaki, Kanagawa (Japan)), Japanese Patent Number JP 4-216496 A, Toshiba Corp., Kawasaki, Kanagawa (Japan), G21D1/00, 6 August 1992, in Japanese (6 p).

The BWR type nuclear plant of the present invention removes radioactive nitrogen compounds in steams to be flown into a turbine system and reduces dose rate of radioactive nitrogen in the turbine system. That is, light sources emitting light to be absorbed to the nitrogen compound and nitrogen compound decomposition/removing devices are disposed at a plurality of places in a main steam pipe connected from the BWR type reactor to a turbine. Light emitted from the light source decomposes the radioactive nitrogen compounds. The nitrogen compound decomposition/removing device comprises a capturing material, such as metal beryllium, for capturing photolyzed radioactive nitrogen. Among radioactive nitrogen compound generated by nuclear reaction in the reactor, those compounds carried over due to their volatility are photolyzed into the form of $^{16}\text{N}_2$ or $^{16}\text{NO}_2$. With such a constitution, they are captured by the nitrogen capturing material. Accordingly, radioactive nitrogen is not contained in steams to be flown into the turbine system. As a result, operator's radiation exposure can be prevented.

2151. THE NORDIC PROGRAMME FOR NUCLEAR SAFETY 1990-1993. PLAN FOR 1992. Nordisk Kernesikkerhedsforskning, Roskilde (Denmark), NKS-92-2, February 1992 (76 p).

The description of planned projects concerning nuclear safety is divided under the headings of readiness for action in situations of abnormal radiation, nuclear wastes and deposition, radioecology, and reactor safety - professional emergency-readiness. Coordination initiatives are also dealt with. In addition to this a survey of projects, coordinators and project leaders and a description of suggested new measures for nuclear safety are given. Under the first heading the subjects dealt with are spreading and local consequences, strategies, measuring methods and data exchange and management for decision-makers, evaluation, harmonization and effecting of plans, public information, a Nordic emergency action exercise and reduction data connected with contaminated areas. The second heading covers criteria for classification of radioactive material, experiences in demolition of uranium-cleaning plants, information management, waste management in the case of field

deposition with radioactivity from past reactor accidents and climatological and geological processes of significance for long-duration safety. Subjects under the third heading of radioecology cover training, quality assurance, aquatic radioecology, agricultural and natural ecosystems. Subjects under reactor safety include safety evaluation, the course of serious accidents, and data on neighbor-reactor system's conditions of safety.

2152. RADIATION PROTECTION OPTIMIZATION USING A KNOWLEDGE BASED METHODOLOGY. REYES-JIMENEZ, J.; TSOUKALAS, L.H. (Tennessee Univ., Dept. of Nuclear Engineering, Knoxville, TN), International Conference on Frontiers in Innovative Computing for the Nuclear Industry, Jackson, WY, 15-18 September 1991, CONF-9109110-11, 1991 (11 p).

This paper presents a knowledge based methodology for radiological planning and radiation protection optimization. The cost-benefit methodology described on International Commission of Radiation Protection Report No. 37 is employed within a knowledge based framework for the purpose of optimizing radiation protection and plan maintenance activities while optimizing radiation protection. The methodology is demonstrated through an application to a heating ventilation and air conditioning (HVAC) system. HVAC is used to reduce radioactivity concentration levels in selected contaminated multi-compartment models at nuclear power plants when higher than normal radiation levels are detected. The overall objective is to reduce personnel exposure resulting from airborne radioactivity, when routine or maintenance access is required in contaminated areas.

2153. COST EFFECTIVE IN SITU SMALL BORE PIPING QUALIFICATION FOR VINTAGE POWER PLANTS. CHAN, A.W.; CHOW, S.C.; RAY, F.H. (Stone & Webster Engineering Corp., Cherry Hill, NJ); WARE, A.G. (Idaho National Engineering Laboratory, ID). Proceedings of Seismic Engineering 1991, 1991 American Society of Mechanical Engineers (ASME) Pressure Vessels and Piping Conference, San Diego, CA, 23-28 June 1991, American Society of Mechanical Engineers, CONF-910602, 1991, pp. 161-164 (337 p).

Small bore piping for vintage power plants built in the late '60s and early '70s were field routed with minimal documentation. To evaluate the technical adequacy of a piping system, a field walkdown must be first made to identify the configuration. For an operating plant, this is a time consuming and expensive process, not only financially but also in terms of radiation exposure to personnel. Faced with such a

substantive task, the plant owner needs to derive a technically sound yet cost effective solution. This paper describes an innovative and cost effective program that was successfully implemented on an early 1970 vintage power plant. The approach relied heavily on the experience and expertise of the engineers performing in situ evaluation and disposition of concerns. It preserved as much as possible the original design practice, but provided sufficient documentation to demonstrate the technical adequacy of the entire population after some modifications.

2154. DECOMMISSIONING OF NUCLEAR POWER PLANTS. EXPERIENCES, METHODS, REGULATORY GUIDELINES. GOERTZ, R.; GOLDAMMER, W.; GRAF, R.; WEIL, L. Series: Praxiswissen Aktuell. Verl. TUEV Rheinland, 1992, in German (213 p).

The spectrum of possible decommissioning measures includes, on the one end of the scale, safe isolation of radioactive materials and parts of the plant, on the other end, the complete dismantling and removal of the whole plant, i.e., turning the site into a green meadow again. For all kinds of decommissioning there are methods and experiences from all over the world. The book addresses those who want to inform themselves on the present state of knowledge in the area of the decommissioning of nuclear power plants. There is a survey of the legal and technical regulations on decommissioning valid at present, a description of the development and state of knowledge regarding decommissioning technology and methods and a report of experiences with decommissioning projects within and outside of the country. The book also discusses the amount and composition of radioactive residual products and waste and ways to dispose of such waste resulting from decommissioning, goes into problems concerning decommissioning after nuclear power plant accidents and views problems concerning risks and liability as regards decommissioned nuclear power plants.

2155. TECHNICAL VERIFICATION TEST FOR DISMANTLING THE SURFACE LAYER OF BIOLOGICAL SHIELD WALL BY USING LARGE CIRCULAR SAW AND WEDGE TECHNIQUE. MIYAZAWA, M.; SASAKI, H.; ITO, A.; TACHIWA, M. (Taisei Corp., Tokyo (Japan)); ONOZAWA, T. (Nuclear Power Engineering Test Center, Tokyo (Japan)); AOYAGI, Y. (Central Research Inst. of Electric Power Industry), Proceedings of the International Meeting on Nuclear and Hazardous Waste Management. Spectrum '90: American Nuclear Society (ANS) International Meeting on Radioactive Waste Technologies, Decontamination, and Hazardous Wastes, Knoxville, TN, 30

September - 4 October 1990, American Nuclear Society, CONF-900977, 1990, pp. 384-386 (510 p).

Nuclear power plant whose operation life has been completed final operation is required to be decommissioned. It is a fundamental decommissioning policy of the Japanese Government that the retired commercial nuclear plant shall be dismantled after mothballing for 5 to 10 years and secure the site for re-utilization. In order to secure safety, it is very essential to develop a highly reliable decommissioning technology. In this paper, judging from the viewpoint of safety and reliability, the authors adopted 'Large circular saw and wedge technique with remote operation' for the verification test of dismantling the surface layer of biological shield wall, which is able to dismantle strong and activated surface layer of concrete and steel plate. This project was performed from 1982 to 1988 entrusted to form Ministry of International Trade and Industry (MITI).

2156. OBSTACLE RECOVERY DEVICE. TERAJ, F.; FURUYA, M.; UGAI, M. (Toshiba Corp., Kawasaki, Kanagawa (Japan)), Japanese Patent Number JP 4-172298 A, Toshiba Corp., Kawasaki, Kanagawa (Japan), G21C19/26, 19 June 1992, in Japanese (11 p).

The device of the present invention comprises a fiber scope for taking a recovery operation portion and an obstacle into a field of vision and photographing the state of the operation in the recovery operation portion and a display section for displaying the photographed image at a remote place. Concretely, the monitor of a remote operation section displays an image photographed by the fiber scope. A operation unit attached with a forceps and a fiber scope are brought closer, for example, to a fuel assembly in a reactor in the recovery operation portion. Then, the obstacle intruded into a minute space between fuels is recovered by the forceps while displaying state of the operation on the monitor of the remote operation section. Such a device certainly recover and remove a minute obstacle present in such a circumstance that a man's hand can not access, by the operation conducted under visual confirmation.

2157. REACTOR DISMANTLING METHOD. OSAWA, K. (Shimizu Corp., Tokyo (Japan)), Japanese Patent Number JP 4-174399 A, Shimizu Corp., Tokyo (Japan), G21F9/30, G21C13/00, 22 June 1992, in Japanese (4 p).

A waste reactor containing pit is previously formed below a portion where a pressure vessel of a reactor is to be installed upon construction of a nuclear power plant. A pressure vessel which becomes

unnecessary due to exhaustion of the life time or the like is lowered and contained in the containing pit and tightly closed so as not to leak radiation. That is, it is lowered in the waste reactor containing pit below by using an appropriate suspending means after withdrawing nuclear fuels, such as enriched uranium from the pressure vessel of the unnecessary reactor, and it is tightly closed by sands and concretes so as not to leak radiation. Since only the pressure vessel is an object for the disposal, the volume to be contained and isolated actually is considerably reduced, and since the containing pit is constituted from the start of the construction of the plant, it is unnecessary to lay it down upon dismantling, and sliding, rising and falling down are scarcely caused. The disposing work can be completed safely and easily, the auxiliary facilities such as buildings can be used as they are, thereby enabling to conduct economical renewal.

2158. DECOMMISSIONING OF CIVIL NUCLEAR FACILITIES: A WORLD REVIEW. BRADBURY, D. (Bristol Polytechnic (United Kingdom)). *Utilities Policy* (United Kingdom), Volume 20, Number 8, August 1992, pp. 755-760.

This communication discusses the worldwide state of progress in the decommissioning of nuclear facilities. In general the technology of decommissioning is straightforward, but although there are many examples of successful decommissioning projects the general progress is slow. The reasons for this are identified as primarily economic, but the lack of waste disposal facilities and the unnecessary personnel radiation doses that may be incurred by early decommissioning are also factors. Finally the redundant structures are relatively safe and stable and there is little technical incentive to dismantle them. The current delays are heavily influenced by political factors which may be subject to change.

2159. MANAGING NUCLEAR ACCIDENTS. GOLDING, D.; KASPERSON, J.X.; KASPERSON, R.E.; GOBLE, R.; SELEY, J.E.; THOMPSON, G.; WOLF, C.P. Westview Press Inc., Boulder, CO, 1992 (124 p).

An accident at a nuclear power plant can pose a serious threat to surrounding populations. If people and their government are poorly prepared, as was the case at Windscale, England in 1957, Three Mile Island (TMI) in the United States in 1979, and Chernobyl in the Soviet Union in 1986, substantial exposure to radiation could occur. Much has been done since the 1979 TMI accident to prepare for a future accident in the United States. The federal government now requires approved emergency plans for all nuclear plants and has established minimum

specifications for such plans. This paper reports that major questions remain regarding the effectiveness of these plans in an actual nuclear accident, although they have performed well in non-nuclear incidents. Because serious nuclear accidents occur only very infrequently, the plans have not been tested in real circumstances.

2160. SAFETY ASSESSMENT OF UNIT 5 (WWER-440/W-213) OF THE GREIFSWALD NUCLEAR POWER STATION. COMMON GERMAN-SOVIET REPORT. Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany), GRS-92, February 1992 (196 p).

The report represents the common results of the program of German-Soviet cooperation in reactor safety and radiation protection. The technical plant and features of type WWER-440/W-213 nuclear power plants, basic legal licensing principles, reactor core and pressurized components, load resulting from accidents, systems engineering, spreading impacts, civil engineering aspects, and the evaluation of operating experience are described.

2161. ALARA PRACTICES TO MINIMIZE OCCUPATIONAL RADIATION EXPOSURE FROM CONTAMINATION AT COMMERCIAL NUCLEAR POWER PLANTS. REYES-JIMENEZ, J.; TSOUKALAS, L. (Tennessee Univ., Knoxville, TN), 7th Annual Meeting of the Southeast Regional Health Physics Society Chapters, 3-5 May 1990, Charleston, SC, CONF-9005435-1, 1990 (3 p).

Short communication.

2162. A DEVICE FOR THE CLEANING OF A LIQUID. HENZEL, N. (Siemens AG, Berlin (Germany)); PURWIN, L. (Siemens AG, Muenchen (Germany)), Siemens AG, Berlin (Germany); 4 February 1988, in German (10 p).

The invention comprises a device for the mechanical and ionic purification of a liquid that is led through an inlet line and is discharged through a outlet line. The device is used for example for the purification of water which circulates in the primary circuit of a nuclear power plant. Between lockable inlet branches and outlet branches, filters connected in parallel are provided, for example powdered resin precoat filters. In addition a junction which can also be shut is to be arranged between the outlet branch of a filter and the inlet branch of another filter. As a result, one can operate the filters in parallel connection or in series connection. If two suitable junctions are available, the order in which the filters connected in series are used is reversible.

2163. VENTILATING COMPONENTS IN NUCLEAR FACILITIES. DIN Deutsches Inst. fuer Normung e.V., Berlin (Germany). Normenausschuss Kerntechnik, Beuth, DIN-25496, Berlin (Germany), May 1992, in German (7 p).

This standard is to be applied to ventilation components of ventilation classes 1 and 2 (see DIN 25 414) for nuclear power stations and similar components in nuclear plants in as far as they are important for radiation protection.

2164. OPERATIONAL EXPERIENCE WITH NOBLE GAS REMOVAL IN A VENTILATED SPACE. WILLIAMS, D.R. (American Electric Power Service Corp., Columbus, OH); LOOPE, D.C. (Donald C. Cook Nuclear Power Plant). Radiation Protection Management, Volume 9, Number 5, September 1992, pp. 51-55.

This paper reports that conventional thermoluminescent dosimeters cannot accurately measure shallow (skin) dose from certain noble gas isotopes. High concentrations of noble gas concurrent with poor TLD response to low energy beta radiation could lead to regulatory improprieties. As such, reducing noble gas concentrations to levels as low as reasonably achievable is the most viable radiation protection option. Operational experience at the Donald C. Cook Nuclear Power Plant indicates that the equation used to predict noble gas activity in a ventilated space with a constant rate of production and decay can be simplified. Using the simplified equation, noble gas activity was predicted with $\pm 70\%$ of the measured concentration.

2165 ORGANIZATIONAL FACTORS INFLUENCING IMPROVEMENTS IN SAFETY. MARCUS, A.; NICHOLS, M.L. (Univ. Of Minnesota, Minneapolis, MN); OLSON, J.; OSBORN, R.; THURBER, J. Proceedings of the U.S. Nuclear Regulatory Commission Nineteenth Water Reactor Safety Information Meeting, Volume 3, Compiled by WEISS, A.J. (Brookhaven National Lab., Upton, NY). Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC, held in Bethesda, MD, 28-30 October 1991, NUREG/CP-0119-Vol.3, CONF-911079-Vol.3, April 1992, pp. 263-287 (523 p).

Research reported here seeks to identify the key organizational factors that influence safety-related performance indicators in nuclear power plants over time. It builds upon organizational factors identified in NUREG/CR-5437, and begins to develop a theory of safety-related performance and performance improvement based on economic and behavioral

theories of the firm. Central to the theory are concepts of past performance, problem recognition, resource availability, resource allocation, and business strategies that focus attention. Variables which reflect those concepts are combined in statistical models and tested for their ability to explain scrams, safety system actuations, significant events, safety system failures, radiation exposure, and critical hours. Results show the performance indicators differ with respect to the sets of variables which serve as the best predictors of future performance, and past performance is the most consistent predictor of future performance.

2166. ACTIVITIES OF BRAZILIAN CNEN IN THE AREA OF NUCLEAR POWER PLANTS LICENSING. ALVES, R.N. (Comissao Nacional de Energia Nuclear (CNEN), Rio De Janeiro (Brazil)). Proceedings of the International Colloquy of Safety for Pressurized Water Reactors. Academia Brasileira de Ciencias, Rio de Janeiro, RJ (Brazil), Workshop on Pressurized Water Reactor (PWR) Safety, Rio de Janeiro (Brazil), 11-12 August 1986, CONF-8608221, 1986, in Portuguese, pp. 29-69 (260 p).

This work reports the activities of the Brazilian CNEN regarding licensing of nuclear power plants. It refers specifically to ANGRA 1 nuclear power plant and discusses several aspects related to reactor licensing, safety, radiation protection, emergency plans, safety standards and radiation monitoring.

2167. NUCLEAR ENERGY AND ENVIRONMENT: LEGAL AND INSTITUTIONAL ASPECTS IN BRAZIL. MARQUES MALHEIROS, T.M. Nuclear Inter Jura '91: Nuclear Law and Nuclear Energy for the Future. International Nuclear Law Association, Harwell (United Kingdom). British Administrative Committee, Nuclear Inter Jura '91: Biennial Conference of the International Nuclear Law Association (INLA) - Nuclear Law and the Challenge of the Future, Bath (United Kingdom), 22-26 September 1991, International Nuclear Law Association, CONF-910923, 1992, pp. 93-103 (794 p).

Environmental control and sanitary surveillance of nuclear and radiological activities are incumbent upon the Federal Union, the States, Federal District and the Municipalities in Brazil. The performance thereof falls under the Environmental National System (SISNAMA) and the Unified Health System (SUS), respectively. The Brazilian Nuclear Energy Commission (CNEN) controls the radiation protection and nuclear safety aspects of those activities. This paper analyses the division of competency on nuclear energy control as well as the necessity of harmonising the nuclear licensing proceedings with the environ-

mental licensing proceedings, i.e., the "Environmental Impact Assessment" (EIA) and its respective "Report on Environmental Impact" (RIMA) provided for in the new Federal Brazilian Constitution. Public participation in the environmental control is also discussed as well as the constitutional and legal requirements for environmental protection applicable specifically to nuclear power plants. In the specific case of the final disposal repository for the radioactive waste generated from the radiological accident in Goiania, the procedures for its licensing are reported.

2168. DOSES TO WORKER GROUPS IN THE NUCLEAR INDUSTRY. KHAN, T.A. AND BAUM, J.W. (Brookhaven National Laboratory, Upton, NY). Radiation Protection Management, Volume 9, Number 6, November/December 1992, pp. 23-34.

This article presents some of the results of a study carried out at Brookhaven National Laboratory's ALARA Center on doses to various worker groups in the U.S. nuclear industry. In this study, data from workers in the industry were divided into male and female groups; the average radiation dose of these two groups and the correlation of dose with age are presented. The male and female workers were further considered in the various sectors of the industry, and correlations of dose with age for each sector were investigated. For male workers, a downward correlation with age was observed, while for women there appeared to be a slight upward correlation. Data from 13 PWR and 9 BWR plants shows that a small, but important, group of workers would be affected by the NCRP proposed constraint of workers' lifetime dose in rem being maintained less than their ages. Various techniques proposed by the plants to reduce dose to this critical group of workers are also presented.

2169. PROCEEDINGS OF THE 3. GENERAL CONGRESS ON NUCLEAR ENERGY, VOLUME 12. Associacao Brasileira de Energia Nuclear, Rio de Janeiro (Brazil), Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq), Brasilia, DF (Brazil), 3rd General Congress on Nuclear Energy, Rio de Janeiro (Brazil), 22 July 1991, CONF-9107239, 1990, in Portuguese (167 p).

The Proceedings of the 3rd General Congress on Nuclear Energy (CGEN), presents about 200 contributed papers. The topics covered by the meeting are: reactor physics and operation; risk analysis, safety analysis, nuclear power plants construction; thermohydraulics; nuclear power plants control and instrumentation; equipment and system design, radioactive management; fuel cycle; design and fabrication of

fuel elements, science and technology materials; instrumentation for radiation detection and dosimetry; shielding, radiation protection, licensing, safeguards, social and environmental impacts; radioisotopes production and application; radiochemistry, radioecology; nuclear medicine and radiobiology. In this volume the contributed papers emphasize the topics radiobiology and nuclear medicine.

2170. THE NORDIC PROGRAMME FOR NUCLEAR SAFETY 1990-1993. REPORT FOR 1991. Nordisk Kernesikkerhedsforskning, Roskilde (Denmark), NKS-92-1, February 1992 (78 p).

The report, covering the year 1991 of the Nordic Programme for Nuclear Safety 1990-1993, presents 18 projects divided into 4 main areas: preparedness in abnormal radiation situations, nuclear wastes and shutdowns, radioecology and reactor safety - knowledge preparedness. The main areas are briefly described and the status of each project is presented.

2171. SELF-SALP/SELF-ASSESSMENT AT CALVERT CLIFFS NUCLEAR POWER PLANT. PIERINGER, P. (Baltimore Gas and Electric, Lusby, MD); SLIDER, J.E. (Slider Associates, Inc., Washington, DC). American Nuclear Society Annual Meeting, Boston, MA, 7-12 June 1992, Transactions of the American Nuclear Society, Number 65, CONF-920606, 1992, pp. 356-357).

In recent years, utilities have undertaken various forms of self-assessment. These methods have as their goal early detection of weaknesses in plant performance to permit timely corrective action. Ideally, self-assessment methods identify problems at a lower threshold than do outside agencies, such as the U.S. Nuclear Regulatory Commission (NRC) and the Institute of Nuclear Power Operations (INPO). One of the more popular methods of self-assessment has been the self-SALP (systematic assessment of licensee performance). This method emulates the procedures of the NRC's SALP to render a subjective, overall assessment of performance. The experience of Baltimore Gas and Electric Company (BG&E) in applying self-SALP methods at its Calvert Cliffs nuclear power plant (CCNPP) provides insights useful to other utilities considering use of self-SALP methods. The factors leading to BG&E's decision to use a different approach may help others evaluate their self-assessment choices. This paper summarizes BG&E's experience with self-SALP methods and describes the methods that will be used to evaluate performance in the future.

2172. OCCUPATIONAL EXPOSURE ANALYSIS AT THE UNIT 1 OF ALMIRANTE

ALVARO ALBERTO NUCLEAR POWER PLANT. MORAES, A. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico, INIS-BR-3023, 1985, in Portuguese (291 p).

In order to obtain a complete knowledge of occupational conditions in a PWR nuclear power station, the individual and collective dose distributions are being analyzed during the Angra I (Rio de Janeiro, Brazil) station activities. Work conditions with identification of critical areas and groups as well as classification of tasks related to reactor maintenance and startup periods are also studied. This paper analyses radiological data measured at different power levels of the reactor and during maintenance and repair services as well as the refueling operation.

2173. SYSTEM, STRUCTURE, AND COMPONENT EVALUATION FOR LIFE-CYCLE MANAGEMENT. HANLEY, N.E.; BANERJEE, A.K.; WOODS, P.B. (Stone and Webster Engineering Corp., Boston, MA); PERRIN, J.S. (Public Service Electric and Gas Co., Hancocks Bridge, NJ); MARIAN, F.A. (Public Service Electric and Gas, Newark, NJ). American Nuclear Society Annual Meeting, Boston, MA, 7-12 June 1992, Transactions of the American Nuclear Society, Number 65, CONF-920606, 1992, pp. 294-296.

In recent years, many nuclear organizations and utilities have studied the possibility of extending the service life of nuclear power plants beyond the original license period. From these studies, recommendations have resulted for maintaining the option of future decisions concerning operating license renewal. Several of the recommendations are considered beneficial to the management and operation of nuclear plants in meeting many of their near-term goals. In 1986, Public Service Electric and Gas (PSE&G) concluded that a full-scale nuclear plant license renewal program for their Salem 1 and 2 and Hope Creek nuclear stations was not cost-effective at that time. Rather, it would be better served if the nuclear plant life extension (PLEX) option were maintained for future consideration. To help plan for the life extension option, a strategic 5-yr life cycle management (LCM) program was begun. In support of the LCM program, evaluations for the following Salem structures and components were performed: (1) intake structures, (2) reactor vessel support, (3) containment liner, and (4) containment structure (below grade). This paper discusses the systems, structures, and components (SSC) evaluation methodology and, as an example, discusses the evaluation performed for reactor vessel support.

2174. REACTOR HANDBOOK. BASIC MANUAL FOR NUCLEAR POWER PLANT OPERATING STAFF. LEDERER, B.J.; WILDBERG, D.W., Hanser, Muenchen (Germany), 1992, in German (349 p).

On the basis of the guidelines on expert knowledge, the book discusses the subjects of atomic physics, heat transfer, nuclear power plants, reactor materials, radiation protection, reactor safety, reactor instrumentation, and reactor operation, with special regard to nuclear power plants with LWR-type reactors. The book is intended for shift personnel, especially gang bosses, reactor operators, and control station operators: for this reason a practical and rather popular style has been chosen. However, the book will also be a manual for other operating personnel, personnel of producer companies, expert organizations, authorities, and students. It can be used as a textbook for staff training, a manual for the practice, and as accompanying book for teaching at nuclear engineering schools.

2175. PROCEEDINGS OF THE THIRD INTERNATIONAL WORKSHOP ON THE IMPLEMENTATION OF ALARA AT NUCLEAR POWER PLANTS. Compiled by KHAN, T.A. (Brookhaven National Laboratory, Upton, NY). U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Washington, DC, NUREG/CP-0143, March 1995 (845 p).

This report contains the papers presented and the discussions that took place at the Third International Workshop on ALARA Implementation at Nuclear Power Plants, held in Hauppauge, Long Island, New York, from May 8-11, 1994. The workshop brought together scientists, engineers, health physicists, regulators, managers, and other who are involved with occupational dose control and ALARA issues. One-hundred and seventy-five persons from eleven countries attended the workshop. The countries represented were: Canada, Finland, France, Germany, Japan, Korea, Mexico, the Netherlands, Spain, Sweden, the United Kingdom, and the United States. The workshop was organized into twelve sessions and three panel discussions. The topics were as follows: Session 1, Controlling Radiation Fields; Session 2, Panel Discussion on recent Recommendations on Dose Limitation; Session 3, Presentation and Panel Discussions on ALARA in New Reactors; Session 4, Pathways to ALARA; Session 5, Panel Discussion on Economics Versus Excellence; Session 6, Short Presentations on ALARA Implementation; Sessions 7A and 8A, PWR and CANDU Presentations; Sessions 7B and 8B; BWR and Gas-Cooled Presentations; Session 9, Decommissioning of Nuclear Power Plants; Session 10, Decontamination of Nuclear Power Plants, and Session 11, Robotics and Remote Handling. The workshop was sponsored jointly by the U.S. Nuclear Regulatory Commission and the Brookhaven National Laboratory's ALARA Center.

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The ALARA Center at Brookhaven National Laboratory publishes a series of bibliographies of selected readings in radiation protection and ALARA in a continuing effort to collect and disseminate information on radiation dose reduction at nuclear power plants. This is volume 8 of the series. The abstracts in this bibliography were selected from proceedings of technical meetings and conference journals, research reports, and searches of the Energy Science and Technology database of the U.S. Department of Energy. The subject material of these abstracts relates to the many aspects of radiation protection and dose reduction, and ranges from use of robotics, to operational health physics, to water chemistry. Material on the design, planning, and management of nuclear power stations is included, as well as information on decommissioning and safe storage efforts. Volume 8 contains 232 abstracts, an author index, and a subject index. The author index is specific for this volume. The subject index is cumulative and lists all abstract numbers from volumes 1 to 8. The numbers in boldface indicate the abstracts in this volume; the numbers not in boldface represent abstracts in previous volumes.

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