International Commission on Radiological Protection

2013 Annual Report

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On the cover:

ICRP members at the 2nd International Symposium on the System of Radiological Protection, Abu Dhabi, October 2013

ICRP 2013 Annual Report

ICRP reference 4842-6196-7132

2014 July 14

Revised 2014 September 02

CHAIR'S FOREWORD

2013 was a period of renewal for ICRP. It saw the beginning of a new term, running from July 1, 2013 to June 30, 2017. New members were elected to the Main Commission and Committees. Indeed, due to the highly successful open call for nominations in 2012, nearly half of our Main Commission and Committee members are new in this term.

ICRP 2013, our Second International Symposium, was held in Abu Dhabi, signalling a commitment to continue this excellent biennial opportunity for ICRP members and the rest of the professional community to network and discuss the evolution of the System of Radiological Protection. There is no doubt that this symposium was appreciated by everyone involved. Based on a post-meeting survey more than 90% of attendees were "extremely" or "very" satisfied, and more than 95% were likely to recommend that their colleagues attend ICRP 2015 to be held in Seoul on October 20-22, 2015.

2013 was the third year following the accident at the Fukushima Daiichi nuclear power plant. ICRP's review of our System of Radiological Protection in light of the accident is on-going. Although the system is fundamentally sound, the accident highlighted areas for improvement. Several of the issues raised will form part of the programme of work for the current term.

An important focus in 2013 continued to be to sustain, expand and improve our important work, in particular through efforts to: maintain and improve the quality, relevance and timeliness of our recommendations; broaden awareness of our recommendations in part by making them more accessible; and, increase engagement with the wider community while maintaining the independence that has been central to the benefits we have brought to the radiological protection community over the last 85 years. To support this, we are working to diversify and grow our funding base, which continues to rely on voluntary contributions.

ICRP and the radiological protection community face many challenges in coming years, but I am convinced that a reformed ICRP will be ready to tackle them and in this regard look forward to working with all stakeholders to strengthen the System of Radiological Protection.

Claire Cousins.

Dr Claire Cousins, ICRP Chair

The International Commission on Radiological Protection

Since 1928, the International Commission on Radiological Protection (ICRP) has successfully developed the System of Radiological Protection as the basis for radiological protection standards, legislation, guidance, programmes and practice worldwide.

ICRP is a charity, registered in the UK, established to advance for the public benefit the science of Radiological Protection, in particular by providing recommendations and guidance on all aspects of radiation protection.

In preparing its recommendations, ICRP considers advances in scientific knowledge, evolving social values, and practical experience. Formulating standards, regulations, and codes of practice is the responsibility of other national and international organisations.

The objective of the work of ICRP is to contribute to an appropriate level of protection against the detrimental effects of ionising radiation exposure without unduly limiting the benefits associated with the use of radiation.

ICRP provides recommendations and guidance on protection against risks associated with exposure to ionising radiation from artificial sources widely used in medicine, general industry and nuclear enterprises, and from naturally occurring sources. These recommendations are published on behalf of the ICRP in the Annals of the ICRP. Each issue provides in-depth coverage of a specific subject area.

Structure

ICRP consists of the Main Commission, the Scientific Secretariat; five standing Committees on: Radiation Effects, Doses from Radiation Exposures, Protection in Medicine, Application of the Commission's Recommendations, and Protection of the Environment; and Task Groups established as needed to undertake specific work.

The structure of ICRP

This structure supports a rigorous quality management system of peer review. The work of Task Groups is reviewed by the relevant Committee(s), and then by the Main Commission. Before most reports are approved for publication, they are circulated to a number of bodies and individual experts, and posted for public consultation through the ICRP website.

Membership

Members come from over 30 countries and from all disciplines relevant to radiological protection. Selected on the basis of their recognised competence and experience, members are volunteers invited to join ICRP as independent experts.

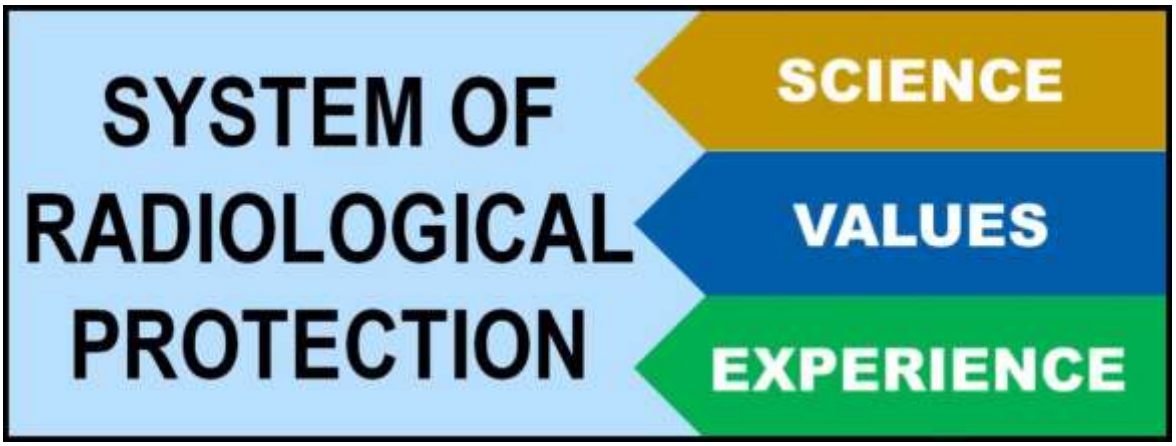
Membership of the Main Commission and Committees is for four year terms, the current term being 2013 July 1 to 2017 June 30. An open call for nominations was held in late 2012, resulting in approximately 200 candidates for Committee membership. Members for the current term were elected during the April 2013 meeting of the Main Commission. A mid-term election was held for one Main Commission member during the October 2013 meeting due to the resignation of a member in the interim.

Claire Cousins, consultant vascular radiologist at Addenbrooke's Hospital, UK, continues as ICRP Chair. Jacques Lochard, Director of CEPN (Centre d'étude sur l'Evaluation de la Protection dans le domaine Nucléaire, France) now serves as Vice-Chair. Five new Main Commission members were elected: John Harrison as Committee 2 Chair, Donald Cool as Committee 4 Chair, Carl-Magnus Larsson as

Committee 5 Chair, Hua Liu, and Sergey Romanov. In addition, many new Committee members were elected, resulting in a turnover of membership nearing 50%. A list of members as of 2013 December 31 is provided in this report.

The System of Radiological Protection

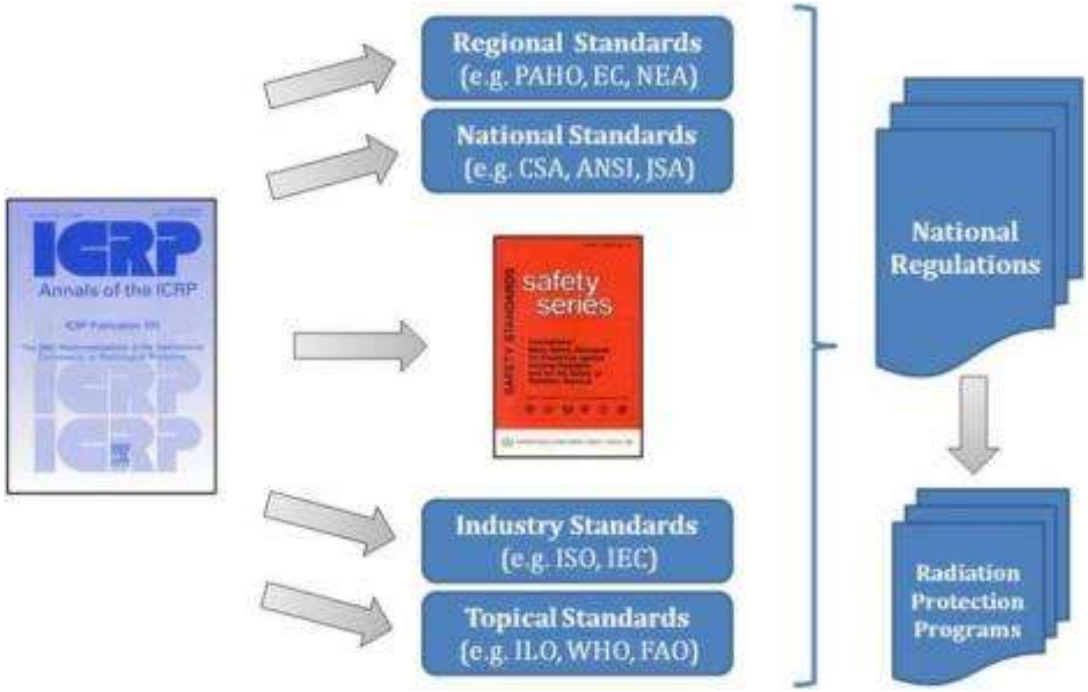
ICRP has produced well over one hundred publications on all aspects of protection against ionising radiation. A few describe the overall **System of Radiological Protection**, most recently ICRP *Publication 103*, The 2007 Recommendations of the International Commission on Radiological Protection. The rest provide more detailed guidance in a particular area, supporting technical information needed to implement the system, or examine the radiological protection implications of the latest science.



The ICRP System of Radiological Protection is based on the latest science, social and ethical values, and nearly a century of experience

ICRP recommendations are used world-wide by intergovernmental and non-governmental advisory and standard setting agencies; government health and other regulatory authorities; educational, scientific, and healthcare institutes; operators, individual professionals; and others with an interest in radiological protection.

The International Atomic Energy Agency International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources is based heavily on ICRP recommendations, as are the similar European Basic Safety Standards. The International Labour Organisation Convention 115, Radiation Protection Convention, General Observation 1992, refers specifically to the recommendations of ICRP.



The ICRP System of Radiological Protection forms the basis of radiological protection standards, regulations, programmes and practice world-wide

Independence and Collaboration

An important strength of ICRP is its ability to provide independent recommendations and guidance. In particular, this independence relates to determining the programme of work and selecting members. However, independence does not mean isolation; engaging with other organisations benefits ICRP's aim to advance radiological protection for the public benefit.

ICRP works with many organisations with an interest in radiological protection, and under a newly established policy maintains formal relations with: the European ALARA Network, European Commission, European Nuclear Installations Safety Standards Initiative, European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery, Heads of the European Radiological Protection Competent Authorities, International Atomic Energy Agency, International Labour Organisation, International Radiation Protection Association, OECD Nuclear Energy Agency, World Health Organisation, and World Nuclear Association. Senior representatives of these organisations participated in a special session with the ICRP Main Commission during the October 2013 meeting in Abu Dhabi.

Main Commission

The Main Commission consists of the Chair and up to twelve other members. The Main Commission is the governing body, setting the policy and programme of work, and approving all official publications.

Main Commission in Abu Dhabi, October 2013: (From left to right back) Jai-Ki Lee, Hans-Georg Menzel, John Harrison, Carl-Magnus Larsson, William Morgan, Sergey Romanov, (From left to right front) Ohtsura Niwa, Eliseo Vañó, Christopher Clement (Scientific Secretary), Claire Cousins, Jacques Lochard, Donald Cool, John Boice, Hua Liu

Formally, the 'Main Commission' is ICRP, providing overall direction and oversight to the larger organisation. The members are also the trustees of ICRP as a registered charity.

The Main Commission sets the programme of work, and reviews and approves all publications prior to consultation or publication. The Chairs of all five standing Committees are members of the Main Commission.

Although not formally a member, the Scientific Secretary is an integral part of the Main Commission, organising and participating in all Main Commission meetings, and often acting as the representative of ICRP.

Scientific Secretariat

The Scientific Secretariat manages the daily business of ICRP, and the Scientific Secretary often represents ICRP at international meetings.

Scientific Secretariat in Abu Dhabi, October 2013: (From left to right) Michiya Sasaki, Taylor Whitter, Lynn Lemaire, Christopher Clement

ICRP operates its Scientific Secretariat in Ottawa, Canada, in an office provided as an in-kind contribution from the Canadian Nuclear Safety Commission.

The Scientific Secretariat includes two full-time paid employees, the Scientific Secretary and Executive Assistant, and three others. The full-time position of Assistant Scientific Secretary is filled through a multi-year cost-free staff loan, currently provided by the Central Research Institute of Electric Power Industry of Japan (CRIEPI). The full-time position of Intern is filled on a four-month rotating basis through the Canadian Nuclear Safety Commission co-op student programme. The ICRP Historian is a part-time position filled on a voluntary basis.

Committee 1 (Radiation Effects)

Committee 1 assesses scientific knowledge on radiation risk, examining possible implications on the System of Radiological Protection.

Committee 1 in Abu Dhabi, October 2013: (From left to right back) Jolyon Hendry (former C1), Dan Stram, Simon Bouffler, William Morgan, Sisko Salomaa, Wolfgang Dörr, Quanfu Sun, Richard Wakeford, (From left to right front) Ohtsura Niwa (Main Commission), Dominique Laurier, Preetha Rajaraman, Tamara Azizova, Nobuhiko Ban, Margot Tirmarche, Ranajit Chakraborty, Werner Rühm, Michael Hauptmann. (Missing) Alice Sigurdson

Committee 1 has expanded to 16 members, 7 of whom are new.

Ohtsura Niwa and Jolyon Hendry updated the TG75 report *Stem cell biology in relation to carcinogenic radiation risk*. Some issues remain and Committee 1 was advised it could expect a revised version by the end of 2013.

Future plans for TG64 *Cancer risk from alpha emitters* were summarized by the Chair Margot Tirmarche. It was decided that this committee would continue to move forward pending joint analysis of Sellafield and Mayak workers.

Two new Task Groups under the auspices of Committee 1 were approved by the Main Commission. TG 91: *Radiation Risk Inference at*

Low-dose and Low-dose Rate Exposure for Radiological Protection Purposes, Chair Werner Ruhm; and TG92: *Terminology & Definitions*, Chair Wolfgang *Dörr*.

Updates on activities at the Radiation Effects Research Foundation (RERF), United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), Multidisciplinary European Low Dose Initiative (MELODI), Open Project for European Radiation Research Area (OPERRA), US National Council on Radiation Protection & Measurements (NCRP), Southern Urals Biophysics Institute (SUBI), and various programs worldwide investigating low dose radiation effects that might impact recommendations on radiation protection were discussed. There were also fruitful discussions with Committee 2 on radiation detriment and Committee 3 on inter-individual radiation sensitivity, and interactions on future Task Groups were recommended.

Outlook

Further areas where work may be initiated and topics that will be kept under surveillance:

- Individual human sensitivity to ionising radiation (with Committee 3)
- Radiation detriment (with Committee 2)
- Shape of the dose response for cancer
- Uncertainties in dosimetry
- Late effects from particle therapy
- RBE for low energy vs. high-energy gammas
- Radiation weighting factors for tritium
- Radiation risk in relation to chemical risk
- Tissue banking, archival tissues, use and value of these resources
- Trans-generational effects

Committee 2 (Doses from Radiation Exposures)

Committee 2 develops reference models and data, including dose coefficients, for the assessment of exposure to radiation.

Committee 2 in Abu Dhabi, October 2013: (From left to right back) Chan Hyeong Kim, Jizeng Ma, John Harrison, Dietmar Nosske, Wesley Bolch, Frank Wissman, Douglas Chambers, John Hunt, (From left to right front) Michael Bailey, Francois Paquet, Marina Degteva, Isabelle Thierry-Chef (guest from IARC for the meeting), Akira Endo, Nina Petoussi-Henss. (Missing) Vladimir Berkovski, Luiz Bertelli, Rich Leggett

Committee 2 consists of 15 members, five serving their first term. It has two long-standing Task Groups, on Dose Calculations (DOCAL) and Internal Dosimetry (INDOS), responsible for development of computational models and reference data needed to assess organ and effective doses from internal and external radiation sources, and to provide dose coefficients for the assessment of doses to workers and members of the public. The current focus of these groups is on development of reference phantoms and associated radiation transport calculations, and efforts to publish the full set of *Publication 103* based dose coefficients over the next few years.

Committee 2 also leads TG79 on Effective Dose, to provide guidance on the use of the quantity ‘effective dose’, and its relation to risk. In addition, TG90 on Dose Coefficients for External Environmental Exposures will provide conversion coefficients for external exposure of members of the public to airborne sources and ground deposits.

Outlook

Reference phantoms are being developed for children of ages 3 months, 1 year, 5 years, 10 years and 15 years and for the fetus and pregnant female at gestational ages of 10, 15, 25 and 35 weeks, to complement those for adults provided in *Publication 110*. These are used to provide reference radiation transport data necessary for calculation of dose coefficients for the inhalation and ingestion of radionuclides. They are also used in calculations of doses from radiopharmaceuticals by TG36 led by Committee 3.

Work is also in progress to replace *Publications 30* and *68* that give biokinetic data and dose coefficients for occupational intakes of radionuclides by inhalation and ingestion, and *Publications 54* and *78* that give information for bioassay interpretation, with a single series of publications on occupational intakes of radionuclides. Part 1 is complete and provides a description of biokinetic and dosimetric methodology, a summary of the *Publication 100* alimentary tract model, a detailed description of changes to the *Publication 66* respiratory tract model, and an outline of approaches for development of systemic models for elements. The use of bioassay data is also discussed. Subsequent parts will describe element-specific biokinetic models and provide dose coefficients and bioassay data. Accompanying electronic files will give detailed information on organ doses and additional bioassay data. Planned publications at an advanced stage are:

- Part 2: hydrogen (H), carbon (C), phosphorus (P), sulphur (S), calcium (Ca), iron (Fe), cobalt (Co), zinc (Zn), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), molybdenum (Mo), technetium (Tc).
- Part 3: ruthenium (Ru), antimony (Sb), tellurium (Te), iodine (I), caesium (Cs), barium (Ba), iridium (Ir), lead (Pb), bismuth (Bi), polonium (Po), radon (Rn), radium (Ra), thorium (Th), uranium (U).

For the first time, dose coefficients will be provided for radioisotopes of radon in the same way as for all other radionuclides. Two values will be provided: one for the special case of underground mines and the other for all other workplaces.

Committee 3 (Protection in Medicine)

Committee 3 develops recommendations and guidance on the protection of patients, staff, and the public against radiation exposure in medicine.

Committee 3 in Abu Dhabi, October 2013: (From left to right back) Sandor Demeter, Colin Martin, Baorong Yue, Katrine Åhlström Riklund, Reinhard Loose, Pierre Scalliet, (From left to right front) Keon Kang, Pedro Ortiz Lopez, Madan Rehani, Eliseo Vañó, Pek-Lan Khong, Yoshiharu Yonekura, Michel Bourguignon. (Missing) Donald Miller, Lawrence Dauer, Kimberly Applegate

The Main Commission approved the Committee 3 draft report Radiological Protection in Ion Beam Therapy for public consultation.

The draft report Radiological Protection in Cone Beam CT was approved by Committee 3 for progression to Main Commission for discussion with regard to public consultation.

Points raised during the Abu Dhabi Symposium in the medical session were consolidated and discussed for inclusion in on-going documents, where applicable and considerations were made for new Working Parties.

ICRP has a long history of producing publications on the radiation dose to patients from radiopharmaceuticals. ICRP is in the process of preparing a comprehensive publication that will consolidate all relevant information on radiation dose to patients from radiopharmaceuticals,

including the most recent addendum, into one volume. The objective is to have a single, referenceable volume for the convenience of end users, while work progresses on developing revisions based on more recent tissue and radiation weighting factors, reference phantoms, and biokinetic models.

Outlook

Committee 3 Task Groups and Working Parties are continuing work in the following areas:

- Occupational radiological protection in brachytherapy;
- Dose to patients from radiopharmaceuticals.
- Framework for justification in medical uses of ionising radiation;
- Occupational protection issues in interventional procedures (fluoroscopy guided)
- Diagnostic reference levels for diagnostic and interventional imaging
- Radiological protection in therapy with radiopharmaceuticals
- Effective dose

Areas where work will be initiated and topics that will be kept under surveillance include:

- Individual human sensitivity to ionising radiations.
- Update of existing publication: Radiation and your patient- a guide for medical practitioner.
- Framework for consolidated optimisation for individual patients
- Dose quantities and units in imaging equipment
- Patient eye dose in CT in light of new threshold of the lens of the eye
- Response to hot topics on radiological protection in medicine

Committee 4 (Application of the Commission's Recommendations)

Committee 4 develops principles and recommendations on radiological protection of people in all exposure situations.

Committee 4 in Abu Dhabi, October 2013: (From left to right back) Senlin Liu, Michael Boyd, John Takala, Jean-Francois Lecomte, Donald Cool, Thiagan Pather, François Bochud, (From left to right front) Michiaki Kai, Ann McGarry, Jacques Lochard, Anne Nisbet, Analia Canoba, Eduardo Gallego, Kun-Woo Cho, Toshimitsu Homma. (Missing) Mark Doruff, Deborah Oughton, Sergey Shinkarev

Committee 4 has undergone a substantial renewal with 10 of the 17 members being new, and the election of a new Chair. The membership reflects a good mixture of regulatory, academic, and operational expertise.

The report of TG80 on deep geological disposal was published as ICRP *Publication 122*, having been developed in cooperation with the waste management and radiation protection committees of the OECD Nuclear Energy Agency. Development of a publication focussing on surface and near surface disposal is under consideration.

The reports of TG71 on Security Screening and TG82 on Protection of the Environment in Various Exposure Situations are in press [published April 2014]. The latter was a cooperative effort of Committees 4 and 5, and provides the approach for integrating the concepts of protection of the environment within the ICRP System of Radiological Protection.

The report of TG81 on Radon underwent public consultation, and should be published in 2014. This is the second Committee 4 report examining existing exposure situations, the other being *Publication 111* on the post-accident protection.

Outlook

TG93 was established to contribute to ICRP's review of lessons from the Fukushima Daiichi accident, and will update *Publication 109* on Protection of People in Emergency Exposure Situations, and *Publication 111* on Protection of People Living in Long-term Contaminated Areas after a Nuclear Accident or a Radiation Emergency. This will be done in consultation with the ICRP Fukushima Dialogue initiative, examining radiological protection aspects of, e.g. justification for and optimisation of emergency decisions; characterisation of the radiological situation; protection of emergency and recovery responders; decontamination and waste management strategies; withdrawal of emergency protective actions; protection of pregnant women and children; information sharing with stakeholders; and emergency and recovery preparedness.

The Committee has continued efforts of the underpinnings of radiological protection with the establishment of TG94 on the ethics of radiological protection. The aim is to consolidate the ethical basis of the system, improve understanding of the system, and to provide a basis for communication on radiation risk and its perception. TG94 benefits from a series of workshops organized in cooperation with the International Radiation Protection Association (IRPA), IRPA Regional Congresses, and the IRPA International Congress.

TG76 on naturally occurring radioactive materials and TG83 on cosmic radiation in aviation continue efforts towards the series of reports on existing exposure situations. A report on contaminated sites may complete this series.

Consideration is being given to a new series of reports on areas in which end-users could benefit from elaboration on application of ICRP recommendations specific to their circumstances. The topics to be covered will be developed in consultation with ICRP's Special Liaison Organisations.

Committee 5 (Protection of the Environment)

Committee 5 develops reference models and data, and guidance on radiological protection of the environment.

Committee 5 in Abu Dhabi, October 2013: (From left to right back) Kathryn Higley, Carl-Magnus Larsson, Per Strand, Almudena Real, (From left to right front) Jordi Vives i Batlle, David Copplestone, Kazuo Sakai. (Missing) Jacqueline Garnier-Laplace, Alexander Ulanovsky, Li Jianguo

Comments resulting from public consultation on the draft publication Protection of the Environment under Different Exposure Situations were received and discussed extensively before finalising the document. This concluded the work of TG82, which was established in 2010 as a joint Task Group between Committees 4 and 5. The outcome is in press, to be published as ICRP *Publication 124*. Due to be released in early 2014 [published April 2014], it will be the first report issued by the Commission's new publisher, SAGE.

Publication 124 is based in previous ICRP publications on the concept and use of Reference Animals and Plants (RAPs) (*Publications 108* and *114*), and provides information on application of the System of Radiological Protection of the environment in planned, emergency and existing exposure situations. It provides recommendations on the use of the Derived Consideration Reference Levels (DCRLs) under all

circumstances where there is, or may be, an environmental exposure of significance above the natural background locally experienced by the relevant biota.

Committee 5 continued its work on the review of experimental determinations of RBE, to guide derivation of specific weighting factors for use in environmental radiation protection, and improved dosimetry of the RAPs.

Outlook

Future work will focus on broadening and consolidating the scientific basis that underpins the System of Radiological Protection as it pertains to the environment (including transfer, dosimetry, and biological effects), drawing on the experience gained in the system's application in planned, existing, and emergency exposure situations. In the near-term this includes finalising work on RBE and improved dosimetry.

Consideration needs to be made for the wider range of ecosystem effects that may be covered in ecological risk assessments, which incorporate the complete suite of stressors that result from human activities, and their effects, to understand the role of radiation effects in this context. One of the aims is to provide recommendations for derivation of specific databases for representative organisms on the basis of the RAP data, as well as recommendations for the application of the system to environmental protection in relation to certain human activities of potential environmental concern.

The ICRP System of Radiological Protection is sound and robust and has contributed to the understanding of environmental impacts in different contexts, e.g. in relation to the Fukushima Daiichi accident, in relation to the London Convention, and in relation to the impact of discharges into the North-East Atlantic Ocean. The consolidation and extension of the system require further fundamental work to improve the understanding of relationships between dose and effect.

Task Groups

Active as of December 31, 2013:

C2 TG4 (DOCAL): **Dose Calculations**, Chaired by *Wesley Bolch*

C2 TG21 (INDOS): **Internal Dosimetry**, Chaired by *Francois Paquet*

C2/3 TG36: **Radiopharmaceuticals**, Chaired by *Sören Mattsson*, under Committees 2 and 3

C1 TG64: **Cancer Risk from Alpha Emitters**, Chaired by *Margot Tirmarche*

C4 TG71: **Protection in Security Screening**, Chaired by *Donald Cool*

C5 TG72: **RBE and Reference Animals and Plants**, Chaired by *Kathryn Higley*

C5 TG74: **More Realistic Dosimetry for Non-human Species**, Chaired by *Alexander Ulanovsky*

C1 TG75: **Stem Cell Radiobiology**, Chaired by *Ohtsura Niwa*

C4 TG76: **Application of the Commission's Recommendations to NORM (Naturally Occurring Radioactive Material)**, Chaired by *Jean-François Lecomte*

C2 TG79: **Effective Dose**, Chaired by *John Harrison*

C4 TG81: **Application of the Commission's Recommendations to Radon Exposure**, Chaired by *Jean-François Lecomte*

C4 TG83: **Protection of Aircraft Crew against Cosmic Radiation Exposure**, Chaired by *Jacques Lochard*

C3 TG87: **Radiological Protection in Ion Beam Radiotherapy**, Chaired by *Yoshiharu Yonekura*

C3 TG88: **Radiological Protection in Cone Beam CT**, Chaired by *Madan Rehani*

C3 TG89: **Occupational Radiological Protection in Brachytherapy**, Chaired by *Lawrence Dauer*

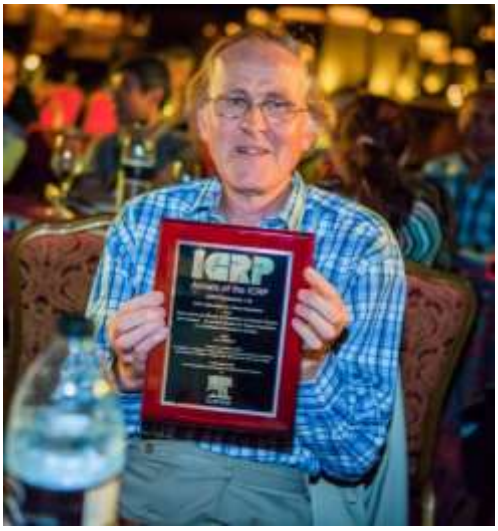
C2 TG90: **Age-dependent Dose Conversion Coefficients for External Exposures to Environmental Sources**, Chaired by *Nina Petoussi-Henβ*

C1 TG91: **Radiation Risk Inference at Low-dose and Low-dose Rate Exposure for Radiological Protection Purposes**, Chaired by *Werner Rühm*

MC TG92: **Terminology and Definitions**, Chaired by *Wolfgang Dörr*

C4 TG93: **Update of ICRP Publications 109 and 111**, Chaired by *Michiaki Kai*

C4 TG94: **Ethics of Radiological Protection**, Chaired by *Deborah Oughton*



CONTINUING FOCUS ON RECOVERY AFTER THE FUKUSHIMA DAIICHI NUCLEAR POWER PLANT ACCIDENT

Summary Report of ICRP Task Group 84: Issues Identified from the NPP Accident in Japan and Recommendations to Improve the System of Radiological Protection

This report continues to be an important input guiding the ICRP programme of work. Wanting to make the report more accessible to the people of Japan, it was translated into Japanese by native Japanese speaking ICRP members and volunteers working through social media. In April 2013 it was made available at www.icrp.org. Similarly, a message from ICRP on the occasion of the 2nd anniversary of the accident was released in both English and Japanese.

Task Group 93 on the update of ICRP *Publications 109* and *111*

Given the recommendation from the TG84, TG93 on updating ICRP Publications 109 and 111 has been launched to reflect the lessons from Fukushima and recent international developments concerning the protection of people in emergency exposure situations, and people living in long term contaminated areas after a nuclear accident or a radiation emergency.

ICRP Fukushima Dialogue Initiative

In 2013, three major dialogue meetings were held in Fukushima City and Iwaki City, and several smaller dialogue meetings in Suetsugi (Fukushima Prefecture) and Hippo (Miyagi Prefecture).

The Fifth Dialogue was held on 2013 March 2-3 at the Date City Hobara Citizen's Center Hall, and dealt with the issue of "returning or not, staying or not" in the affected areas. The Sixth Dialogue was held on 2013 July 6-7 at Fukushima City Health and Welfare Center, and discussed the

present situation and the challenges being faced by the citizens of Iitate, who have evacuated and were cut off from their own land, and living in exile for more than two years since 2011 April 22. The Seventh Dialogue, held on 2013 November 30 and December 1 at Higashi Nippon International University in Iwaki City, focussed on self-help actions taken by local people in cooperation with experts.










ICRP 2013

The Second International Symposium on the System of Radiological Protection

Following the success of ICRP's 1st symposium in 2011, the 2nd International Symposium on the System of Radiological Protection was held in Abu Dhabi, on 2013 October 22-24.

ICRP 2013 attracted nearly 300 registered participants from 37 countries: Argentina, Australia, Austria, Bahrain, Belarus, Belgium, Canada, China, Cyprus, Czech Republic, Finland, France, Germany, India, Ireland, Italy, Japan, Korea, Kuwait, Luxemburg, Norway, Oman, Portugal, Qatar, Russian Federation, Saudi Arabia, Singapore, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, UAE, UK, Ukraine, and USA. Participants came from all six Gulf

Cooperation Council states, making up about 40% of the attendees. Five topical sessions were held.

Tissue reactions: The road from science to protection

This session began with the basic science of tissue reactions, with emphasis on the emerging concerns of radiation-induced radiogenic cataracts and circulatory disease. Presentations also addressed questions of dosimetry, international implementation of new dose limits, implications in medical imaging and other areas, and science and value aspects.

Advances in recovery preparedness and response following Fukushima

Experiences from Japanese government and non-government perspectives, including engaging with local stakeholders, and progress on clean-up efforts in Fukushima, were a highlight of this session. Two presentations also covered progress outside Japan on planning for recovery following a major accident.

NORM issues in the real world

A review of the ICRP System of Radiological Protection on existing exposure situations, followed by an overview of ICRP's current efforts on radiological protection for Naturally Occurring Radioactive Material (NORM), introduced this session. This was balanced by a presentation on practical

experience in regulation and management of NORM in North America.

A presentation from the Federal Authority on Nuclear Regulation outlined current regulatory developments in the UAE, and a presentation from the Abu Dhabi National Oil Company explored local issues related to waste management in NORM.

What do we need from ICRP in medicine?

This session opened with views from ICRP on the use of Effective Dose in Medicine, followed by a review of recent and current ICRP efforts in radiological protection in computed tomography (CT). Recent epidemiological studies in paediatric CT were critically examined. Evolving efforts in radiological protection in medicine in the UAE and Saudi Arabia, as well as international views from the World Health Organisation, were presented.

The ICRP approach to environmental radiation protection: issues and application

The ICRP approach to protection of the environment, the subject of an ICRP publication in press, was presented, followed by an examination of information on relationships between environmental exposures and consequences for wildlife, and a proposal to improve dosimetry for reference animals and plants. Three presentations focussed on the marine environment, including use of the ICRP system, marine

biodiversity in Abu Dhabi, and modelling marine exposures and effects after the Fukushima accident.

Proceedings will be published in the Annals of the ICRP. Thanks to support from the German Federal Ministry of Environment, Nature Conservation and Nuclear Safety, registered participants will be eligible to receive a printed copy at no charge.

Given the success of an ICRP's series of symposia, planning has already begun for the **3rd International Symposium on Radiological Protection**. It will be held in **Seoul, Korea, 2015 October 20-22**, in conjunction with the next biennial joint meetings of the Main Commission and Committees.

ICRP PUBLICATIONS

Two reports were published in the Annals of the ICRP in 2013. Their abstracts are on the following pages. In addition, a Russian translation of *Publication 118*, Arabic translations of *Publications 111* and *117*, and Korean translations of *Publications 101A, 101B, 105, 109, 111, 112, 113* and *115* became available.

Obtaining ICRP Publications

An index to all ICRP publications can be accessed through www.icrp.org, clicking on “Publications”.

From 1928 to 1959, the reports of ICRP, including those under ICRP’s former name International X-ray and Radium Protection Committee, were published as articles or on behalf of ICRP by other organisations. What later became known as ICRP *Publication 1* was the first volume issued directly by ICRP, published as a book by Pergamon Press. Eventually, ICRP moved to a journal format, producing *Publication 24* as Volume 1, Issue 1 of the Annals of the ICRP in 1977. In 2004, Pergamon Press was acquired by Elsevier, who continued to publish the Annals of the ICRP for many years, up to and including *Publication 123*, Volume 42, Issue 4.

Following a long and carefully considered competitive process, ICRP decided to continue publication of the Annals of the ICRP with SAGE Publications. SAGE will be responsible for production and distribution beginning with *Publication 124*, and is already handling requests for new subscriptions and orders of back catalogue titles.

Subscriptions

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Publication 122: Radiological Protection in Geological Disposal of Long-lived Solid Radioactive Waste

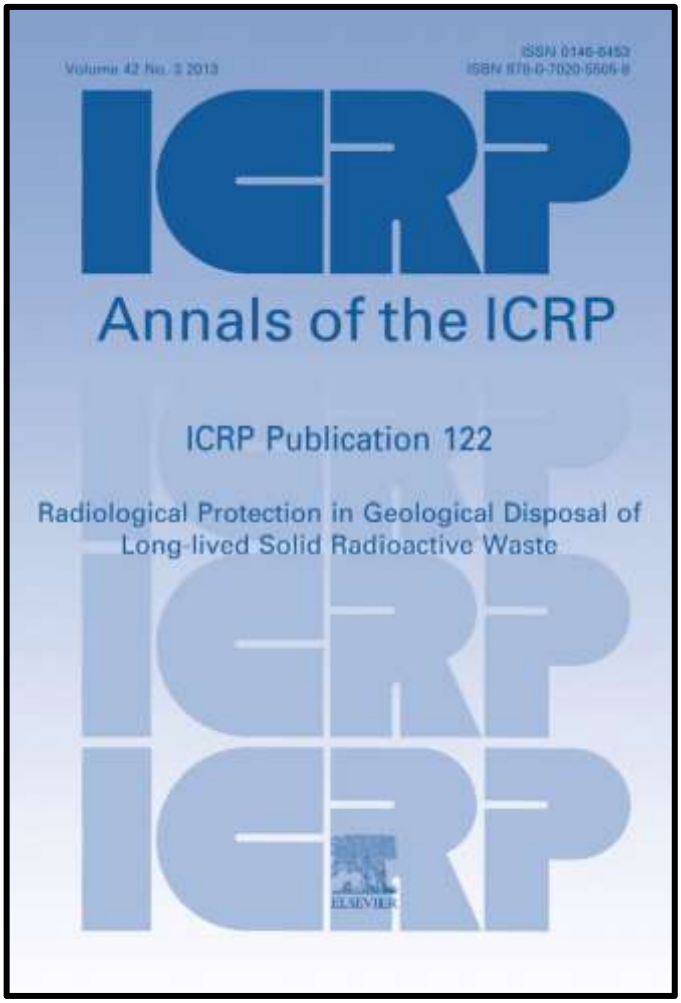
W. Weiss, C-M. Larsson, C. McKenney, J-P. Minon, S. Mobbs, T. Schneider, H. Umeki, W. Hilden, C. Pescatore, M. Vesterlind

This report updates and consolidates previous recommendations of the ICRP related to solid waste disposal. The recommendations given apply specifically to geological disposal of long-lived solid radioactive waste. The report explains how the ICRP System of Radiological Protection described in *Publication 103* can be applied in the context of the geological disposal of long-lived solid radioactive waste. Although the report is written as a standalone document, previous ICRP recommendations not dealt with in depth in the report are still valid.

The 2007 ICRP System of Radiological Protection evolves from the previous process-based protection approach relying on the distinction between practices and interventions by moving to an approach based on the distinction between three types of exposure situation: planned, emergency and existing. The Recommendations maintains the Commission's three fundamental principles of radiological protection namely: justification, optimisation of protection and the application of dose limits. They also maintain the current individual dose limits for effective dose and equivalent dose from all regulated sources in planned exposure situations. They re-enforce the principle of optimisation of radiological protection, which applies in a similar way to all exposure situations, subject to restrictions on individual doses: constraints for planned exposure situations, and reference levels for emergency and existing exposure situations. The Recommendations also include an approach for developing a framework to demonstrate radiological protection of the environment.

This report describes the different stages in the lifetime of a geological disposal facility, and addresses the application of relevant radiological protection principles for each stage depending on the various exposure situations that can be encountered. In particular, the crucial factor that influences the application of the protection system over the different phases in the lifetime of a disposal facility is the level of oversight or 'watchful care' that is present. The level of oversight affects the capability

to control the source, i.e. the waste and the repository, and to avoid or reduce potential exposures. Three main time frames are considered: time of direct oversight, when the disposal facility is being implemented and is under active supervision; time of indirect oversight, when the disposal facility is sealed and oversight is being exercised by regulators or special administrative bodies or society at large to provide additional assurance on behalf of society; and time of no oversight, when oversight is no longer exercised in case memory of the disposal facility is lost.



Publication 123: Assessment of Radiation Exposure of Astronauts in Space

G. Dietze, D.T. Bartlett, D.A. Cool, F.A. Cucinotta, X. Jia, I.R. McAulay, M. Pelliccioni, V. Petrov, G. Reitz, T. Sato

During their occupational activities in space, astronauts are exposed to ionising radiation from natural radiation sources present in this environment. They are, however, not usually classified as being occupationally exposed in the sense of the general ICRP system of radiation protection of workers applied on Earth. The exposure assessment and risk-related approach described in this report is clearly restricted to the special situation in space, and should not be applied to any other exposure situation on Earth. The report describes the terms and methods used to assess the radiation exposure of astronauts, and provides data for the assessment of organ doses.

Chapter 1 describes the specific situation of astronauts in space, and the differences in the radiation fields compared with those on Earth.

In Chapter 2, the radiation fields in space are described in detail, including galactic cosmic radiation, radiation from the Sun and its special solar particle events, and the radiation belts surrounding the Earth.

Chapter 3 deals with the quantities used in radiological protection, describing the *Publication 103* system of dose quantities, and subsequently presenting the special approach for applications in space; due to the strong contribution of heavy ions in the radiation field, radiation weighting is based on the radiation quality factor, Q, instead of the radiation weighting factor, w_R.

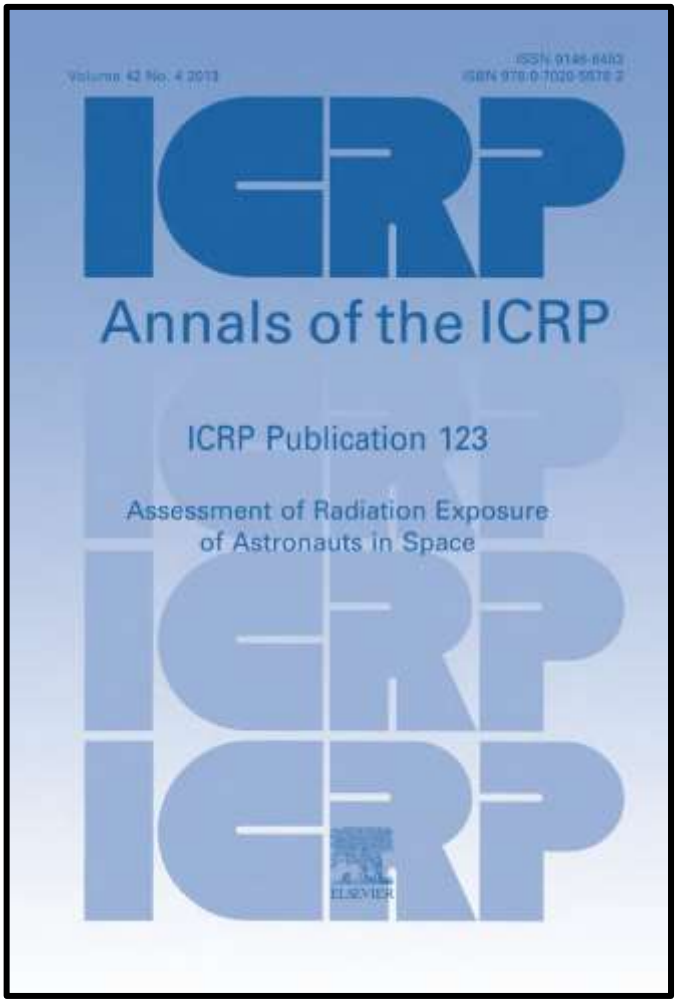
In Chapter 4, the methods of fluence and dose measurement in space are described, including instrumentation for fluence measurements, radiation spectrometry, and area and individual monitoring. The use of biomarkers for the assessment of mission doses is also described.

The methods of determining quantities describing the radiation fields within a spacecraft are given in Chapter 5. Radiation transport calculations are the most important tool. Some physical data used in radiation transport codes are presented, and the various codes used for calculations in high-energy radiation fields in space are described.

Results of calculations and measurements of radiation fields in spacecraft are given. Some data for shielding possibilities are also presented.

Chapter 6 addresses methods of determining mean absorbed doses and dose equivalents in organs and tissues of the human body. Calculated conversion coefficients of fluence to mean absorbed dose in an organ or tissue are given for heavy ions up to Z = 28 for energies from 10 MeV/u to 100 GeV/u. For the same set of ions and ion energies, mean quality factors in organs and tissues are presented using, on one hand, the $Q(L)$ function defined in *Publication 60*, and, on the other hand, a Q function proposed by the National Aeronautics and Space Administration. Doses in the body obtained by measurements are compared with results from calculations, and biodosimetric measurements for the assessment of mission doses are also presented.

In Chapter 7, operational measures are considered for assessment of the exposure of astronauts during space missions. This includes preflight mission design, area and individual monitoring during flights in space, and dose recording. The importance of the magnitude of uncertainties in dose assessment is considered.



Annex A shows conversion coefficients and mean quality factors for protons, charged pions, neutrons, alpha particles, and heavy ions ($2 < Z \leq 28$), and particle energies up to 100 GeV/u.

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ICRP membership totals nearly 250 experts from more than 30 countries. The membership of the Main Commission, Scientific Secretariat, and Committees as of 2013 December 31 is shown below. The membership of Task Groups can be found at www.icrp.org.

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FINANCES

ITEM	2013	2012	2011	2010	2009
Incoming Resources					
Contributions Received	482,334	533 025	650,955	617 168	418 408
Royalties *	103,772	199 059	70,071	107 551	107 231
Interest and Other Income	30	1 331	78	0	3 247
Total Incoming Resources	586,146	733 414	721 104	724 719	528 886
Resources Expended					
Promotion of Radiological Protection	300,075	401 855	627 326	552 953	532 464
Governance Costs †	384,780	269 846	288 646	169 027	133 095
Other Resources Expended	23,037	13 034	21 873	2 752	(22 834)
Total Resources Expended	707,896	684 735	937 845	724 732	642 725
Net Movement in Resources	(121,750)	48 679	(216 741)	(13)	(113 89)
Total Funds Carried Forward	**100,328**	**222 078**	**173 399**	**390 140**	**390 153**
BALANCE SHEET					
Tangible Fixed Assets	0	1 032	2 680	4 329	5 977
Current Assets	95,683	107 572	236 567	391 445	400 563
Debtors (falling due within one year)	194,986	242 167	38 498	168 413	0
Creditors (falling due within the year)	(190,341)	(128 693)	(104 346)	(174 047)	(16 387)
Net Assets	**100,328**	**222 078**	**173 399**	**390 140**	**390 153**

This is a summary of ICRP annual financial statements as audited by Tudor John Chartered Accountants, Epsom, UK. All amounts are expressed in US dollars.

* In 2012 ICRP reverted to accrual accounting for royalties. Historically royalties had been accounted for on a cash basis (royalties earned in a year being received and recognised as income in the following year). Due to this change royalties for 2012 include royalties received in 2012 (earned in 2011) and royalties earned in 2012 (received in 2013).

† The increase in governance costs in 2011 relates to an adjustment to more appropriately allocate Scientific Secretariat costs. The increase in governance costs in 2013 relate to launching of the "Advancing Together" fundraising campaign.

The majority of ICRP support is received in kind. For example, members' institutions make members' time available without charge and, in many cases, cover their costs of attending ICRP meetings. In 2013 several organisations, acknowledged on page 21, also provided in kind support specifically for ICRP 2013.

ICRP is financed primarily through voluntary contributions from organisations with an interest in radiological protection. All voluntary contributions are accepted with the understanding that they do not influence the ICRP membership or programme of work. Those providing financial contributions to ICRP in 2013 were:

- Australian Radiation Protection and Nuclear Safety Agency
- Cameco Corporation‡
- Canadian Nuclear Safety Commission‡
- Chinese Society of Radiation Protection (中国辐射防护学会)
- Danish National Board of Health (Statens Institut for Strålehygiejne, SIS)
- European Commission
- Finnish Radiation and Nuclear Safety Authority (Säteilyturvakeskus, STUK)
- French Institute of Radiation Protection and Nuclear Safety (Institut de radioprotection et de sûreté nucléaire, IRSN)
- German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, BMUB)
- Health Canada
- Icelandic Radiation Safety Authority (Geislavarnir ríkisins)
- International Atomic Energy Agency
- International Radiation Protection Association
- International Society of Radiology
- Japan NUS Co Ltd. (日本エヌ・ユー・エス株式会社, JANUS)
- Japan Radioisotope Association (日本アイソトープ協会, JRIA)‡
- Korea Radiation Safety Foundation (한국방사선안전재단, KORSAFe)
- Landauer Europe‡
- Norwegian Radiation Protection Authority (Statens strålevern)
- Nuclear Energy Agency, Organisation for Economic Co-operation and Development
- Russian Southern Urals Biophysics Institute (ЮЖНО-УРАЛЬСКИЙ ИНСТИТУТ БИОФИЗИКИ)
- Spanish Nuclear Safety Council (Consejo de Seguridad Nuclear, CSN)
- Swedish Ministry of the Environment (Miljödepartementet)
- US Department of Energy
- US Environmental Protection Agency
- US Nuclear Regulatory Commission

‡ All or part of the contributions from these organisations were directed to ICRP 2013.

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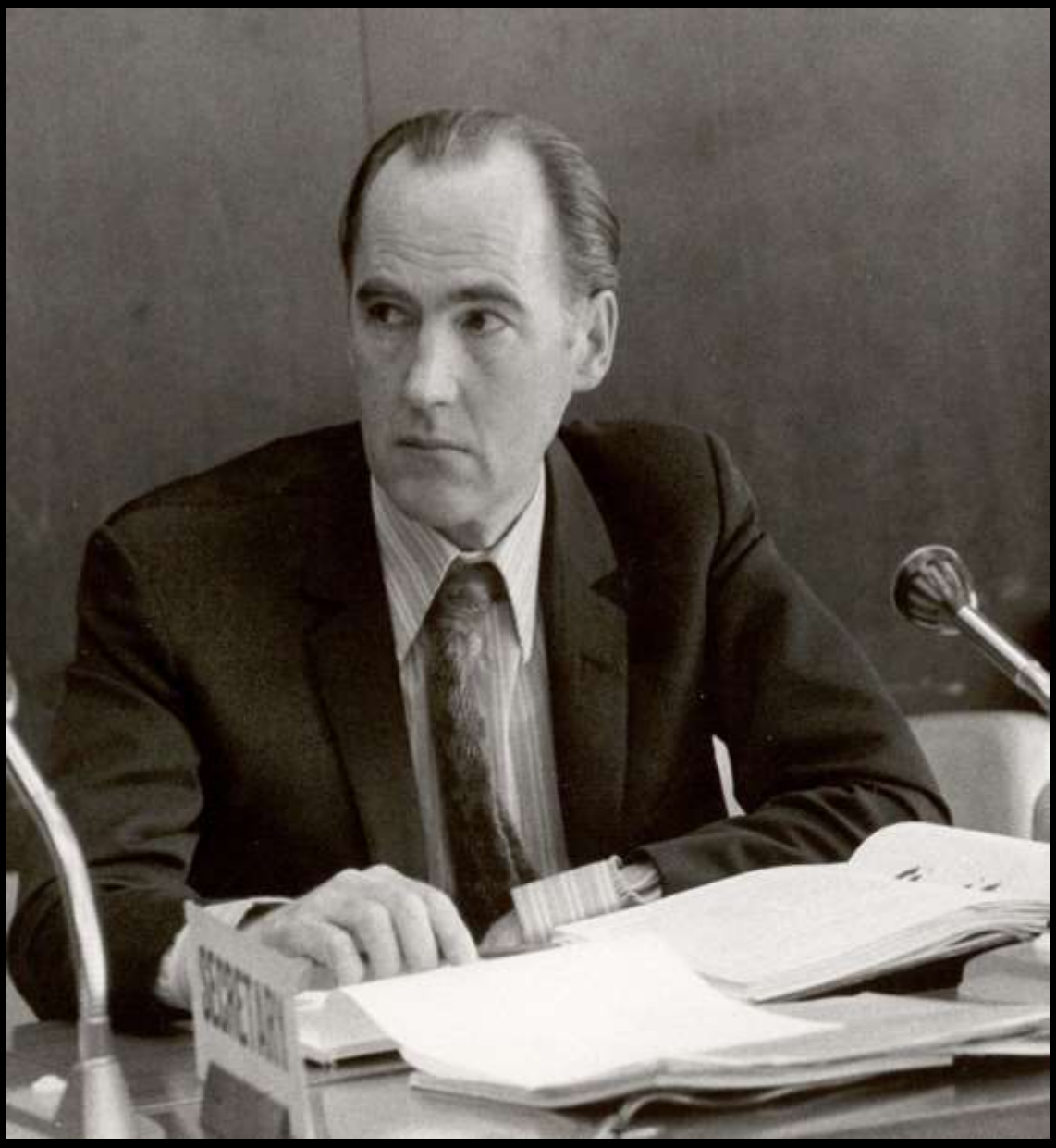

David Sowby, BA MD FSRP

1926 – 2014

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