MEETING REPORT

Report on the 5th International Conference on Low Dose Radiation

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Birmingham, UK, 3–5 February 2009

The 5th International Conference on Low Dose Radiation entitled 'The future for Radiation Protection' was held in Birmingham on 3–5 February 2009. The meeting was organized by the Nuclear Institute and was supported by the Society for Radiological Protection and the European Nuclear Society.

The opening session of the meeting concentrated on regulatory and advisory issues and, after an opening address by the chair John Cooper, began with a talk on the ICRP recommendation by Annie Sugier. Annie explained that since its inception in 1928, the ICRP had made recommendations to advisory bodies and regulatory agencies on the fundamental principles on which radiological protection is based. She focused specifically on the most recent 2007 recommendations which replaced those published in 1990. The latest recommendations, while not containing any changes in recommended limits, contain an evolutionary change in which the previous process-based approach of practices and interventions are replaced by ones based on exposure situations (e.g. planned, emergency, existing). Specifically, exposure should require a justification and there should be optimisation, which may entail some iteration. Annie concluded by explaining that the future challenges lay in understanding the relationship between alpha emitters and cancer risk, the biology of tissue reactions and the extent of any association with non-cancer effects.

David Copplestone gave a presentation on the implications for radiological protection of the protection of non-human species. He explained that there needs to be a system in place to demonstrate that the environment is protected from ionising radiation and that in the last decade there had been considerable effort in collating data and developing assessment processes. The main driver has been the need to demonstrate compliance with conservation legislation and the Environment Agency has a duty to review the environmental permits for releases of radioactive material to ensure that no adverse effects will result.

Ian Robinson followed this by explaining that one of the aims of the Health and Safety Executive is to secure the protection of workers and members of the public from work-related exposures to ionising radiation, principally from the nuclear industry. He explained that the regulatory issues could be categorized as renaissance (one-stop regulatory shop for new build issues), resources (training being arranged through company training schemes, NSAN, NNL, and university initiatives e.g. University of Central Lancashire and Dalton Nuclear Institute), regulatory standards (production of principles, good practice guides, maintenance of standards), research (more required to better understand reactor operation and the needs of radioactive waste management and decommissioning) and performance review (duty holder, regulator; efficiency of interaction between the two).

The second session concentrated on the implications of the new ICRP recommendations. Augustin Janssens began the session with an explanation of the implications for the Euratom basic safety standards, in which he explained that the revision of the standards was undertaken to incorporate the new ICRP recommendations as well as integrating all radiation protection legislation into a single directive covering all natural radiation sources, naturally occurring radioactive materials (NORM) industries, building materials and radon in dwellings and workplaces. The directive develops the concept of a graded approach to regulatory control that accounts for the effectiveness of controls and the risk, and the concepts of exemption and clearance have been worked through in more detail. Further issues that have emerged include the use of constraints and reference levels and the principle of justification (especially in relation to medical exposure).

Sylvain Saint-Pierre explained the implications of new ICRP recommendations for the global nuclear industry. He began by explaining that the international system of radiological protection was under review by IAEA. His view was that the draft new Basic Safety Standard contains many inconsistencies that do not lead to greater harmonisation.

Wolfgang Weiss presented the implications for emergency preparedness and response. He explained that in the past most emphasis in planning for and response to an emergency situation has been placed on selected protective measures in the early phase of an emergency to keep the doses received below levels where severe deterministic health effects can be excluded and/or where the risk of stochastic effects in...
the population is considered ‘acceptable’. The new ICRP recommendations propose a coherent conceptual framework for protection in all types of exposure situations including emergency ones, with the ICRP recommending a reference level for emergencies between 20 mSv and 100 mSv annual effective dose. He explained that it is necessary to identify the dominant exposure pathways, the timescales over which the dose will be received, and the effectiveness of the available protection options. Ted Lazo presented the Organisation for Economic Co-operation and Development Nuclear Energy Agency’s views on the challenges identified for the management of occupational and public exposures for new nuclear power plants.

Steve Ebdon-Jackson completed this session by explaining the implications for medical exposure. Steve explained that medical exposures were classed as planned exposures. Within justification, however, although optimisation still applies, there is a recognition that dose constraints have limited application. Steve pointed out a couple of omissions from the latest recommendations that they do not appear to include a range of exposures that are included as medical exposures in Europe and they do not address the issue of healthy volunteers in multiple research studies.

Session 3 began with Julian Preston explaining the mechanisms for radiation-induced carcinogenesis. The process of tumour development is a multi-step process that involves multiple changes in genes involving cell signalling and growth regulation, cell cycle control, apoptosis, differentiation and angiogenesis, all of which result in unlimited cell proliferation. In addition the process can involve epigenetic changes that are not direct alterations of DNA sequence. In a general form, these genetic changes can involve gene mutations or DNA rearrangements leading to a gain of function (e.g. oncogenes) or to a loss of function (e.g. tumour suppression genes). It is well known that ionising radiation is a ‘complete carcinogen’ in that it can induce tumours at a broad range of organ sites. What is yet to be established, however, is whether there are any mutations unique to radiation and if any of them are organ-specific. Current advances in molecular technologies make the study of such mechanistic issues feasible.

John Boice then gave an overview on what epidemiology tells us about radiation risks. John pointed out that radiation epidemiology has become so sophisticated that human studies have become the basis for radiation protection standards as well as compensation schemes. He explained that continued studies of children whose parents were exposed to radiation have not yet provided any detectable genetic effects. Radiation epidemiology tells us that: a single exposure can increase your risk for life; the young are more susceptible than the old; females are more susceptible than males; risks differ by organ or tissue; and some sites do not have a convincing risk associated with them. Radiation epidemiology has demonstrated excess cancers for exposures over 100 to 150 mSv and many data are consistent with a linear relationship between dose and effect up to about 2 Sv. For radiation protection, a linear no-threshold model is used to interpolate risks from higher doses to the low dose domain where epidemiology is incapable of distinguishing effects.

Mark Little summarized the recent epidemiological evidence in relation to non-cancer effects. He explained that a number of non-cancer disease endpoints have been associated with low and moderate doses of ionising radiation, including cardiovascular diseases, cataract, cognitive function, respiratory and digestive diseases, with cardiovascular disease having the greatest potential to impact on population risk. Mark then presented a review of the epidemiological literature for cardiovascular disease, explaining that there was a range of risks that varied by at least two orders of magnitude, possibly as a result of confounding factors. He then explained that possible biological mechanisms included damage to endothelial cells and subsequent induction of an inflammatory response or a possible somatic mutation. He concluded that although the evidence for a cause-and-effect interpretation is growing, it cannot yet be reliably inferred or excluded.

Sven Ove Hansson gave an overview of the ethical basis for standards. Sven argued that radiation protection gives rise to several difficult ethical questions, including: should the ultimate criterion of acceptability refer to the protection of individuals or to a group of individuals? To what extent does voluntariness and consensus affect the acceptability of risk? What role should economic considerations have? What if any effect should scientific uncertainty have? He argued that moral philosophy can help clarify some of these issues in the context of radiation protection.

In session 4, Mike Calloway explained the Nuclear Decommissioning Authority’s project to determine the end state, in consultation with stakeholders, of the nuclear sites for which they are responsible. Chris Fayers presented on the working group development of a UK code of practice for clearance and exemption to establish a set of cross industry standards. The working group involved the regulators. He explained that existing exemption orders are currently under review and a working group are contributing to this review within the framework of principles and practices that have been established within the code of practice.
Pete Burgess presented on advances in the measurement of low level radionuclides. He explained that the measurement of radioactivity at low levels can be done relatively easily and cheaply compared to other pollutants and outlined recent developments in measurement techniques.

Roger Wilmot explained the dose implications of very low level radioactive waste disposal. He outlined recent changes in policy in which a re-examination of practices and assumptions behind the disposal of small amount of waste to landfill and incineration without an authorisation was undertaken. He concluded that the results from these assessments indicated that existing policy would not lead to calculated doses above regulatory concern. Annie Sugier completed this session by explaining the role of stakeholder involvement in French regulations for the nuclear sites in France.

John Harrison began session 5 by explaining recent developments in internal dosimetry. He explained that new dose coefficients will be required following publication of new ICRP recommendations in 2007. This will need to take account of changes in radiation and tissue weighting factors. New and revised models will be required and new reference phantoms will be adopted for males and females that will be used to calculate equivalent dose separately before averaging to give effective dose to a reference person. John explained current model validity and also unresolved uncertainties. He also pointed out that ICRP models are also used in the calculation of best estimates of dose for epidemiological studies.

Chris Perks summarized advances in personal occupational radiation dosimetry in the UK. He outlined the requirements and legal basis for dosimetry. Future trends will include fine adjustment of technologies, increased harmony of dosimetry systems in Europe, improvements in international comparisons, and electronic means of reporting and accessing approved dosimetry services.

In the final session of the conference, Mike Thorne explained the experiences of the DOE licence application for a high level waste repository at Yucca Mountain and the technical response from the State of Nevada. The State of Nevada established an expert review of the licence application and submitted over 200 contentions where in its view the application was incorrect or inadequate. Bob Smith presented on the environmental regulation of long-lived radioactive waste and in particular on the revised guidance which is to be issued shortly on land-based disposal of solid radioactive waste. Magnus Westerlind gave a talk on the practical implementation of management options for long-lived radioactive waste in which he outlined the issue of site selection in Sweden and the factors involved in the selection process.

In addition, the following posters were presented:

- Benrd Grosche: European radiobiology archives
- Samantha Watson: HPA's advice on radiological protection criteria for all types of nuclear waste
- Tekeshi Iimoto: evaluation of radon-222 exhalation rate from soil
- Maria Snelzer: cohort profile of the German uranium miners cohort
- Bob Major: the characterisation and sentencing of radioactively contaminated particles
- Wayne Oatway: the work of the National Dose Assessment Working Group
- Sadiq Bukhari: evaluation of the radiological dose of the coastal population through dietary intake of sea food caught off Palk Strait in South East India

In summary, this meeting had a very interesting and varied group of speakers. Pity the conference was held at a time when Birmingham was engulfed in Arctic conditions!

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