MEETING REPORTS

SRP Meeting on Protecting Biota from Ionising Radiation DisTec 2004

To cite this article: 2004 J. Radiol. Prot. 24 189

View the article online for updates and enhancements.

Related content
- The FASSET Framework—an overview
  C-M Larsson
- Radiological protection of the environment in Sweden
  Lars-Erik Holm, Lynn Hubbard, Carl-Magnus Larsson et al.
- Issues around radiological protection of the environment and its integration with protection of humans: promoting debate on the way forward
  G P Brownless
Meeting reports

SRP Meeting on Protecting Biota from Ionising Radiation
Edinburgh, 23 January 2004

Approximately 100 people attended the one-day meeting in Edinburgh on Protecting Biota from Ionising Radiation, one of the hot topics in radiological protection. As Campbell Gemmell (Chief Executive of SEPA) commented in his introduction to the meeting, ICRP Publication 91 identifies this as an important conceptual gap in the current system of radiological protection that needs to be filled. However, he also emphasised that the current system of radiological protection, although having its roots in the workplace, has been extended to man in the environment, and does provide substantial protection of the environment as a whole. He, therefore, considered that the further work that has to be undertaken should be directed to refining and developing the existing system. In particular, the need for such additional work should not be taken to imply that the current system is substantially inadequate. He pointed out that, within the wider remit of SEPA, considerations of protecting both human health and the environment, including the balancing of benefits and detriments, is applicable to a wide range of issues, from radioactive waste discharges to greenhouse-gas emissions. Comparisons of detriments from different types of human activities are difficult, but are a necessary part of policy development.

George Hunter (SEPA) introduced the first session with a plea for presenting information on the environmental impacts of ionising radiation and radioactivity in a way that was more comprehensible to stakeholders. He suggested that dosimetrically-based analyses are best seen as a behind-the-scenes tool for deriving environmental quality standards, expressed as radionuclide concentrations in environmental media. He commented that concentration-based standards, such as are employed by the US DOE (http://homer.ornl.gov/oepa/public/bdac/), permit measurements to be made on the objects in the environment that it is desired to protect and the immediate determination of their degree of protection. Although not stated explicitly, a clear implication from these remarks is that current monitoring regimes could encompass such concentration-based standards with little modification, thereby proving cost-effective to industry and regulators alike.

Following these introductory remarks, Den Woodhead (Independent) provided a review of techniques of environmental dosimetry. He emphasised that instrumental dosimetry in the environment is generally difficult and often impossible. Nevertheless, dose estimation is essential for assessing the impacts of radioactive waste discharges, and for the interpretation of field studies or laboratory irradiation experiments. These considerations lead to extensive reliance on mathematical models. As he said, these models can be made as complex as desired, but the degree of useful detail that can be incorporated is generally restricted by the amount of relevant data available. Whereas complex mathematical phantoms are often used for human dosimetry, the phantoms used for dosimetry of non-human biota are typically simple homogeneous cylinders or ellipsoids, with radionuclides assumed to be uniformly distributed throughout the organism or the surrounding media. Calculational techniques for evaluating organism doses in these simplified geometries have improved in the last few decades, but these improvements have been at the 10% level relative to the early semi-analytical calculations.

Den also illustrated a situation in which radiation dose rates had been high enough to make direct measurements (on plaice in the north-east Irish Sea). These studies showed good agreement between LiF dosimeter measurements and theoretical calculations for the most exposed fish, but also demonstrated that many fish exhibited much lower doses because of their migratory behaviour. Finally, he noted that an outstanding issue is the formulation of a dose equivalent to flora and fauna (DEFF), which requires definition of radiation weighting factors relevant to the effects of interest at the dose rates of concern.

Duncan Jackson (Enviros) described a study on the health of small mammal populations exposed to chronic irradiation as a consequence of residence in the Chernobyl exclusion zone. Due to restriction of human activities in this zone subsequent to the accident, there has been a considerable increase in the abundance and diversity of wildlife. Before 1986, there were about 20 to 35 rodents per hectare, but, by 1987, 2500 rodents per hectare were recorded at some sites. In areas with the highest levels
of contamination, there is limited evidence for a shift in population structure, with a preponderance of juvenile and sub-adult bank voles (the most common rodent present) during spring sampling. This observation may be consistent with population fragility over winter, with repopulation during the summer, but the evidence is inconclusive. Apart from this, no substantial evidence of changes in sex ratios or organ size with degree of contamination was observed. These, essentially negative, observations, raise the question of whether gross reproductive or morphological effects of radiation can ever be detected in studies over one or a few seasons in a heterogeneous natural environment. This issue was raised by an ecotoxicologist in discussion, who commented that when addressing the ecotoxicological impacts of non-radioactive contaminants, attention is concentrated on indicators of impact, such as changes to DNA. Use of such indicators is also being explored with respect to ionising radiations (see, e.g., Ush et al 2003 Environmental biodosimetry: a biologically relevant tool for ecological risk assessment and biomonitoring J. Environ. Radioact. 66 121–139), but was not covered in any of the presentations at the meeting. This left unanswered the issue of interpreting bioindicators at the cellular and sub-cellular level with respect to impacts at the individual and population level.

Awadhesh Jha (School of Biological Sciences, University of Plymouth) presented a fascinating study on the effects of incorporated tritium on the marine worm Platynereis dumerilii. This species is readily maintained in the laboratory, but the technique could be extended to a variety of other marine invertebrates. Effects were studied at the embryonic and larval stages over a dose range of 0.02 to 29 mGy. However, results were expressed in terms of the concentrations of tritium used. Concentration-related reductions in proliferation rate index were found, as were concentration-related increases in sister chromatid exchanges, chromosomal aberrations and numbers of abnormal embryos/larvae. These results occasioned considerable discussion, because of the low absorbed doses received. However, it should be noted that these doses were calculated on the assumption that tritium concentrations in the embryos and larvae were the same as in water and no weighting factors for RBE were applied, although a number of commentators indicated that this might be appropriate. It was suggested that complementary experiments with external gamma irradiation would be of interest. In particular, external irradiation with ultra-soft x-rays would provide an exposure regime more consistent in energy deposition terms with tritium exposure than would external irradiation with gamma rays.

The morning session concluded with an overview of the FASSET (Framework for AssEssment of Environmental impact) by Carl-Magnus Larsson (Swedish Radiation Protection Authority). The FASSET programme encompasses: source characterisation and initial hazard analysis; ecosystem description and selection of reference organisms; exposure analysis and subsequent conversion to dose rates; effects analysis (supported by an effects database); and guidance for interpretation. Most deliverables from FASSET have now been issued and are available from the project website (www.fasset.org), as is the FASSET Radiation Effects Database (FRED). Details of the FASSET project are also to be published in a special issue of this journal, scheduled for December 2004.

FASSET is to be followed by a new EC-funded project, ERICA (Environmental Risk from Ionising Contaminants: Assessment and management). As with FASSET, this will be co-ordinated by Carl-Magnus. It will be directed to the development of practical assessment tools; risk characterisation; decision making involving stakeholder dialogue; and case studies. Carl-Magnus characterised FASSET as having mainly addressed conceptual and scientific issues, whereas ERICA will move to greater consideration of matters relating to policy and techniques.

The uncertainty surrounding radiation weighting factors appropriate to flora and fauna attracted much attention in the morning discussion, but Carl-Magnus asked: ‘Does it really matter, when we are discussing a spread in weighting factors of perhaps 2 to 10, in comparison to uncertainties in concentration factors of three orders of magnitude?’

In introducing the afternoon session, Juliet Long (UKAEA) noted the shift in thinking on protecting the environment from the effects of ionising radiation, in that it is now regarded almost as axiomatic that environment-specific standards be introduced. However, there is a need to ensure that regulatory frameworks are clear, comprehensible and not overly burdensome given that there is no evidence that environmental harm results at current authorised levels of discharge.

Developing this theme, although most speakers were committed to the need for revision and development of the system of radiological protection to encompass explicit protection of non-human biota, a challenge to this position was presented by Jim Smith (Centre for Ecology and Hydrology, Winfrith Technology Centre) in the first presentation of the afternoon session. He argued that current measures to protect humans are sufficient to protect the environment and that there was a danger that environmental protection from ionising radiation and radionuclides could be over-emphasised relative to protection from other environmental pollutants and human activities. He
also pointed out that the system of protection need not guarantee the total absence of deleterious effects, as many currently permitted activities are associated with gross damage to the environment, e.g. damage to the seabed by bottom trawling. Jim computed estimates of no-effects thresholds in terms of radionuclide concentrations and suggested that these are neither achieved nor generally achievable under the current regulatory regime. On the limitations of existing knowledge, he commented that there will always be an infinite number of data gaps and that the key question is whether the data are sufficient for hypothesis testing. In his view, the available, relevant data are far more extensive than they are for most (and possibly all) chemical pollutants. He also considered that fate and transport modelling are better developed than for chemical pollutants. Overall, he suggested a pragmatic approach in which we retain the current ICRP hypothesis (if humans are adequately protected then other living organisms are also likely to be sufficiently protected), but rewrite it to more clearly reflect the evidence that supports it; continue to test it; explain the scientific consensus on this issue; and concentrate money and effort on more important environmental problems. Although this presentation raised considerable discussion, it is noteworthy that the majority opinion expressed at the meeting appeared to support the view that current developments in protecting the environment are a response to a ‘conceptual gap’ in the regulatory framework, rather than concern that real harm is evident from routine emissions. In the discussion, attention was also drawn to a key conclusion of the recent IAEA conference in Stockholm—although we can say that the current system is protective of the environment, we cannot yet state with certainty that the environment is protected.

Carol Robinson (Independent, but formerly of the IAEA) described international work on the protection of non-human biota, with an emphasis on the role of the IAEA. She discussed the widely used dose rate threshold provided in IAEA Technical Reports Series No 332, clarifying that the statement that there is no convincing evidence that a chronic dose rate of $<1\,\text{mGy\,d}^{-1}$ will harm animal or plant populations represents a scientific judgement, not a basis for standards setting. In particular, she emphasised that the report had been rigorously reviewed, but had not been subject to Member State approval and that there are areas to which its conclusions do not apply, e.g. if individuals rather than populations are of primary concern or if other environmental stresses are also of importance. In this context, she mentioned IAEA-TECDOC-1270 (Ethical considerations in protecting the environment from the effects of ionising radiation), which points out that the focus in conservation is often on the protection of individuals. In her view, the current system of radiological protection requires development, irrespective of whether it is adequate, because there is a need to incorporate an explicit commitment to protect the environment. She also pointed out that this implies an emphasis on overall impacts in a specific area, rather than the source-related emphasis that has typically been employed in assessing impacts on humans.

With respect to future ICRP recommendations, Carol commented that the proposed derived consideration levels for each type of reference organism are unlikely to be sufficient alone, but that more specific criteria will depend on national or regional factors. However, there is a role for international organisations such as the IAEA in harmonising approaches. A possible way forward is in terms of derived environmental activity concentrations that take account of exposure to humans and non-human biota, with the exposure of humans generally being the determining factor. Finally, she drew attention to the more extensive discussions included in the Proceedings of the 2003 International Conference on the Protection of the Environment from the Effects of Ionizing Radiation (www.rasanet.iaea.org/downloads/meetings/stockholm_conf.pdf).

Augustin Janssens (European Commission, DG TREN.H4) provided an overview of Community policy on control of the disposal of radioactive wastes and the surveillance of levels of radioactivity in the environment. The specific issue of protection of non-human biota was covered only to a limited degree. Under the EURATOM Treaty, the mandate of the Commission extends only to the protection of the health of workers and the general public. However, he did comment on the Stakeholder Conference of 2–3 December 2002. This provided input to the Community Environmental Action Programme on radiation protection and included a session on protection of the natural environment. The stakeholders supported Community involvement in this area. Furthermore, the ICRP was criticised for using natural background as a reference for standards setting for humans, but this approach was considered suitable for non-human biota.

Notwithstanding this endorsement from the Stakeholder Conference, the Commission is not intending to proceed with the Environmental Action Programme and Augustin could not provide any guidance on future developments on protection of the environment at the European Community level.

Finally, Peter Merrill (Environment Agency) described the progress that they have made in developing an interim, staged approach to assessment. An interim methodology for assessment was
set out in the Environment Agency/English Nature Report 'Impact Assessment of Ionising Radiation on Wildlife', R&D Publication 128. This includes a spreadsheet-based assessment tool, covers terrestrial, estuarine and aquatic ecosystems, and is already being relatively widely used. In-house studies have complemented this with simplified radionuclide transport models suitable for use in screening assessments.

By application of these tools, the Environment Agency has completed Stage 1 and Stage 2 (screening) assessments of Natura 2000 sites in England and Wales. The screening assessments are based on dose rates set at 5% of IAEA-proposed thresholds and cautious assumptions on radionuclide behaviour in the environment. As a result of these assessments, approximately 100 permissions for radioactive waste discharges have been identified that may have a potential impact on Natura 2000 sites and require Stage 2+ assessments. Information relevant to the performance of such assessments has been provided in the Environment Agency Report 'Habitats regulations for Stage 3 assessments: radioactive substances authorisations', R&D Technical Report P3-101/SP1a. The aim was to complete such assessments of the 40 highest priority sites by April 2004.

Peter also set out the proposed contributions of the Environment Agency to the ERICA project. These include the risk characterisation handbook, outputs from a UK stakeholder event and descriptions of specific case studies. He noted that an important outstanding issue is the characterisation of uncertainties in assessments. He also emphasised that the Agency aims to translate the detailed scientific work that is being undertaken into a robust, durable regulatory system, with due regard to the requirement for proportionality.

In the final discussion, Roger Coates (BNFL) also made a plea for proportionality, commenting that many people in industry feared that a large and extended scientific programme might be put in place to address the issue of impacts on non-human biota, with knock-on implications for operational activities and decommissioning.

In conclusion, Augustin Janssens commented that the issue is not whether we believe that explicit protection of the environment is required. Rather, although there are not seen to be any major problems arising from the current system, there is a need for a clear framework to demonstrate that the environment is protected and to provide a basis for discussions with NGOs, ecologists and the public. In this context, there is a need to be seen to address all relevant principles for protection of the environment and to use a methodology equivalent to that employed for other pollutants. He also emphasised the need to move forward in this area and not to continue to go over old ground—the right science and the right political position would be needed to deliver a robust regulatory framework. The now discontinued Community Environmental Action Programme could have provided the funding base and the international context for the work required. Augustin concluded with a plea for all concerned to write to the European Commission to demand just such a framework.

Overall, the meeting was extremely useful. It included a good mixture of background information for those people who have recently acquired responsibilities in this area, new data of considerable interest, and interesting opinions robustly and coherently expressed. If anything was lacking, it was a discussion of how we should characterise the endpoints of interest at a detailed level, how we should generalise data on environmental transfer factors, e.g. through the use of allometric techniques and, perhaps, specific limits which might be set—either as incurred doses or derived environmental concentrations.

M Thorne, D Jackson, D Stone and A Whittall

DisTec 2004
Berlin, 26–28 April 2004

DisTec (Disposal Technologies) was planned as a series of conferences to report on progress in technical and safety related topics in radioactive waste disposal and to serve as an international forum for the exchange of ideas and experiences. The first DisTec conference was held in 1998 in Hamburg and the second in 2000 in Berlin. The conferences are organised between the BfS (German Office of Radiation Protection) and their contractor DBE, with support from the NEA, IAEA and EC.

In Germany, the Federal Government, through the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), is responsible for the management and disposal of radioactive waste. The BfS assists the BMU in the exercise of the latter's federal powers.

DisTec 2004 attracted 233 participants with 23 countries represented (11 from Japan—the largest contingency outside Germany). The three-day conference heard sessions on international co-operation for radioactive waste disposal; site selection; HLW, ILW and LLW disposal techniques; repository safety; backfilling and sealing; long-term interim storage and public and political aspects.
Derek Taylor gave an update on the EC’s draft Waste Directive (on the management of spent nuclear fuel and radioactive waste). While the European Parliament voted in favour of binding legislation for disposal, four Member States (Germany, UK, Sweden and Finland) voted against. Germany because of the difficulties within its domestic programme and the UK because there is no disposal programme for the time being. Sweden and Finland voted no since they are at an advanced stage in the realisation of HLW repositories and they did not want to be disturbed in their national policies.

The latest version of the Waste Directive includes amendments from the European Economic and Social Committee and removes the disposal timeframes giving responsibility to each Member State to set up their own timeframes (and to have them peer reviewed).

Based on ‘eurobarometer’ opinion surveys conducted in 1998 and 2001, Taylor believed that if the nuclear waste problem was ‘solved’ then nuclear energy could become the green energy option.

Alexander Nies (Head of Division of Radioactive Waste Management and Disposal at the BMU) gave a complementary ‘green’ keynote message stating that the paramount objective of the German Federal Government is for an increase in renewables in a framework of a highly efficient and sustainable energy future. However, Nies stated that whilst the decision has been taken to phase-out nuclear power, the Government is committed to finding a credible solution for HLW and spent fuel disposal which (worldwide) is waiting for a convincing solution.

The declared objective of the BMU is to follow the recommendations of the AkEnd report (on Site Selection Procedures for Repository Sites) which provides a systematic site selection procedure based on technical and socio-economic criteria. Nies acknowledged that comprehensive ‘know-how’ exists at the BfS and their contractor DBE but the question raised is how to retain this ‘know-how’ under the current disposal moratorium.

Peter Metcalfe gave his overview of the IAEA’s Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. There are 34 contracting parties each producing National Reports (see www-rasanet.iaea.org/conventions/waste-jointconvention.htm) with an obligation to attend three-yearly review meetings. The first meeting was held in Vienna in November 2003 (with Laurence Williams as president). One observation from the November meeting was that too many countries tried to defend themselves rather than be frank and open about their deficiencies. Comparatively little attention was given to the issue of managing disused sealed radioactive sources, an issue of principal interest for some of the smaller non-nuclear power countries and this together with the subject of effluent discharge control was identified as needing more consideration at the next meeting.

The IAEA in Vienna, NEA in Paris and the Commission of the European Union are strongly involved in international co-operation. These three organisations have different objectives, which were outlined in respective presentations, but there’s the old problem of avoiding competition and duplication. This problem has straightened-out to a certain extent but there are still overlaps. Because disposal projects are not fast advancing in any Member state, there is a tendency for invention and creation of new issues in order to have a ‘problem’ to work upon.

In Lithuania a near-surface facility for L/ILW has been decided. The media were informed of all the criteria so they could transparently follow the procedure for selection of a suitable site.

In Japan, a ‘solicitation approach’ has been adopted by NUMO who are managing the task of finding a national HLW site and working on the design of generic repository concepts without having a chosen geological formation or site/municipality. Much effort is being put into public dialogue in order to achieve a volunteer site but there is no ‘Plan B’ if no site/region volunteers.

ANDRA started operation of their VLLW facility at Morvilliers in October 2003. The design of the facility is similar to that of industrial hazardous waste repositories. Although not a ‘nuclear facility’ under French law, the facility has a safety case, which closely follows the methodology of Centre de l’Aube (2 km away) using the same ‘critical group’. ANDRA’s Centre de la Manche L/ILW disposal facility entered its post-closure monitoring phase in January 2003.

Slovakia has developed two different spent fuel storage concepts for Mochovce and Bohunice and the clear favourite is dry storage. The Environmental Impact Assessment is well advanced and will be finished by May 2004.

COVRA in the Netherlands have developed a novel approach for the design of an HLW storage facility, employing a local artist to paint the building bright orange with Einstein’s formula, \( E = mc^2 \) and Planck’s formula, \( E = h\nu \) written on the outside. The idea is to positively engage the local community rather than distancing them by communicating safety solely in terms of meaningless numbers.

DisTec 2006 in Dresden is a possibility, but mixed views were expressed given the fall in attendance since DisTec 2000 (when over 450 attended). All this in the context of a German coalition government (Greens and Social Democrats) who are pursuing a policy of phase-out for nuclear power
and an increase in renewables, notably wind power (Bonn is hosting the first international conference for renewable energy in June 2004).

David Brazier