Radiological protection and the environment

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The radiological protection world is roughly divided into two camps when it comes to the issue of environmental protection: those who believe that nothing more need be done in terms of radiological protection of the environment and those who do. Yet both camps can more or less agree that the environment is well-protected, so why all the debate?

Radiological protection of the environment is based on the recommendations of the International Commission on Radiological Protection (ICRP), whose current view is that measures to protect humans from radiation will give sufficient protection to the rest of the environment, since humans live in the environment and ingest things that have grown in it. Hence, contamination in one part of the environment would impact on humans and therefore be controlled.

This approach has been increasingly debated over the last ten years, including at an NEA workshop (NEA, 2003), and there is a feeling that the issue should be revisited by the radiological protection community. There are basically two arguments for developing the system of radiological protection in the area of environmental protection:

i) At present it is not easy to demonstrate that it works because it does not directly assess harm other than to humans.

ii) Some parts of the environment may be isolated from humans. So contamination may not affect human exposure and therefore these areas would be, in effect, excluded from the system of protection. For example, this might apply to contamination that built up at the bottom of a large, deep lake.

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It would be fair to point out here that usually at least some humans live in the vicinity of nuclear installations, since installations are not usually remote from civilisation. Accordingly, "unprotected" parts of the environment are rare (and possibly non-existent?), even though radioactivity can travel long distances and be persistent. This last observation helps to explain the paradox described above whereby there is reasonable agreement that the environment is well-protected from anthropogenic sources of radiation, yet a divergence of views on whether more should be done.

All NEA member countries have legislation in place for protection of the environment. Given interest expressed, however, the ICRP has set up a committee to address the issue, the European Commission has funded large research projects (EC, 2004; EC, 2007), the IAEA is active in the area (for example, see IAEA, 2002) and several NEA member countries have been developing their own assessment approaches. To date, this work has broadly looked at the ethical basis for protection and building toolboxes for assessing harm to the environment. The NEA has also been busy in the area of environmental protection. In addition to the workshop already mentioned, its Committee on Radiation Protection and Public Health (CRPPH) has completed a study on current legal approaches and trends (NEA, 2007) and at the annual meeting of the CRPPH in May 2007, the latter debated the topic with the support of two discussion papers: one looking at the policy issues, and a second comparing chemical and radioactive substances regulation.

Strategic issues: what does protecting the environment mean?

This section looks at what "protecting the environment" means and shows how this apparently abstract question is important. Intuitively, the question of what protecting the environment means may seem straightforward, but in fact, the recent NEA study on radiological environmental protection has found that there is no clear view of what actually constitutes protection of the environment (NEA, 2007).

For example, the United Nations Convention on the Law of the Sea stipulates that countries shall take "all measures... that are necessary to prevent, reduce and control pollution of the marine environment from any source", which seems an uncompromising statement. Yet this should be seen in the context of a Convention that establishes the right of nations to exploit marine resources and fisheries. Further reading of the Convention shows that pollution is defined as something that causes harm. But what is harm? Is it the presence of a substance in the environment, or is it the substance(s) at a level that, say, kills fish? So the apparently abstract question in the section heading is in fact very important. In this example, it might mean the difference between breaching an international convention or not.

The NEA concluded that the key approach to protecting the environment was a trade-off, balancing environmental (and human) harm against the benefits of an activity. Depending on where the balance point is, a certain level of spending to protect humans and the environment would be expected, and in some cases an activity might be banned. The figure illustrates this schematically, with some of the commonly used protection terms added (albeit somewhat subjectively). It also shows that increasing concern over the environment in past decades has moved the balance point, in effect shifting the burden of proof from "need to show harm" to stop an activity to "need to show little/no harm" to carry out an activity. The CRPPH discussion paper comparing chemical versus radioactive substances regulation draws similar conclusions.

Current developments in environmental radiological protection have to some extent sidestepped this issue of "what is environmental protection?" by focusing on harm to non-human biota. This topic is the subject of the next section, where developments and issues in this area of radiological protection are described.

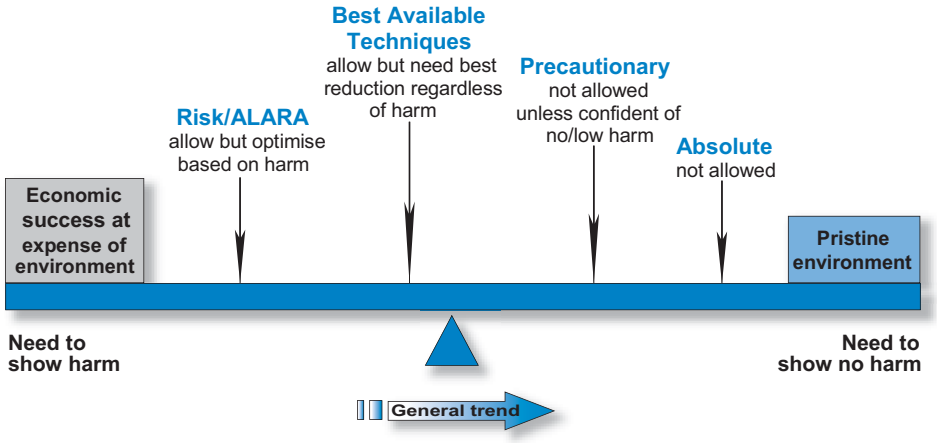
Protection of non-human biota

There are essentially two challenges associated with protection of non-human biota:

i) the level of protection that should be given (a similar question to that in the previous section); and
ii) the availability of tools to assess harm.

The general (but not unanimous) view is that, in most cases, a holistic level of protection, such as protection of an ecosystem, is appropriate, rather than protection of an individual animal or plant. The NEA study broadly supported this holistic view, insofar as laws defined environmental protection. However, ecosystems are very complicated, non-linear systems. This is why most, if not all, proposed approaches to radiological protection of non-human biota use reference animals and plants. Essentially, a practical methodology to assess harm to an ecosystem will have to look at selected parts of the ecosystem in the belief that protecting these parts will protect the whole. But what are these parts? Which biota are the critical ones? Should these be protected at the individual, community or population level? What is the critical stage of their life cycle? There are in fact a wide range of possible endpoints from which to choose. Although much work has been done to address these questions through UNSCEAR and the European

Progressive trade-offs and environmental protection



The general trend will probably stop and even reverse slightly for nuclear energy as concerns mount over climate change and security of energy supply. Pressures from globalisation may also affect priorities. Sustainable development is not shown: it is currently used in a flexible way and so its position varies.[1]

Commission, for example, this is probably the most contentious area in the radiological protection of non-human biota and one that the ICRP is examining.

Thanks to recent work in NEA member countries as well as under EC auspices, the situation is a much happier one when it comes to assessment tools. Ten or fifteen years ago, it would have been very difficult to link the concentration of a radioactive substance in environmental media to the radiation dose to an animal or plant, since the necessary models were not readily available. This is not the case today, as downloadable software applications exist that can perform these calculations, for instance the ERICA assessment tool (EC, 2007). Clearly, a large number of assumptions are used, but this is not unusual in environmental modelling. Probably the major weakness in using these tools lies in correlating dose to effect,[2] since some species will have a much greater sensitivity to radiation than others, and available databases (for example EC, 2004 and EC, 2007) will show that there are gaps and uncertainties in experimental results, which provide the link between dose and harm.

Next steps

The ICRP Committee 5 on environmental protection is examining protection of non-human biota and will produce documents over the next four years (the NEA has been granted observer status on this Committee). In parallel, a project sponsored by the European Commission, called "PROTECT" is seeking to develop standards for environmental radiological protection; the International Atomic Energy Agency has a co-ordination group on the subject; and the NEA Secretariat will participate in both. The NEA Committee on Radiation Protection and Public Health may also organise a workshop on possible policy approaches to the issue or establish an expert group to liaise with the ICRP.

In practice, several member countries will be building new nuclear power stations over the coming years. Therefore, environmental impact assessments (required in most, if not all, member countries) will need to be carried out. Thinking back to the figure, it is likely that the priority given to environmental protection will not change in the next few years: the burden of proof regarding harm to the environment will be on the proponents of a new plant. What is the best way to satisfy this burden of proof? Although tools now exist to help, the current system is not well-equipped to answer this demand, since even if it protects the environment, it does not have the tools and structure to demonstrate that it does. Hence, serious consideration should be given to developing the system to make it easy to show that the environment is protected, because the question will certainly be asked. As any material deficiencies in the current system seem small, adoption of a cost-effective solution should be a priority, and consensual development of such an approach may be best tackled by an open debate of the topic, a process which should only help strengthen the final conclusion. ■

Notes

1. This is recognised and discussed in a paper by Greenpeace Research Laboratories and co-workers, see Johnston (2007).
2. Dose is necessary at some stage since, for example, an animal living in a burrow is not likely to have the same exposure as an animal living in a tree. However, in principle dose can be "hidden" in a computer model, with the user only putting activity concentrations in and getting effects out.

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