

Radiological Protection of the Environment, including Non-Human Species- Views from the Global Nuclear Industry

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Abstract – This paper updates the WNA key messages on the RP of the environment. This paper shows that the chronology of views (2000-2008) leads to a recognition that the current RP system has provided adequate protection of people and of the environment. In early 2000s, doubts were raised on the adequacy of the RP system. Next (2002-2005), the international community forged the view that the current RP system has in practice provided appropriate standards of environmental protection, but also acknowledged that the system needs further development to fill a ‘conceptual gap’. In 2005, the IAEA plan of activities on the RP of the environment formalized international developments and conditioned the future revision (if any) of current standards. During 2006-2008, ICRP issued new guidance on RP of non-human species which offers little on an assessment framework of practical use and on a compelling case for such assessments. This guidance, based on the new ICRP concept of Reference Animals and Plants, falls short in terms of environmental protection approach. A milestone study on the RP of non-human species is the SENES independent overview (2007) which ‘*confirmed that both people and nature have been adequately protected from radioactive releases from all kinds of nuclear sites, old and new*’. This overview covers case studies for nuclear sites including some that had experienced major accidents. It derives that the earlier acknowledgement on the ‘conceptual gap’ appears no longer valid or at the very least, that the gap (if any) is extremely small. The RP of the environment is part of the on-going revision of the current IAEA Basic Safety Standards (BSS). We emphasize that the recently published BSS draft 1.0 in July 2008 covers (with adequacy) RP of the environment through general provisions (free of provisions to non-human species) on the assessment of environmental impact.

KEYWORDS: *policies and standards, radiological protection, environment, non-human species, animals and plants, industry, world challenge on energy-environment.*

1. Radiological Protection of the Environment as part of the Wider Picture

1.1 Global Challenge on Growing Energy Needs and Environmental/Public Health Issues

It is widely recognized that world-scale growing energy needs and environmental/public health issues are the key challenges of the current era and that the two are closely interconnected. Also, if abstraction is made of the long-term security of energy supply, ‘Energy’ is local but ‘Environment’ is global – simply meaning that local energy choices can impact negatively or positively on the planetary environment. With this in mind, opportunities for negotiating growing energy needs tend to be limited and sensitive due to their direct link to local development. In other words, often, energy needs are virtually not negotiable. This means that progress on the energy-environment challenge relies more on wise choice of energy supply which can best mitigate growing environmental and public health issues. (Radiological protection of the public is a sub-set of public health.) Another key point to emphasize is an increasing need for a better balance between countries that are facing more pressing challenges, and those countries that can afford further delays – e.g. at the more local level, delays can be associated with a weak energy growth forecast for the coming decade in a context of acceptable environmental and public health issues that are not expected to deteriorate greatly.

At the international level, with the increasing pressure on governments and industry from around the world to deliver on clean energy (CO₂ free) and on environmental and public health, it is clear that an adequate international system of safety standards (such as those of the IAEA¹) can no longer be developed in isolation of this world challenge. One of the key reasons for this is that international

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¹ IAEA International Atomic Energy Agency of the United Nations

safety standards impact on regulations which in turn bear implications on the ranking of the energy sources that can help progress on this world challenge. In other words, it may lead to using more or less of a given energy source with the caveat that some energy sources may carry much broader negative environmental and public health implications. With the important role that the global expansion of nuclear energy can play in the world challenge on energy and environment, it is clear that IAEA must pay more attention to the development of a truly sound - meaning integrated and balanced - IAEA Global Safety Regime. The required institutional support for this should start from a clearer policy on energy and environment at the United Nations (UN) level, together with a clearer mandate for the IAEA and for the other relevant UN organizations to implement this policy as appropriate throughout their institutional programs. The same is also valid for the OECD² and its Nuclear Energy Agency (NEA). There is a compelling case for IAEA and NEA to ramp-up efforts on the world challenges. In comparison, much less gain is expected from IAEA and NEA at the site-specific level.

1.2 Reality Check on the World's Environmental and Public Health Challenges

Prior to discussing views on the radiological protection of the environment – including the protection of non-human species, it is useful to reflect on the current drivers that really impact the world environmental and public health issues. This reality check helps keeping sight on the essentials. Such drivers rank as follow in decreasing order of importance:

- 1) climate change and its widespread long-term consequence on the planetary environment;
- 2) air pollution of all kinds – which is widespread;
- 3) water pollution of all kinds – also wide spread;
- 4) intense industrial activities (e.g. chemicals and their usage, oil and gas and their usage, agriculture, fishery, forestry, and many others); and
- 5) urban developments.

What is clear from this succinct list is that ‘exposure to ionizing radiation’ is not even part of the prevailing factors that represent a true challenge to the world’s environment and public health. As an approximate guess, ‘exposure to ionizing radiation’ may sit at the 100th rank or even more! Interestingly, the famously false ‘environmental’ issue of nuclear waste management and disposal can only be a subset of ‘exposure to ionizing radiation’. This means that the world challenge on environment and public health would remain the same irrespective of nuclear waste, and of their current management and disposal.

As viewed in Section 1.1, CO₂ free energy sources - including nuclear energy are key to help progress on this world challenge. It derives from this that a sound and efficient radiological protection of the environment must be part of a broader approach to worldwide environmental and public health protection. Otherwise, there is a real risk that tiny gain in radiological protection of the environment could mask the potential for considerable gain in overall protection that nuclear energy is capable to deliver. In comparison to nuclear energy, most large-scale energy sources (e.g. fossil fuels: coal, oil land gas) carry much broader negative environmental and public health implications. Worldwide organizations such as the UN, IAEA, OECD-NEA and others must pay more attention to this key issue.

2. Views on the Radiological Protection of the Environment

The adequacy of the current RP system is recognized worldwide. In brief, the practical implementation of this system builds-in multi layers of prudence and protection which ensure that radiation exposure to people is well below the range of levels (e.g. from few mSv/y to about 100 mSv) that would bear a possible, though theoretically small, long-term risk of health detriments. Beyond about 100 mSv and up to about 1,000 mSv, this long-term risk has been conclusively demonstrated. Understandably, the level of protection achieved for people is several orders of magnitude smaller than levels (about 1,000 mSv or more) that can cause immediate or rapid health detriments. The corresponding control

² OECD Organisation for Economic Co-Operation and Development

and monitoring of any release of radioactivity or any emission of ionizing radiation in the environment is such that the health impact on any other living things (meaning animals and plants or the so-called ‘non-human species’) is also tiny. This is evidenced by the fact that the resulting environmental concentrations of radioactivity are also well below those levels that are indicative of potential harm to populations of animals and plants. In fact, the study of effects from ionizing radiation on animals and plants require laboratory conditions with concentrations of radioactivity that can rarely be found in the environment. Indeed, such laboratory experiments on animals and plants require concentration that are several orders of magnitude higher than the highest concentrations found in the immediate surroundings of typical facilities which are subject to radioactive releases or emissions of ionizing radiation such as large-scale nuclear sites.

Nevertheless, since the early 2000s, the views on the RP of the environment have been extensively discussed at the international level. A chronology of these views follows. Three time periods were considered: early 2000s, 2002-2005 and 2006-2008. In addition, future perspectives for the period beyond (e.g. 2010s) are offered.

2.2.1 Early 2000s

In the early 2000s, some parties (e.g. anti-nuclear organizations and some international experts) raised doubts about the RP system’s adequacy to protect animals and plants. (The system adequacy to protect people has not been challenged.) Some extreme views even claimed that the RP of animals and plants has been entirely overlooked. This false assertion neglected the fact that the high level of control and monitoring practically implemented for the releases of radioactivity or emissions of ionizing radiation is not only beneficial to human health protection, but also to the health protection of animals and plants.

2.2.2 The 2002-2005 Time Period

During the 2002-2005 time period, a series of forums involving key international RP organizations (e.g. IAEA, OECD-NEA, UNSCEAR³ and ICRP⁴) took place on the RP of animals and plants. In parallel, a number of research projects initiated developmental work on related assessment frameworks.

One key milestone event was the IAEA international conference on RP of the environment in October 2003 in Stockholm, which anchored a basis for future developmental work in this field towards an assessment framework of practical use.

A subsequent key milestone was IRPA11 where an international consensus on the RP of the environment emerged. A WNA paper [1] expressed this consensus as part of IRPA11 in 2004: ‘*There is wide agreement that the current system of radiological protection has in practice provided appropriate standards of environmental protection, but also wide acknowledgement that the system needs to be further developed for completeness in order to fill a conceptual gap (i.e., exposure of non-human species where human exposure is not the predominant concern) and to address some specific outstanding situations.*’ This WNA paper also offered a set of key messages with regard to international developments on this challenging topic. We invite the reader to consult them. For the most part, these messages remain currently valid. The only exception to the currently validity of these key messages concerns the above acknowledgement (i.e. the conceptual gap to fill, and the specific outstanding situations to address). As we will see later in Section 2.2.3, this concern is now considerably toned down due to new studies that weaken the support on the earlier acknowledgement. The increasing world challenge that governments and industry need to face on growing energy needs and environmental issues also contributes to tone down this concern.

³ UNSCEAR United Nations Scientific Committee on the Effects of Atomic Radiation

⁴ ICRP International Commission on Radiological Protection

A third milestone event is the IAEA plan of activities on RP of the environment [2] which was issued as a draft in 2004 and finalized in August 2005. This IAEA plan of activities formalized, at the governmental level, the international developments to be carried out towards an assessment framework for the RP of the environment. Among others, it includes a road map for this development as well as a necessary broad condition for any work that may ultimately lead to the revision of current standards. This broad condition is stated as follow by the IAEA: *'To develop an international consensus on the need for, and if necessary, the form and content of, standards that address the protection of non-human species.'* In other words, a compelling case and consensus for such standards remains to be seen. (Also, in the IAEA context, the word *'need'* implies here a *'regulatory need'* - not a wish or a desire.) The key messages of the WNA paper in 2004 were part of the discussions that supported the IAEA plan of activities.

2.2.3 The 2006-2008 Time Period

In the 2006-2008 time period, the initial developmental research projects that began earlier on assessment frameworks for the RP of non-human species reached completion. In parallel, ICRP issued new guidance on this specialized topic. This includes a small component in the new 2007 ICRP recommendations [3] which were published early in 2008 as well as a draft report on the new concept of Reference Animals and Plants (RAP) which was also issued (for consultation) in 2008 [4]. This complements the ICRP earlier thoughts published in 2003 on a framework for assessing the impact of ionizing radiation on non-human species [5]. The WNA views on this ICRP documentation are given below.

Although the new ICRP recommendations contain broad wordings on RP of the environment and on non-human species, they offer little in terms of an assessment framework and of a compelling case for such assessments. In fact, RP of the environment remains narrowly covered through the new RAP concept. This new concept, pushed forward by ICRP 2003 and 2008 as a new policy tool, falls short of playing any role of significance in *'real'* environmental protection (including its demonstration). To illustrate this, it is easy to imagine that for the protection of the marine environment (e.g. fish health and public health related to fish consumption), radiation effects on animals and plants are not even part of the prevailing factors that are widely known to adversely impact the environment: e.g. overfishing, oil spills, climate change, chemical releases, etc. There are also plenty of examples that can be used to show that this is also valid for the protection of the terrestrial and atmospheric environments.

Moreover, there is a strikingly imbalanced and huge gap throughout the ICRP documentation between a wish to stimulate scientific developments in the narrow field of radiation effects on animals and plants and the act of demonstrating compliance which requires matured and well established scientific knowledge and expertise. In fact, this ICRP report confuses the scope of existing broad environmental protection regulations (e.g. regulations on endangered species and biodiversity) with the narrow topic of radiation effects on animals and plants. As the latter is rather trivial, it is clear that such a narrow demonstration would add little to a *'real'* demonstration of environmental protection that account for the prevailing factors that do impact on the environment.

As a milestone among the new studies published on the topic of RP of non-human species, we emphasize an independent expert overview published by SENES Consultants in 2007 [6] which *'confirmed that both people and nature have been adequately protected from radioactive releases from all kinds of nuclear sites, old and new.'* (This study is publicly available on the WNA website.) In particular, this study shows that the impact of ionizing radiation on the environment is low and well below reference levels at which adverse health effects to populations of animals and plants might be expected. This is the conclusion of an overview of worldwide case studies which assessed ecological risk at a wide range of nuclear sites. In particular, SENES examined cases covering a range of nuclear sites from uranium mines to nuclear power plants, plants that reprocess and recycle used nuclear fuel, and disposal sites for radioactive waste. Their overview included sites that had experienced major accidents, such as Chernobyl. For perspective, the study also included examples of sites where enhanced levels of natural radioactivity are released into the environment, such as offshore oil and gas

platforms. The observation of the “low impact” of ionizing radiation on nature shown in the SENES study is strengthened by the fact that it is also valid for the sites involved in the early development of nuclear fuel cycle programs and of the related military facilities, which saw both normal operations and some significant accidents. In fact, the overview shows that even in the event of very high doses and dose rates, such as those experienced following the Chernobyl accident, where adverse health effects on animals and plants have been observed locally, populations of animals and plants appear to recover within a reasonably short time period once the radiation dose rates were reduced. No high dose rates to populations of plants or animals were seen with controlled radioactive discharges. This key finding demonstrates that the application of the current RP system, which includes a variety of standard protective practices for containing radioactive sources, controlling and limiting radioactive releases to the environment, and protecting people, has in fact also provided an adequate level of protection to populations of animals and plants. This overview provided reassurance against the concern expressed in this decade by part of the international expert community, which suggested that the environment may not have been adequately protected from exposures to ionizing radiation and that the RP system was incomplete. It derives from this that the acknowledgement (i.e. the ‘conceptual gap to fill’, and the ‘specific outstanding situations to address’) stipulated earlier in Section 2.2.2 appears no longer valid or at the very least, that the ‘conceptual gap’ (if any) is extremely small and that the ‘specific outstanding situations’ (if any) are extremely rare.

Finally, the most important international context in which views on RP of the environment can take a practical form, is at the IAEA and in particular as part of the on-going revision of the current IAEA Basic Safety Standards – the so-called IAEA BSS [7] – published in 1996 which regroup the Radiation Safety Standards. These deliberations are led by the IAEA Radiation Safety Standard Committee (called RASSC). On this point, IAEA recently published in July 2008 IAEA BSS draft 1.0 [8] which reflects the current stage of international deliberations. We emphasize that BSS draft 1.0 covers RP of the environment through general provisions on the assessment of environmental impact. It does not include any provisions on the RP of non-human species. With this in mind the introduction of BSS draft 1.0 includes the following section (Section 1.22) on the RP of the environment: *‘1.22. The aim of radiation protection of the environment (Safety Principle 7) is to protect ecosystems against exposure that would have adverse consequences for populations of a living species. The present system of radiation protection generally provides appropriate protection of the ecosystems in the human environment against harmful effects of radiation exposure. However, there is often an expectation that this be demonstrated, rather than assumed. This is normally accomplished through an environmental assessment, which identifies the targets (s), defines the appropriate criteria for protection, assesses the impacts and compares results of the available protection options. The method and criteria for these assessments are still being developed and will continue to evolve. Radiation impacts within a particular environment constitute only one type of impact and in most cases, may not be the dominant impact of a particular facility or activity. Thus, radiation protection of the environment is to be viewed within the broader context of assessing all the impacts on the environment. These standards are designed to clearly identify protection of the environment as an issue to be assessed, while leaving flexibility to incorporate the results into the appropriate decision making processes.’*

In our view and based on the SENES study, the part on the adequacy of the current RP system in the IAEA plan is a touch too weak. If not, one would have to specify what is meant by ‘...generally provides...’ and by ‘...the human environment...’. In other words, based on practical evidences, what are those situations for which the current RP system has not adequately protect the environment? We would also argue that there are plenty of demonstrated evidences which show that non-human species are also provided adequate protection. In other words, this is not really an assumption. The rest of the text seems too much influenced by the ‘dose assessments’ angle as a driver of the protection when in fact ‘assessment’ covers other key drivers such as containment, pollution control, monitoring and contingencies that are all accounted for as part of a risk-based approach. Also, the broader context of RP of the environment is insufficiently developed. Among others, the link to the world challenge on energy and the environment (as described herein in Section 1.1) and to the related key role that nuclear energy can play in it, is notably missing. Given the broad scope of IAEA, this key omission must be rectified.

2.2.4 The Period Beyond (e.g. 2010's)

The attention put on the RP of the environment in the 2000s is expected to decrease rapidly in 2010s due to the steadily increasing concern about the global challenge of growing energy needs and environmental/public health issues. In particular, climate change and its widespread long-term consequences on the planetary environment will continue to dominate the world's environmental challenge. In comparison, RP of the environment is expected to have a very small role, and even more so the RP of animals and plants. At the international level, it seems unlikely that the 'remains to be seen' compelling case and consensus on the need for new regulatory standards on the RP of animals and plants (as specified in the related IAEA plan of activities) can ever be made.

3. Summary Conclusions

The above shows that the views on the RP of the environment have been extensively discussed at the international level in the 2000s. In the early 2000s, some parties raised doubts about the RP system's adequacy to protect animals and plants. During 2002-2005, the international community forged the view that the current RP system has in practice provided appropriate standards of environmental protection, but also acknowledged that the system needs to be further developed for completeness in order to fill a conceptual gap (i.e., exposure of non-human species where human exposure is not the predominant concern) and to address some specific outstanding situations. In 2005, the IAEA plan of activities on the RP of the environment formalized the international developments to be carried out towards an assessment framework of practical use. Among others, the IAEA plan's conditioned the future revision (if any) of current standards: *'To develop an international consensus on the need for, and if necessary, the form and content of, standards that address the protection of non-human species.'* In other words, a compelling case and consensus for such standards remains to be seen. WNA was supportive of the above.

During 2006-2008, the initial developmental research projects that began earlier on assessment frameworks for the RP of non-human species reached completion and ICRP issued new guidance on this specialized topic, including a small component in the new 2007 ICRP recommendations and other material on its new concept of Reference Animals and Plants (RAP). This complemented the ICRP earlier thoughts published in 2003. Altogether, this ICRP documentation offers little in terms of an assessment framework of practical use and of a compelling case for such assessments. RP of the environment remains narrowly covered through the new RAP concept which falls short of playing any role of significance in 'real' environmental protection (including its demonstration). Moreover, there is a strikingly imbalanced and huge gap between a wish to stimulate scientific developments in the narrow field of radiation effects on animals and plants and the act of demonstrating compliance (as part of any regulatory regime) which requires matured and well established scientific knowledge and expertise. The ICRP documentation confuses the scope of existing broad environmental protection regulations (e.g. regulations on endangered species and biodiversity) with the narrow topic of radiation effects on animals and plants.

As a milestone among the new studies on the RP of non-human species, is the independent expert overview published by SENES Consultants in 2007 which *'confirmed that both people and nature have been adequately protected from radioactive releases from all kinds of nuclear sites, old and new.* This study (publicly available on the WNA website) shows that the impact of ionizing radiation on the environment is low and well below reference levels at which adverse health effects to populations of animals and plants might be expected. This overview of worldwide ecological-risk case studies covers a range of nuclear sites including some that had experienced major accidents, such as Chernobyl. The "low impact" shown in this overview is strengthened by the fact that it is also valid for the sites involved in the early development of nuclear fuel cycle programs and of the related military facilities, which saw both normal operations and some significant accidents. The overview shows that even in the event of very high doses and dose rates, such as those experienced following the Chernobyl accident, populations of animals and plants appear to recover within a reasonably short time period. No high dose rates to populations of plants or animals were seen with controlled radioactive discharges. It derives from the above that the earlier acknowledgement on the RP of the environment

(i.e. the ‘conceptual gap to fill’, and the ‘specific outstanding situations to address’) appears no longer valid or at the very least, that the ‘conceptual gap’ (if any) is extremely small and that the ‘specific outstanding situations’ (if any) are extremely rare.

The RP of the environment is part of the on-going revision of the current IAEA Basic Safety Standards (BSS). We emphasize that the recently published BSS draft 1.0 in July 2008 covers RP of the environment (with adequacy) through general provisions on the assessment of environmental impact. These general provisions are free of any provisions on the RP of non-human species.

For the time period beyond (e.g. 2010s), the attention put on the RP of the environment in the 2000s is expected to decrease rapidly due to the steadily increasing concern about the global challenge of growing energy needs and environmental/public health issues. In particular, climate change and its widespread long-term consequences on the planetary environment will continue to dominate the world environmental challenge. In comparison, RP of the environment is expected to have a very small role, and even more so the RP of animals and plants. At the international level, it seems unlikely that the ‘remains to be seen’ compelling case and consensus on the need for new regulatory standards on the RP of animals and plants (as specified in the related IAEA plan of activities) can ever be made.

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