INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

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Second Announcement

ICRP Workshop on *Surface Disposal of Radioactive Waste*

The Celecton Fukushima

Monday, November 6, 2017

Organised by the International Commission on Radiological Protection (ICRP)
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Background

ICRP Task Group 97 has been working on application of the Commission's recommendations for surface and near surface disposal of solid radioactive waste to prepare a plain-language publication that describes and clarifies the application of the recommendations for the protection of the public and workers (*Publications 101* & *103*) as well as the environment (*Publication 124*). The publication will discuss how the fundamental radiological protection principles are to be applied over the life cycle of surface and near surface disposal including the transitioning from planned exposure to existing exposure situations in the case of a loss of institutional control. Application of the graded approach in implementing the principles and advice in all facets of a facility's life cycle, based on the hazard posed, including the degree of isolation of the waste, will also be discussed. The publication will consider *Publications 46*, *77*, and *81* in light of the Commission's current recommendations, taking into account recent international experience.

Objectives

ICRP welcomes this opportunity to share information on radiological protection in surface and near surface disposal of radioactive waste with Task Group 97 members, regulators, implementers, and relevant stakeholders concerning the practical implementation of the Commission's recommendations.

Registration

Attendance at the symposium is free-of-charge, however, advance registration is required as attendance is limited to 100 participants. Please send your name, affiliation, and e-mail address to Haruyuki Ogino (ICRP Assistant Scientific Secretary) at rpwaste@icrp.org by 31 October, 2017.

Venue

The Celecton Fukushima (13-73, Ootamachi, Fukushima-shi, Fukushima 960-8068, Japan)

Programme

10:00 – 10:30 (1) Overview of work of ICRP Task Group 97

Thiagan Pather (ICRP)

10:30 – 11:00 (2) Overview of ICRP approach to waste management

Christepher McKenney (ICRP)

11:00 – 11:30 (3) Overview of strategies for surface disposal and lifetime of disposal facilities

Jean-Paul Minon (ICRP)

11:30 – 12:00 (4) Ethics of radioactive waste management: what are our responsibilities protecting today and tomorrow?

Behnam Taebi (ICRP)

12:00 – 13:00 Lunch break

13:00 – 13:30 (5) Transition out of regulatory control and post-closure institutional control – what can be expected in the long term

Phil Metcalf (ICRP)

13:30 – 14:00 (6) Management of Natural Occurring Radioactive Materials (NORM): A Canadian Perspective

John M. Takala (ICRP)

14:00 – 14:30 (7) Japanese regulations for waste management

TBD (Japan)

14:30 – 15:00 (8) NEA initiative on Fukushima Daiichi waste management

Hiroshi Rindo (OECD/NEA)

15:00 – 15:30 (9) Draft guideline of Japan Health Physics Society for waste management in existing exposure situation after a nuclear accident

Daisuke Sugiyama (CRIEPI)

15:30 – 16:00 Coffee break

16:00 – 17:00 Panel discussion (chaired by Thiagan Pather, ICRP TG97 Chair)

17:00 – 17:10 Closing remarks

(1) Overview of work of ICRP Task Group 97

T. Pather

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Abstract– The work of the International Commission on Radiological Protection (ICRP) helps to prevent cancer and other diseases and effects associated with exposure to ionising radiation, and to protect the environment. Since 1928, ICRP has developed, maintained, and elaborated the International System of Radiological Protection used world-wide as the common basis for radiological protection standards, legislation, guidelines, programmes, and practice. ICRP has published more than one hundred reports on all aspects of radiological protection. Most address a particular area within radiological protection, but a handful of publications, the so-called fundamental recommendations, each describe the overall system of radiological protection. The International System of Radiological Protection as developed by ICRP is founded on (i) the current understanding of the science of radiation exposures and effects and (ii) value judgements. These value judgements take into account societal expectations, ethics, and experience gained in application of the system. ICRP is an independent, international organisation with more than two hundred volunteer members from approximately thirty countries across six continents. These members represent the leading scientists and policy makers in the field of radiological protection. ICRP is comprised of a Main Commission, a Scientific Secretariat, four standing Committees (on Effects, Doses, Medicine, and Application), and a series of Task Groups. The Main Commission and the Scientific Secretariat work together to direct, organize, and oversee the work of ICRP. The Committees advise the Main Commission in their area of expertise. They direct the work of Task Groups, and play an important role in ensuring the quality of ICRP reports. Task Groups are established to undertake a specific task, normally the production of a single ICRP publication, and are generally comprised of a mixture of Committee members and other experts in the field invited to contribute to the work. ICRP Task Group 97 has been working on application of the Commission's recommendations for surface and near surface disposal of solid radioactive waste to prepare a plain-language publication that describes and clarifies the application of the recommendations for the protection of the public and workers (*Publications 101* & *103*) as well as the environment (*Publication 124*). The publication will discuss how the fundamental radiological protection principles are to be applied over the life cycle of surface and near surface disposal including the transitioning from planned exposure to existing exposure situations in the case of a loss of institutional control. Application of the graded approach in implementing the principles and advice in all facets of a facility's life cycle, based on the hazard posed, including the degree of isolation of the waste, will also be discussed. The publication will update the recommendations in *Publications 46*, *77*, and *81* in light of the Commission's current recommendations, taking into account recent international experience and will be a companion document to *Publication 122* on Radiological Protection in Geological Disposal of Long-lived Solid Radioactive Waste. ICRP welcomes this opportunity to share information on the work of Task Group 97 with regulators, implementers, and relevant stakeholders concerning the practical implementation of the Commission's recommendations.

(2) Overview of ICRP approach to waste management

C.A. McKenney

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Abstract–The International Commission on Radiological Protection (ICRP) Task Group 97 has been working on application of the Commission's recommendations for surface and near surface disposal of solid radioactive waste to prepare a plain-language publication that describes and clarifies the application of the recommendations for the protection of the public and workers (*Publications 101* & *103*) as well as the environment (*Publication 124*). The 2007 Recommendations of the ICRP recognized three types of exposure situations: planned, emergency, and existing situations. For each of the situations, the three fundamental guiding principles of radiation protection (i.e. justification, optimisation, and dose limitation) are applied. This presentation provides an overview on the application of the three principles to waste disposal by first providing the basic principle and then, some implication or aspect that results from waste disposal, especially, the consideration of the long time periods post-closure. After an introduction to the principles, an overview of the three exposure situations is provided. Utilizing the fundamental principles and exposure situations, an overview of waste disposal applications is reviewed. In the vast majority of cases, the design and operation of a waste disposal site is a planned exposure situation. Some countries may have legacy sites, such as sites with mining waste that were later brought under regulatory control. Emphasis is placed on the fact that while the activity is planned, the doses in the future are not. Many of the actions taken today are to reduce the probability and consequence of an exposure occurring, i.e. a potential exposure. Waste disposal involves long time periods and a reliance on passive safety systems. Due to these time periods, it is impossible to know if people would be present in to be exposed at a specific time period. Therefore, the Commission recommends using a hypothetical representative individual for the long-term dose and risk calculations. In addition to human health metrics using representative individuals, the Commission recommends using the Reference Animals and Plants as one approach to assess impacts to the environment. While this can have challenges similar to the representative individual due the long time periods resulting in a change in the environment, the use of Reference Animals and Plants offers an additional line of argument and reasoning in building a safety case using endpoints that are different from, but complementary to, protection of human health. Consideration of environmental protection, where appropriate, will thus broaden the basis for risk-informed decision making, and address issues that may have differing levels of importance for different stakeholders.

(3) Overview of strategies for surface disposal and lifetime of disposal facilities

J.P. Minon

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Abstract–All human activities produce waste. Also, the applications of radioactivity produce waste: radioactive waste. As radioactivity decays with time, radioactive waste can be dealt with by isolating it from human and environment as long as it may be harmful. This is the aim of disposal facilities which have to provide protection during the necessary period of time. This period depends on the radioactivity content of the waste and can range from centuries up to millions of years. All type of waste can be disposed of in underground facilities in deep geological layers the waste being isolated from the biosphere for time periods comparable with geological timeframes. After closure, the facility must be able to operate independently as a stand-alone facility for assuring the requested level of isolation, e.g. without human intervention. Some waste can be disposed of in near surface facilities provided that the decay time and the inventory in long-lived radionuclides are compatible with the needed active surveillance, e.g. no longer than a few centuries. Indeed, instead of deep underground disposal facilities, surface disposal facilities are located in the biosphere. The choice of the disposal types is a matter of national strategy, and should be optimized considering the waste fluxes and volumes, the interim storage available capacity, and the transportation issue. The ICRP system of radiological protection applies to disposal facilities taking into account their specificities, e.g. the long-time frames involved and the related uncertainties and the relevant risk of human intrusion. The safety functions (containment, retardation and isolation) are implemented along the successive time phases according the ICRP system of radiological protection for the different exposure situations. A strategy has to be developed, with participation of all stakeholders, to guarantee the expected level of protection during all the time phases. This strategy applies to the disposal system as a whole: the site, the waste inventory and the disposal facility. The strategic options are bounded by uncertainties related to post-closure radiological impact, socio-economic and policy factors, available sites. Impact calculations have to be supplemented by assessment of various designs and material choice options to face a wide range of events and processes: the long-term safety is supported by robust design implemented throughout sound and effective management systems. It is also clear that at siting stage, the radiological assessment will be only one of the factors but will be unlikely to dominate the decision due to its preliminary nature and associated uncertainties at this stage.

(4) Ethics of radioactive waste management: what are our responsibilities protecting today and tomorrow?

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Abstract–Nuclear technology has created great benefits, but it has also given rise to many new and significant risks, including the risks associated with radioactive waste management. When evaluating those risks in policy-making, there is a tendency to focus on the *social* or *public acceptance*, emphasizing that the radioactive waste management option must be accepted by the public. I will argue that concentrating solely on social acceptance threatens to obscure several important ethical issues of radioactive waste management. Following the notions of 'good governance of risky technology', *good* radioactive waste management needs to involve both social acceptance and *ethical acceptability*, because it is only in conjunction that these two concepts gain serious relevance for policy-making. Conceptually, it is helpful to combine these notions, because they are mostly complementary; social acceptance studies are often in need of an ethical addendum, while existing ethical analysis would very much benefit from including stakeholders' opinions. In this talk, I will first present six reasons why a sole focus on social acceptance would not sufficiently capture the relevant ethical issues of radioactive waste management. More specifically, I will discuss the problems that acceptance could be based on (i) incomplete information or (ii) for the (ethically) wrong reasons. Moreover, the question remains unanswered (iii) whose acceptance we should be striving for. The latter problem could be exacerbated when dealing with (iv) international and (v) intergenerational risks. The question of (vi) distribution of risks and benefits also typically remains unanswered in risk acceptance studies. The first three problems could best be categorized under the heading of *procedural justice* while the latter three fall best under the heading of *distributive justice.* Following the literature on *nuclear ethics*, *energy justice*, as well as a forthcoming publication of ICRP that has identified justice as one of the four core values of the system of radiological protection, I argue that ethically acceptable radioactive waste management should at least account for issues of procedural and distributive justice; both justice notion have a spatial and a temporal dimensions, relating to space and time respectively. The ethical intricacy of this issue is that different requirement of justice might be potentially conflicting. For instance, complying with our obligations to protect future generations could create additional burdens for the present generations (as a whole). Moreover, it could create an instance of (spatial) injustice among the currently living generations. Ethically acceptable radioactive waste management should sufficiently account for these potentially conflicting situations.

(5) Transition out of regulatory control and post-closure institutional control – what can be expected in the long term

P. Metcalf

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Abstract–Radioactive waste that is generally considered internationally to be suitable for disposal near or on the surface is characterised by a radionuclide content of primarily short-lived radionuclides, that is less than a radioactive half-life of around thirty years, and containing limited amounts of longer lived radionuclides. Near surface is generally considered to be within a few tens of metres of the surface and a region within which human intrusion could reasonably be expected to take place. The underlying basis for this thinking is that most of this radioactivity will decay within a period of around three hundred years, during which time it is reasonable to assume that society will maintain some form of control over the disposal facility site, that will be aimed at preventing any inadvertent human intrusion into the waste disposed of at the site. The radiological impact of any intrusion beyond this period will not be high because of the radioactive decay of the radionuclides within the waste, hence the need for control over the site beyond such time becomes less important. Questions that need to be addressed in respect of near surface disposal facilities in terms of this approach are; Should the control in place after closure of an operational facility be the same as that during operation? When can control over a site be removed? What, if any control should remain in place in the longer term, i.e. beyond around three hundred years? The presentation addresses these issues and the basis for deciding on the nature and duration of control following closure of a near surface radioactive waste disposal facility. It will address the reducing level of hazard with time and the considerations that need to be given to the associated reduction in risk and the need for balanced judgements to be made concerning the nature and duration of control, in consultation with all relevant stakeholder at the time such decision are to be made.

(6) Management of Natural Occurring Radioactive Materials (NORM): A Canadian Perspective

John M. Takala

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Abstract–Naturally Occurring Radioactive Material (NORM) are present in low concentrations in most natural substances and they can become concentrated as a result of human activities and have diverse physical, chemical, and radiological properties. The processing of raw materials in resource industries such as uranium mining, phosphate fertilizer production, coal, oil, and gas industries, may increase the concentration of radionuclides such that specific measures need to be taken based upon the radiological properties of the material during its lifecycle from production to disposal. The radioactive elements of particular interest in NORM include the uranium and thorium decay series and ^{40}K. These radionuclides present a variety of potential radiological challenges including external gamma radiation and inhalation hazards from radon and long-lived alpha radionuclides. In addition, the diversity of sources of NORM mean they are associated with a wide range of products and situations, some with their own non-radiological hazards that also must be considered in potential protection strategies from an occupational and environmental perspective. In Canada, radioactive materials and activities associated with the nuclear fuel cycle, including uranium mining, are federally regulated, whereas most other activities associated with NORM fall under provincial regulation. The overall Canadian regulatory approach with NORM and their associated hazards and their practical application in terms of current practices will be reviewed. In terms of waste disposal, the wide range of physical and chemical properties of NORM materials dictate that a variety of approaches from engineered surface facilities to disposal in underground salt caverns are used.

(8) NEA initiative on Fukushima Daiichi waste management

H. Rindo[1, 2]

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Abstract–Following the accident at the Fukushima Daiichi nuclear power plant (NPP) in March 2011, different types of post-accident radioactive waste were generated. For example from on-site decontamination activities, there is the management of contaminated water, decommissioning of the four reactors and from the hydrogen explosions that occurred. Radioactive waste resulted from the accident has different properties when compared with waste generated by nuclear power plants operating under normal conditions. Specific management methods or strategies will therefore be needed to manage the post-accident waste. After the accident, the NEA Radioactive Waste Management Committee (RWMC) underlined the importance of including post-accident waste management and co-operation on decommissioning techniques for the Fukushima Daiichi NPP in the strategic areas of the NEA Programme of Work as it relates to radioactive waste management. In 2014, the RWMC established the Expert Group on Fukushima Waste Management and Decommissioning R&D (EGFWMD) with the primary aim of offering advice on the management of large quantities of Fukushima Daiichi on-site waste that has complex properties, and of sharing experiences with the international community and NEA member countries. The EGFWMD consisted of international experts who have gained experience in waste management, in radiological contamination or in decommissioning and waste management R&D after the Three Mile Island accident and the Chernobyl accident, and also Japanese experts from government organizations, research institutes and TEPCO who are involved in radioactive waste management generated in Fukushima Daiichi NPS. The EGFWMD focused on technical issues of waste management, such as radiological characterisation and categorisation of post-accident radioactive waste and contaminated materials, but also on social issues such as stakeholder engagement and interactions between regulator and implementer. The group published its final report in 2016 which provides advice on post-accident waste management, particularly to research and development (R&D) institutions in Japan on their overall strategy for managing the waste generated on-site by the accident. It also provides information on strategies to be implemented in case of an unplanned, unexpected accident in the future. The case studies in the report present substantial information on the history of accident site management and lessons learnt, leading to many potentially helpful recommendations. The report includes information on (i) state-of-the-art techniques and experiences with waste characterisation and classification, including application after major accidents, (ii) regulatory supervision: regulations, regulatory guidance and regulatory procedures (e.g. review of safety cases), and (iii) application of international recommendations, standards and guidance. Every accident is different. The post-accident (after emergency) scenario is unpredictable and often specific to the prevailing circumstances. Post accident waste management requires knowledge and information that are not within the usual experience of conventional utility and service management organisations. Managing decommissioning and radioactive waste after a major accident requires a different approach from those that are used in normal nuclear plant operations.

(9) Draft guideline of Japan Health Physics Society for waste management in existing exposure situations after a nuclear accident

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Abstract–There is a desire in existing exposure situations after a nuclear accident to reduce exposures to levels that are close to or similar to situations considered as normal. In the environmental remediation process, large amounts of contaminated wastes and substances including removed soils are accumulated as a result of decontamination activities. The management of radioactive waste must be an essential part of the remediation process and should be optimised under the framework of radiation protection to reduce the ambient dose in existing exposure situations since the generation of radioactive wastes is inevitable in decontamination. The Working Group on radioactive waste management under the Standardisation Committee in the Japan Health Physics Society (JHPS) recognises that we should develop a guideline of radiation protection for the management of radioactive waste in existing exposure situations for a practical, reasonable and sustainable environmental remediation. In existing exposure situations, intermediate reference levels, which are the source-related restriction to the dose that individuals may incur, can be adopted as a tool in the optimisation of radiation protection to reduce the existing ambient dose. The currently available radiation protection framework for radioactive waste management, however, had been developed only for planned exposure situations including introduction and operations of radioactive sources under a normal radiation dose level under which compliance with the dose limit of 1 mSv/y for public exposure is demonstrated. Therefore, the Working Group proposes a stepwise approach of radiation protection for the management of radioactive waste generated in the remediation process to reduce exposure under existing exposure situations. The presentation will provide a draft guideline; (1) a reference level for waste management should be selected from the dose band of 1 to around 10 mSv/y below the reference level for the existing ambient dose, and (2) the final target reference level for the disposal of the waste should be set at 1 mSv/y, under the relevant stakeholder involvement. We will also discuss the implication the stepwise approach through simplified case studies in typical situations after the Fukushima Daiichi nuclear accident.