International Experts Meeting "Radiation Protection after the Fukushima Daiichi Accident: Promoting Confidence and Understanding"

CHAIRPERSON'S SUMMARY

INTRODUCTION

This is the sixth International Experts Meeting organized under the IAEA Action Plan on Nuclear Safety. The purpose of the meeting is to provide an opportunity for experts to discuss the various radiation protection issues, that have been highlighted by the Fukushima accident and to consider how these should be addressed at both the national and international levels.

The importance of the subject matter, which addresses both technical issues and societal concerns, is underlined by the fact that the IEM has attracted over 200 participants from 69 Member States and 10 International Organizations. In addition, the organizers have used the meeting as an opportunity to involve as many young professionals as possible as part of the Agency's programme of capacity building.

It is important at the outset to put the scale of the Fukushima accident in context. We know that, as a result of the preceding earthquake and tsunami, up to 16,000 people lost their lives, over 6,000 were injured and close to 3,000 are still missing[1]. In addition, approximately 400,000 people were evacuated and a similar number of homes were destroyed. As reported during the meeting this week, some 113,000 people from 11 municipalities were evacuated by government order and a further 50,000 subsequently evacuated voluntarily. While in this meeting we are focusing specifically on the nuclear accident and its consequences, we must never forget that it was only one component of a much larger disaster that needed to be addressed by the Japanese authorities at the same time.

TECHNICAL ISSUES

Release of Radionuclides to the Environment

There is still some uncertainty about the source term from the Fukushima accident, but more accurate estimates have become available with time elapsed since the accident. The current estimates of the atmospheric releases of iodine-131 are of the order of 100-500 peta becquerels (PBq), while the releases of caesium-137 are within the range 6 to 20 PBq. The amount of caesium-134 released to the atmosphere was similar to that of caesium-137. Unlike the situation that followed the Chernobyl accident, there are also large discharges to the marine environment, representing of the order of 10% and 50% of the atmospheric discharges of iodine-131 and caesium-137 respectively. Marine discharges are still continuing but they are not large in terms of radioactivity levels.

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[1] National Police Agency of Japan http://www.npa.go.jp/archive/keibi/biki/index_e.htm

As of February 2014, the total discharges represent of the order of 10% of the discharges that took place following the Chernobyl accident. This figure may increase depending on the scale and duration of future discharges to the marine environment.

The committed effective dose over 50 years has been estimated using maximum deposition densities. This calculation shows that caesium-137 is the radionuclide of most radiological significance, representing about 73% of the committed effective dose, while caesium-134 represents an additional 26%. Because of its much shorter half-life, the significance of caesium-134 as a contributor to radiation dose diminishes relatively quickly with time and caesium-137 assumes a greater importance in percentage terms. Because of its short half-life, iodine-131 represents very much less than one percent of the committed effective dose.

(Conclusion) Early real-time sampling and personnel monitoring is important to improve the source term estimation and reduce the uncertainty in estimated values.

Transfer of Radionuclides in the Environment

Studies have been undertaken in several different environments and different behaviour of the deposited radio caesium has been observed.

In <u>undisturbed areas</u>, physical decay is the predominant mechanism in reducing external gamma dose rate. Some vertical migration also takes place, but horizontal migration of radio caesium is generally not observed. In <u>forest areas</u>, the radio caesium is generally retained and recycled within the ecosystem. However, vertical migration down the soil profile is also observed, and horizontal migration can take place due to water movement and landslides, depending on topography and the extent to which the area is disturbed. In <u>urban areas</u> and on surfaces such as roads, the radio caesium is easily removed and accumulates in nearby land. In such cases, the "decontamination factor" is considerably higher than that attributable only to physical decay.

Regarding the marine environment, large volumes of contaminated groundwater with low levels of radioactivity continue to be released from the reactor site into the sea. The principal radionuclides in the releases are tritium, strontium-90 and caesium-137.

(<u>Recommendation</u>) While the releases of tritium and strontium-90 to the marine environment are not expected to account for a large percentage of the collective dose or significant individual doses, their radiological impact should be documented and evaluated for public reassurance.

Health Effects

In addition to the studies carried out in Japan, both WHO and UNSCEAR have undertaken international assessments of the possible health consequences of the Fukushima accident. The estimates of doses received by the public in these studies and assessments are in good agreement, with the average individual effective dose being typically 1 mSv or less, and a range up to about 25 mSv.

The majority of workers at Fukushima Daiichi received individual doses below the national limit of 250 mSv for radiation workers engaging in emergency work, although six workers received higher doses. For these six workers, internal exposure was the dominant exposure pathway. Around 170 workers may have received doses above 100 mSv and 12 workers have been assessed with thyroid doses in the range of 2-12 Gy, primarily from iodine-131.

Three years after the accident, there have been no deaths caused directly by exposure to radiation due to the accident. As the system of radiation protection is based on the linear-no-threshold model, any radiation exposure, no matter how small, is considered to carry with it some degree of risk. For that reason, existing models attribute an increased risk of late effects (i.e. cancers) among the exposed populations. Because of the limitations of epidemiological studies in terms of the population size required to demonstrate an increased incidence of late effects and based on the available data, radiation doses received by residents and workers seem to be too low to detect any increase of late effects directly related to radiation exposure.

Following the Fukushima accident, exposures due to iodine-131 were minimized as a result of restrictions on the sale and consumption of milk and other food products likely to be contaminated. Consequently, most of the thyroid doses in the Fukushima Prefecture were as a result of inhalation. However, there is considerable variability of iodine-131 uptake among individual members of the public and considerable uncertainty in the estimated thyroid doses.

Thyroid screening studies in Japan using ultrasonography have shown that the incidence of thyroid nodules and cysts is broadly similar across the country and no increased incidence is evident in the exposed populations. One estimate presented at the meeting indicated a small increase in thyroid cancer of the order of 0.1% over the next 50 years has been predicted assuming an average dose to the thyroid of 20 mGy. The majority of these would be expected to be observed in future years, but may not be distinguishable from the background incidence.

While no direct health effects may be discernable, impacts on mental and social well-being such as depression and post-traumatic stress have been observed in the affected Japanese population. The fact that the psychosocial impact can outweigh direct radiological consequences was also observed after the Chernobyl accident.

(Conclusion) Because of the uncertainty in the currently available dose estimates, it is important that work continues both to better establish the range of individual doses received and also to determine if there are any identifiable health consequences in terms of late

effects, including non-cancer effects, in the exposed populations. The Fukushima Health Management Survey will be an important contributor to this work.

Foodstuffs and Drinking Water

Several important issues have been raised in respect of the control of foodstuffs and drinking water contaminated as a result of a radiological or nuclear accident. Currently many national and international standards exist in terms of activity concentration in specific foodstuffs, but these are not always consistent in terms of the permitted maximum concentrations, the terminology used and the circumstances to which the standards apply. This causes confusion for both national authorities and the public. This is a particular issue for developing States who may not have the necessary infrastructure to both establish, and monitor compliance with, national standards for radioactivity in foodstuffs.

The existence of different national standards has a direct impact on trade in that it may be difficult for States to export foodstuffs that exceed the values they apply nationally. If importing countries reduce activity concentrations in existing national standards to comply with those levels established by the exporting country, the public may feel that in the past they were not adequately protected. In areas which are seriously affected by radioactive contamination, the optimized strategy is normally to apply countermeasures. Continuing to grow food which cannot be sold generates large amounts of waste that needs to be managed, while discontinuing farming has a negative impact on the ecosystem. Both these latter options also have significant economic and societal costs and so it is preferable to maintain the lifestyle of farmers, fishermen and hunters. The production of bio-fuel and fibre crops is an option provided that there is a market for such products, and they are acceptable to the public.

(Conclusion) The relevant international organizations need to prioritize work to develop a harmonized approach to the control of foodstuffs and drinking water contaminated as a result of a nuclear or radiological accident. This needs to be simple to implement and take fully into account the issues that apply in the Accident State, other affected States and non-affected States. Similarly, guidance needs to be developed on the international trade in and the control of contaminated non-food commodities.

Remediation

Remediation of urban and rural environments has been necessary even though internal and external doses as a result of the Fukushima accident have been lower than expected. The various remediation technologies that were developed following the Chernobyl accident have, in general, been shown to be effective in responding to the Fukushima accident, although the degree of effectiveness has been influenced by local conditions.

However, the technical aspects are only one consideration. For remediation to be successful, proper attention needs to be given to societal factors affecting decision-making, including local priorities and knowledge. The affected populations need to be involved in the setting of remediation priorities and in assessing progress and effectiveness. Information, expertize, and resources should be available to support local communities.

Remediation involves not only clean-up of land and structures, but also reduction of doses by acting on pathways of exposure. In the recovery phase, both agricultural measures and well-informed individual behaviours play a key role in this.

Self-help actions by communities and individuals should be encouraged and supported through the promotion of radiation protection culture. Individuals and communities with the knowledge and skills to enable them to make informed choices and behave wisely will result in reduced individual doses as these depend heavily on individual behaviour. In addition, understanding of the situation and a sense of control will enhance confidence and therefore overall wellbeing.

Dose reduction is one of many factors influencing decision making in remediation. This is particularly true when individual doses are in the range of 1 to 20 mSv. Societal, environmental, and economic considerations must be taken seriously. Available resources must be spent wisely, and, actions taken to reduce doses may have negative environmental or other impacts. For this reason, all factors must be taken into account to ensure optimal decision-making.

In addition, many of the remediation programmes that have been implemented have high associated costs.

(Conclusion) The ultimate success of remediation programmes depends on the combined efforts of actions by the local authorities, affected communities, and individual citizens.

Social Media

When we compare the Chernobyl and Fukushima accidents, one very noticeable difference on the societal level is the availability of and access to information. We now have the Internet, social media has become one of the main sources of information exchange, especially among young people, and even crowdsourcing, defined as the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, is a fact of life in some countries. As we have heard during this meeting, the right to know and the right to understand have evolved into the right to participate. The public is no longer prepared to sit idly by if their needs are not being met – they simply go out and organize things themselves.

In the area of radiological protection, this brings new challenges, but also opportunities. In a world where there is no longer any limit on the number of “instant experts” who can convey very different and even contradictory messages to large groups of people over a very short time period, and where everybody can create news, there is a responsibility on government authorities and agencies to provide information in a timely manner and to disseminate it as widely as possible. The authorities also need to make themselves a trusted information source in advance of any incident or accident so that their views are sought and valued after an incident or accident has taken place.

But crowdsourcing, for example in the collection and dissemination of radiation data, can also help to instill confidence in information from official sources. But to continue to be effective, these public groups need to maintain their independence; to be seen to work too closely with the authorities will diminish their effectiveness, and consequently also their credibility, making them redundant. For government authorities and agencies, crowdsourcing certainly is the “genie that will not go back in the bottle”. It is necessary to accept that this technology is here to stay and that empowerment of the public is not necessarily a negative development.

(Conclusion) The development of social media brings challenges in terms of the increase in the sources and the amount of information, even contradictory information, that is available and the difficulty in identifying credible sources. This is a challenge for national authorities, but can also be used to their benefit as social media provides a much more efficient outlet for dissemination.

Risk Communication

Throughout the meeting we discussed the importance of communication, and specifically risk communication. Communication is necessary between experts, between government agencies, between experts and government agencies, and with the public. While risk communication is an accepted science-based discipline, it is nevertheless a discipline at which the radiation protection community is not particularly adept.

It is important to communicate with the public in their own terms using terminology they understand. In the case of emergencies, messages need to be clear and simple, supported with facts and figures, and should be set into the context to explain the data more clearly to the recipient audience. Thes messages need to be prepared in advance, and practiced. There is a large amount of work involved, but as a profession this is work that we need to prioritize. We need to understand that people need to know that we care before they care what we know.Very often, technical issues have a low priority in public decision-making and proper communication that takes societal concerns and values fully into account is important.

We need to provide a firm basis for communicating and promoting a better understanding of radiation risks and the System of Radiation Protection to all stakeholders and in particular the members of the public. In this respect we may well look to IRPA and the IRPA Associated Societies as the voice of the more than 18 000 radiation protection professionals in more than 60 countries. They are close to their communities and are therefore very well placed to become a trusted source of expertise for the wider community.

(Conclusion) The need for better communication falls on the radiation protection community as a whole. We need to dedicate resources to ensure we adequately inform decision-makers and the general public about radiation, radiation risks and the underlying philosophy and ethics of the System of Radiation Protection. If people don't understand our advice, it is unreasonable to expect them to implement.

System of Radiation Protection

We heard at the start of the meeting that the system of radiation protection stood up well to the very demanding "test" of Fukushima: No contradictory information was brought forward at the meeting and this confirms that the System has shown to be robust and tailored to the demand presented by such a major accident. However areas for improvement of the system have been identified and are currently being addressed by the ICRP.

One area for improvement relates to complexity. There is a widespread feeling that in recent years the System of Radiation Protection has become overly complicated even so that the professionals have difficulty in fully understanding it. Furthermore, we have reached the stage where there may well be too much focus on the numbers, and not enough on the philosophy underpinning those numbers. The application of the System of Radiation Protection cannot be effective unless it involves sound judgement based on strong ethical considerations accepted societal values.

A lot of effort has been put into application of the principle of justification to planned exposure situations; there is now a need for ICRP to further develop thinking on justification in emergency exposure situations and in existing exposure situations. The ICRP also needs to address the transition from an emergency exposure situation to an existing exposure situations.

(Recommendation) While the System of Radiation Protection is, generally, fit for purpose, it should be modified and improved in line with the lessons from the Fukushima accident.

Capacity Building

The IAEA has an important role to play in capacity building, and this International Experts Meeting provided an ideal opportunity to contribute to the knowledge and skills of young professionals. It is important to remember that the response to the Fukushima Daiichi accident will last over several years, even decades, and radiation protection expertise is one of the key skills required – the young experts of today will have to bear that responsibility and we in turn have a responsibility to help develop them as best we can. This is not just an issue for Japan as we need to learn and spread all the lessons learned in Fukushima across the profession and reflect them in international and national policies.

IRPA as the voice of the radiation protection professionals plays an important role in capacity building of young scientists. It is a priority for IRPA to support young practitioners and scientists in their work in radiation protection, in their education and training, and in their efforts to become members of the radiation protection community.

(Recommendation) All States should develop and implement a national strategy in relation to building and maintaining competence in radiation protection.

For the summary of the meeting the following suggested RECOMMENDATIONS for future IAEA activities have been identified.

(1) There are many examples of good coordination and cooperation between international organizations in responding to radiation protection issues from the Fukushima Daiichi accident. The IAEA should take the lead to firmly establish and build on these relationships at the organizational level.

(2) The IAEA should work with other international organizations to develop a harmonized approach to the control of foodstuffs and drinking water contaminated as a result of a nuclear or radiological emergency that addresses the needs of all States.

(3) The IAEA should work with other international organizations to develop guidance on the control of non-food commodities contaminated as a result of a nuclear or radiological emergency.

(4) Any nuclear or radiological emergency can impact even distant States, thus the authorities are expected to undertake reassurance monitoring, as a minimum. The IAEA should continue to support the development of radiation monitoring and measurement infrastructure in developing countries.

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