Findings from a workshop on the practical implementation of the new ICRP recommendations: a contribution of the NERIS Platform

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Abstract: In 2010, the NERIS Platform was established to combine organisations from operational, research and stakeholder communities involved in nuclear and radiological emergency response and recovery. By the end of February 2012, 43 organisations from 22 countries have joined the Platform, including national and local authorities, technical support organisations, professional organisations, research institutes, universities and non-governmental organisations.
One of the NERIS Platform working groups is focused on the practical implementation of the new ICRP recommendations: how they can be applied in the national context; and how they can be integrated into existing Decision Support Systems for emergency and recovery preparedness and management. To support this activity, the ICRP working group of the NERIS Platform organised an international workshop in Bratislava in February 2012. This Workshop provided a forum for discussion and sharing of experiences on the implementation of the ICRP Recommendations. International, European and national perspectives were presented on the protection of people in emergency exposure situations and those living in long-term contaminated areas after a nuclear accident or a radiation emergency. Furthermore, the workshop provided an opportunity to explore the methodological and computational aspects related to the practical introduction of these recommendations in the existing decision support tools used in European Countries.
The paper presents the main findings of the workshop with particular emphasis on the methodological aspects and computational tools that might be implemented into the decision support systems ARGOS and RODOS in the frame of the NERIS-TP project.

Key words: NERIS Platform, ICRP Recommendations, implementation, decision support

1 Introduction

The European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (NERIS Platform) was established in June 15, 2010 (Mustonen, in Duranova et al. 2012). The Mission of NERIS is to promote the involvement of different stakeholders and improve public confidence in capabilities of the key players in management of nuclear and radiological emergencies in Europe (Croteau et al., these proceedings). The NERIS Platform encourages European, national, regional and local authorities, technical support organisations, operators, professional organisations, research institutes, universities, non-governmental organisations, and national and local stakeholders to co-operate in emergency management, and to facilitate access to expertise and technology in maintaining competence in the field of nuclear and radiological emergency management. The NERIS Platform has, in March 2012, 43 member organisations. A Strategic Research Agenda (SRA) will provide the basis for priorities of future research and development in order to achieve the Vision.

One of the NERIS Platform working groups is focused on the practical implementation of the new ICRP recommendations: how they can be applied in the national context; and how they can be integrated into existing Decision Support Systems for emergency and recovery preparedness and management. This challenge is also tackled with a European research project, NERIS-TP. To support this activity, the ICRP working group of the NERIS Platform held an international workshop in Bratislava, Slovak republic in February 2012, entitled "Preparedness for Nuclear and Radiological Emergency Response and Recovery: Implementation of the ICRP Recommendations organised by VUJE in cooperation with ICRP. 88 persons from 26 different countries participated.

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The Workshop provided a forum for discussion and sharing of experiences on the implementation of the ICRP Recommendations. The international, European and national perspectives were presented. Facilitated discussions were devoted to specific issues related to both the application of ICRP recommendations and methodological aspects of decision support tools. Topical break-out groups focused on how decision aiding tools may support the decision making process and gave insights into development and implementation of protection strategies.

The topics for the four parallel break-out group sessions were:

Topic 1: Regulatory challenges in the preparation for an emergency and how simulation models may support this

Topic 2: Challenges in the practical implementation of countermeasure strategies and their optimisation during an emergency and how simulation models can support this

Topic 3: Challenges in the practical implementation of countermeasure strategies and their optimisation in existing exposure situations and how decision aiding tools can support this

Topic 4: Societal and communication issues and how decision aiding tools might support this.

Following a short summary of some of the main presentations, the main findings of the workshop and breakout session will be are presented in detail.

2 ICRP Recommendations and their implementation

In 2007, the new ICRP Recommendations (ICRP-103, 2007) on radiation protection principles were issued presenting a distinct evolution of those issued more than 10 years earlier (ICRP-60, 1990). These recommendations play an important role as they influence national, European or even international standards that will become national or international law at one point in time (Raskob, in Duranova et al. 2012). Earlier guidance for the protection of the public in the event of a nuclear accident (ICRP-63, 1992) categorized accidents in three sequential stages: pre-release, release and post-release. All earlier publications have given general principles for planning protective actions mainly during the early and intermediate phase of a nuclear accident.

The main evolution from ICRP 60 to ICRP 103 can be presented as follows (Lochard, in Duranova et al. 2012):

- No more distinction between practices and interventions. The two concepts are replaced by three generic exposure situations, which cover all conceivable exposure situations:
    - planned exposure situations (identical to practices),
    - emergency exposure situations,
    - existing exposure situations;
- The principles of justification and optimization apply to all three exposure situations;
- Dose limits apply only to planned exposure situations;
- Boundaries exist for optimization as either dose constraints or reference levels;
- The concepts of action levels and intervention levels are abandoned.

According to the characteristics of the exposure situation, including the degree of controllability of the radiation sources, the ICRP recommends a dose scale (corresponding de facto to a risk scale) with three bands: 0 to 1 mSv/yr, 1 to 20 mSv/yr and 20 to 100 mSv/yr, in order to select dose constraints and reference levels.

For the protection of the public in case of a nuclear accident the ICRP recommends to select reference levels:

- in the 20–100 mSv/yr band for emergency exposure situations,
- in the lower part of the 1–20 mSv/yr for existing exposure situations, with the objective of reducing exposure below 1 mSv/yr in the long term,
- values of reference levels and timeframe will vary from place to place depending on the local circumstances.

The key issue is the transition from emergency exposure situation to existing exposure situation. ICRP Publications 109 (ICRP-109, 2009) and 111(ICRP-111, 2009) propose a flexible framework for guiding actions in case of a nuclear accident or a radiological emergency.

The key guidance is to:

- avoid doses above 100 mSv,
- reduce exposure (ALARA) all the time,

- engage affected people in the management of the situation,
- develop radiation protection culture among the affected people,
- adopt 1 mSv/year as a long term objective.

The radiation protection issues and experiences of the Japanese Earthquake and Fukushima Daiichi nuclear accident were presented at workshop and showed that ICRP Recommendations 103, 109 and 111 were all helpful in implementing emergency protective actions (Homma, in Duranova et al. 2012). A general lesson learned from the Fukushima accident was the implicit assumption that such severe accidents could not happen and thus insufficient attention had been paid to preparedness for such accidents by operators and authorities. Consistent policies and criteria for implementation of urgent and long-term measures, including return to normality, need to be established in the preparedness process, even for emergencies with low probability. Arrangements for taking precautionary urgent protective actions before a release need to be established on the basis of plant conditions. International guidance should be developed for the application of operational criteria during the emergency response phase. Practical recommendations, with internationally harmonized criteria, are needed for control of contaminated foodstuffs and water.

An ICRP Main Commission Task Group 84 has been established on Initial lessons from the NPP Accident in Japan (ICRP TG84, 2011). The ICRP TG84 is expected to compile lessons learned related to the efforts carried out to protect people against radiation exposure during and after the emergency exposure situation and, in light of these lessons, to consider *ad hoc* recommendations to strengthen the ICRP system of radiological protection for dealing with this type of exposure. Additional efforts are being considered, including facilitating the transfer of experience from communities affected by the Chernobyl accident in Europe. The organization of ICRP missions to the affected territories close to Chernobyl, and to the area around the Fukushima Daiichi nuclear power plant are one step of the whole process.

2.1 Application of ICRP recommendations by International institutions

The European Union Basic Safety Standards will consolidate all existing Directives and thus broaden the scope to all exposure situations and categories of exposure, including the protection of the environment (Janssens, in Duranova et al. 2012). This new text follows the situation-based approach recommended by ICRP (Publication 103). The requirements for emergency preparedness have been worked out in more detail, and the use of reference levels for emergency response is highlighted. The accident in Fukushima prompted reflection on the Euratom legal framework, including the Basic Safety Standards, the arrangements for the early exchange of information (ECURIE) and legislation on the nuclear safety of nuclear installations. With regard to the legislation on maximum permitted levels in food, there will be further reflection on the consistency between the controls in place after Chernobyl and after Fukushima, as well as their consistency with the values for the placing on the market of food and feed in the EU in the event of a future accident.

An interim edition of the International Atomic Emergency Agency (IAEA) Safety Requirements document: "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards" (the revised BSS) was published in November 2011 (IAEA, 2011). The revision of the BSS was coordinated by a BSS Secretariat consisting of representatives of the IAEA, FAO, EC, ILO, UNEP, PAHO, WHO and NEA/OECD. The BSS takes into account the Fundamental Safety Principles (IAEA, 2006), the findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the 2007 recommendations of the ICRP (ICRP, 2007) and other applicable ICRP statements and publications (Boal, in Duranova et al. 2012). The Incident and Emergency Centre (IEC) of the IAEA is the global focal point for preparedness and response to nuclear and radiological incidents and emergencies irrespective of their cause (Buglova, in Duranova et al. 2012). In the area of preparedness the Centre continuously works to develop standards and guidance for strengthening Member States' preparedness; practical tools and training programs to assist Member States in promptly applying the standards and guidance; and organizes a variety of training events and exercises.

The Expert Group on Implementation of New International Recommendations for Emergency Exposure Situations (EGIRES) has been mandated by the Committee of Radiation Protection and Public Health (CRPPH) to investigate issues in, and approaches to, the implementation of the new ICRP recommendations and revised Basic Safety Standards of the IAEA. The expected output of the expert group is to prepare a report on issues in 2012 (Milligan, Okyar, in Duranova et al. 2012).

World Nuclear Association (WNA) representatives (Saint-Pierre, 2012) pointed out, that Fukushima has taught us that radiological protection (RP) for emergency and post-emergency can be much more than a simple evacuation lasting 24 to 48 hours with people safely returning to their homes shortly afterward. On optimization of emergency and post-emergency exposures, the only 'show in town' in terms of international RP policies improvements has been the issuance of the ICRP's new general recommendations. However, no matter how genuine these improvements were, they have not been "road tested" to the practical reality of severe accidents.

3 Challenges in the practical implementation

3.1 Methodological aspects and updates of computational models

The "reference level" proposed for emergency and existing controllable exposure situations, represents the level of dose or risk, above which it is judged to be inappropriate to plan to allow exposures to occur, and for which therefore protective actions should be planned and optimised. All exposure pathways and all relevant protective actions have to be considered when deciding on the optimum course of action to be taken. Protective strategy means a set of relevant protective actions. A consequence, the reference level concept requires an integrated treatment of all exposure pathways for accidental and existing exposure situations, thus differs considerably from the existing concept of single exposure pathways resulting in actions such as sheltering, evacuation and distribution of stable iodine tablets (Raskob, in Duranova et al. 2012). The reference level and the integrated management approach results in a new target for the preplanning and optimisation that is called "residual dose" after a certain time period, typically defined as one year. This value can be seen as the target for any management strategy. None of the existing models can deal with these new recommendations.

All European member states use intervention criteria for individual countermeasures. This is reflected in the mathematical models implemented in modern Decision Support Systems such as ARGOS (Hoe *et al*, 2002) and RODOS/JRODOS (Raskob, 2010). Further to this, at present, the approaches used in Europe for the definition of the intervention limit differ from country to country. The most serious difference is the usage of the projected dose or the averted dose. The latter one is in line with the "old" ICRP recommendations whereas the projected dose reflects the new recommendations. For example the 23 countries represented in the RODOS system use both the averted dose (14 countries) and the projected dose (9 countries).

The planned extension of the two European Decision Support Systems JRodos (Ievdin *et al*, 2010) and ARGOS (Hoe *et al*, 2002) with respect to the new ICRP-103 (ICRP, 2007) recommendations should be applicable for nuclear accidents and radiological emergencies and comprise a new screening model for countermeasure strategies and the possibility to optimise dose reducing actions with the models ERMIN (Charnock, 2010) and AGRICP (Gering *et al*, 2010), respectively, and scenario preparation tools to support the user in defining countermeasure strategies.

The screening model (Landman *et al*, 2012a) takes into account all terrestrial exposure pathways, including ingestion, and considers sheltering, evacuation, relocation, food restrictions, and the use of iodine tablets for thyroid blocking, for reducing or avoiding doses. The screening goal is the identification of action strategies that limit the total effective equivalent dose, received from all pathways over a given time period, the "criterion dose", below a given reference revel.

As part of the ongoing European project NERIS-TP, a revision has been made of some parameters influencing dose estimates in the European emergency management decision support systems RODOS and ARGOS. On the basis of measurements, new values for the natural ventilation rate governing early ingression of contaminants into dwellings have been derived for different parts of Europe as well as other potential parameterisation improvements (e.g. physicochemical forms of contaminants) for the decision support systems (Andersson, in Duranova et al. 2012).

The question of the contribution of collective dose to optimisation of protection strategy has been discussed (Camps, in Duranova et al. 2012). Based on studying three nuclear/radiological accident scenarios it was found that the use of collective dose in combination with the (reference levels of the) individual dose as defined in the 2007 ICRP recommendations can be a useful tool in the preparedness as well as response phase of a nuclear/radiological accident. Especially plotting the collective dose as a function of the minimum individual effective dose or calculating the collective dose for specific

values of minimum individual doses can give insight in collective exposure and can support decisions related to the overall protection strategy.

3.2 Case studies in National experiences

The approaches to implementation of ICRP Recommendations and national experiences were presented and discussed.

In Germany, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has asked the German Commission on Radiological Protection (SSK) to provide advice on the revision of the German "Radiological Fundamentals for Decisions on Measures for the Protection of the Population against Accidental Releases of Radionuclides" (Radiologische Grundlagen). A working group has been established to guide the preparation of a new version of that document (Raskob, in Duranova et al. 2012). Within the discussion it turned out that the practical application of the new recommendation for professionals working in the operational community is extremely important. As the current recommendations are widely accepted and operational all over Germany, it was investigated to which extent the current procedures can be taken over with minor modifications. Therefore, calculations were issued to check whether the residual dose of 100 mSv in the first year would be exceeded when – formally – the existing intervention criteria for sheltering, evacuation and relocation would be applied. In most of the calculations performed, the application of the individual measures assured that the one year dose stays below 100 mSv. However in 2 out of 10 cases, the residual dose limit was exceeded. The main explanation seems to be the nuclide vector of the two releases which was very different to those which have been used to generate the intervention criteria in Germany. This also questions the possible approach to continue using single countermeasures to satisfy the ICRP 103 approach.

Radiation and Nuclear Safety Authority (STUK) has drafted proposals for new guides (STUK, 2011) for intervention levels in different phases of an emergency to be adopted by the Ministry of Interior (MoI) in Finland. These guides are written separately for early phase and intermediate phase of a radiological emergency. STUK selected 20 mSv effective residual dose from all exposure pathways during the first year of an emergency as the reference level. This overall goal has been supplemented with the following general guidance; if a projected dose without protective measures is during the first year:

- higher than 10 mSv, it is necessary to perform protective measures; radiation expose is dominant in decision making,
- 1 – 10 mSv, protective measures are usually justified but other factors effect decision making,
- below 1 mSv, the protective measures may be carried out especially if they are easily feasible; other factors are dominant in decision making.

More specific criteria are given for separate countermeasures as a projected dose in a certain time period or as an operational intervention level (OIL) in a quantity which can be directly measured (external dose rate, magnitude of surface contamination, concentration level) or as a trigger (such as plant conditions).

Health Protection Agency (HPA) is updating and consolidating UK Emergency and Recovery advice following changes in International Guidance (Nisbet et al., these proceedings). Current advice was published in 1997. The revised advice will consider the initiation of emergency countermeasures based on averted dose criteria and optimisation of the subsequent protection strategy based on reference levels of residual dose. The advice illustrates that the type of protection strategy selected depends on the contribution of different exposure pathways over time to projected dose, and this will vary according to the scenarios considered as reasonably foreseeable. Due to the potential impact of the advice, a wide range of stakeholders are being consulted. In particular, feedback will be required on the potential for adapting current practices for sheltering and stable iodine prophylaxis to situations involving longer duration releases or those with a prolonged threat phase. The advice document will contain guidance for emergency planning and response, criteria for the withdrawal of emergency countermeasures, factors to consider during the transition to an existing exposure situation and the management of long term contaminated areas. It is the first time that the whole spectrum of advice will be presented in a single publication, which is expected to be published in 2013, following a public consultation process.

3.3 Challenges in the practical implementation - facilitated discussions outcomes

Topic 1: Regulatory challenges in the preparation for an emergency and how simulation models may support this (Mustonen, in Duranova et al. 2012)

During the Fukushima accident it was difficult to get reliable information and data from Japan and also from authorities of different European countries. There were European citizens in Japan during the accident and all European countries wanted to protect them according to the best knowledge they had. Authorities received information from IAEA but that information was always delayed due to different reasons. The protective actions taken by European and other countries were done more or less independently, which might have caused some confusion among foreigners in Japan. The retrospective international investigations should give a real view on that. Especially actions to evacuate foreigners from the neighbourhood of the Fukushima Dai-ichi power plants and from Japan, to distribute and advice people to take iodine tablets in Japan, and to monitor passengers returning from Japan are important issues. All actions taken by foreign authorities should have been based on realistic simulation of the prevailing and predicted radiation situation. To be able to make such simulations, experts in different countries need to have realistic estimations on source terms and data of weather conditions. If these initial data are missing or if they are not consistent, bases for decisions in different countries will diverse, resulting inconsistent decisions. Therefore it is important that simulations in different countries are based on reliable data.

Questions for discussion in this topic were following:

1. Are the present information exchange systems (ECURIE, EURDEP, etc.) enough for today's European conditions? (Fukushima and I-131 release in Budapest as examples)
2. How could we improve European coherence of national decisions in a nuclear or radiological emergency having radiological impact in several countries?
3. Do we need a joint European data base for various radiological and meteorological parameters to be used by national experts in different European countries?
4. Do we need a joint European data base for decisions taken by different countries including bases for the decisions?
5. Do we need a new European ordinance presuming national authorities to use such kind of data bases?

The topic has been discussed from an authority point of view. The Fukushima accident as well as the presented exercise scenario (Landman, in Duranova et al. 2012) were addressed in the discussion.

Topic 2: Challenges in the practical implementation of countermeasure strategies and their optimisation during an emergency and how simulation models can support this (Raskob, in Duranova et al. 2012)

With the ICRP recommendations 103, 109 and 111, new concepts and quantities have been introduced into emergency management and rehabilitation. Two of them will possibly influence national procedures, but for sure they will influence countermeasure simulation approaches:

1. The concept of a "reference level" for emergency and existing controllable exposure situations that represents the level of dose or risk, above which it is judged to be inappropriate to plan to allow exposures to occur, and for which therefore protective actions should be planned and optimised.
2. When deciding on the optimum course of protective actions, all exposure pathways and all relevant actions have to be taken into account.

The major changes for the simulation models result from the second recommendation that all exposure pathways must be considered when deciding on protective actions. Up to now all countermeasure simulations in the early phase of an emergency are carried out by considering individual countermeasures such as sheltering or evacuation, if a dose limit for the respective action is exceeded. This approach has to be revised and strategies of countermeasure combinations analysed and simulated with the ultimate goal in mind not to exceed the reference level over a given time period, typically one year.

In modifying existing simulation tools, the following questions may need to be answered:

1. Is the "residual dose" the right target for decision making?
2. Should the new models support the use of operational intervention levels (OILs) and emergency action levels (EALs) as trigger levels for initiating a countermeasure strategy?

3. Is there a possibility to stay with the individual intervention levels but optimise them in advance that they fit to the reference level?
4. Is there a need to have more than one reference level, dependent on the threat?
5. How to define the dose criteria for the lifting of measures?
6. Is the dose from food part of the simulation strategy or should a dose from food consumption of 5-10 mSv be assumed as maximum related to the current maximum concentration levels defined after Chernobyl in food?

The discussion focused on the usage of tools in the various phases of an emergency, having a clear distinction between the preparedness and the response phase. There was little discussion about the technical content of the proposed new screening tool; the reason was that the content of the proposed tool was not known to several members of the audience and there was not enough time to discuss this in detail. The discussion focused on the experience from the Japanese case, where most decisions were based on the plant status – in the early phase and monitoring in the later phase. Concern was raised that simulation models might be only suitable to support decisions on the time frame of days but not months and years. In the emergency phase the group felt that information on the plant status and from monitoring is important to verify simulation models. On the other hand the group favoured the use of simulation models in the preparedness phase as an input for the implementation of strategies.

Topic 3: Challenges in the practical implementation of countermeasure strategies and their optimisation in existing exposure situations and how decision aiding tools can support this (Nisbet, in Duranova et al. 2012)

Following the accident at the Chernobyl Nuclear Power Plant in 1986, the Soviet government chose long term evacuation/relocation over extensive decontamination measures. In marked contrast, the Japanese government has recently embarked on a decontamination effort of unprecedented scale, following the accident at the Fukushima Daiichi Nuclear Power Plant in 2011. These two situations clearly represent extreme responses to significant and long term contamination in the environment that has impacted on food production systems, inhabited areas and the countryside and forests, used for recreation and gathering foods from the wild. This prompts the following key questions about the practical implementation of countermeasure strategies in existing exposure situations and tools that could be used to assist decision makers in managing these politically sensitive and emotive issues.

- How clean is clean?
- Do we have the necessary tools for managing existing exposure situations?
- How can decision-aiding tools in particular, be used in existing exposure situations?

The group agreed, that ‘How clean is clean’ depends on a range of factors including: the scale of the contaminated area; political factors; source of the contamination i.e. accident or malicious event; trust in the authorities; whether preparedness, awareness and information exchange are well developed; understanding of the balance between radiological and non-radiological risks by the population; stakeholder involvement in the decision making process; availability of places for dialogue at the local level; prioritisation of needs in the local context, including different clean up standards on a case by case basis. The successes from Japan in the existing exposure situation after an accident has been influenced and supported by the existence of the culture of re-building following natural disasters, local initiatives and networks for decontamination activities, availability of tools such as technical approaches and monitoring equipment and social networking.

Regarding the availability of right tools the answer was ‘Yes”, as there are such products as AGRICP (Food production) and ERMIN (inhabited areas), MOIRA (hydrology modelling tool), EURANOS Recovery Handbooks (Food production; inhabited areas), SAGE Handbook and CODIRPA which provide support for the development and maintenance of RP Culture. But all tools need revising post Fukushima accident.

The decision aiding tools can be used to assess the overall evolution of residual dose, they help identify exposure pathways and points to intervene, they enable elimination of options and provide an audit trail of decisions. The limitations are, that they do not include uncertainties, may not be able to distinguish between similar sets of options on the basis of residual dose, and they are unsuitable for malicious acts because of different source terms, particle size, deposition velocity and physico-chemical parameters.

Topic 4: Societal and communication issues and how decision aiding tools might support this (Oughton, in Duranova et al. 2012)

The Fukushima accident highlighted a number of challenges linked to communication and stakeholder relationships, as well as a variety of social, cultural and economic concerns. These include examples of contradictory information, especially European/USA vs. Japanese: advice to evacuate, distance at which to evacuate, confusion of food export/import regulations, etc. While the use of models was appreciated, predictions were challenged by stakeholders. The accident demonstrated the diversity of actors involved in the situation, and the complicated relationships. These include diversities both within and between countries (e.g., Japan, Europe, rest of the world), as well as important cultural differences. Contamination of goods and food products raised particular challenges related to consumer trust, economic consequences and producer requirements. While linked to general issues related to the setting of values and criteria, the different demands and concerns of producers, traders and consumers – and requirement for rapid decisions, underlined the complexity and multidimensional aspects.

The accident also demonstrated the huge requirement for information from many actors including journalists, authorities, governments and the public. There was a particular demand for data on who was affected, for measurements of persons and products, and independent assessments from different actors. There was a focus particularly in western media on the radiological risks, often at the expense of the much larger direct impacts of the earthquake and tsunami. Finally the use of social media and internet offered new challenges as well as new opportunities.

Questions raised:

1. While some of the social and political challenges were similar to those seen after Chernobyl, what were the most important differences?
2. How can we improve the definition of stakeholders and the framing of the problems, recognising the complexity of the stakeholder networks and relationships?
3. The issue of trade of goods and foodstuffs from contaminated territories clearly illustrates the interaction of technical, management, as well as social concerns. If consumers lose trust in a product this can have serious economic consequences. How might stakeholder and communication processes support the improvement of strategies to address this issue?
4. In Japan, the citizens started to carry out their own decontamination. How can this be addressed in management strategies?
5. What opportunities are there for exploitation of social media and networking within emergency preparedness? How to best approach the issue of contradictory information?

The overarching aims of the breakout group was to have a focused discussion on the stakeholder and communication dimensions of the challenges, with the aim of highlighting those issues of most relevance to the ICRP recommendations, and to provide input on how these may be best addressed in decision support tools.

The group recognised some general challenges recognized in communication and information such as: differences between Fukushima and Chernobyl in the amount and availability of information, as well as the trust in authorities; the basic need for information, at all stages of the accident; challenges in communication of difficult and complex issues (mSv/mGy/Bq); the time needed to deal with false rumours and contradictory information, especially language barriers. A range if different stakeholders were recognized such as public, affected persons, physicians and health workers (and other professionals or their representatives), journalists (of which not all sensationalists – many want to give a balanced report), and experts (the complaints of lack of information tended to come from experts rather than public). Social media as an communication media was recognised such as: Twitter and Facebook and well as blogs and commentary pages on mass media newspaper websites.

Concrete recommendations for communication included

- Listen – take time to learn what people want to know; to understand the questions they have; and to learn what they already know;
- Build up networks during ”peace time”, for example with science journalists or through stakeholder dialogue which provide opportunities to listen and learn.;
- Be sensitive to both harmonization and pluralism;

Finally different challenges in the different stages of accident situation were identified. These included differences in actual emergency and emergency preparedness; as well as differences in situations requiring basic knowledge and facts and situations those where people want concrete advice

on actions. On this basis, three directions of advice were derived, related to the preparedness, emergency and post emergency situations (see conclusions).

4 Conclusions

The first NERIS Workshop initiated a large momentum in bringing together a wide community of participants to discuss openly the ICRP recommendations, and challenges, experiences and views with regard to their practical implementation. It facilitated access to expertise and technology and helped to maintain competence in the field of management of nuclear and radiological emergencies for the benefit of European countries and citizens, as well as non European countries.

The discussions reflected the current thinking with the experience of using individual measures since more than 20 years, and decision support tools that can support these actions. The ARGOS and RODOS consortiums will continue developing new advanced tools, informing the NERIS partners about their ideas and using the feedback received. Key challenges for the new models are to:

- Include all exposure pathways in a consistent way in one simulation model
- Provide a flexibility that allows assessing different potential threat scenarios to derive OILs and EALs.
- Provide a methodological approach and guidance to optimise late phase countermeasures such as decontamination and ingestion
- Not lose usability of the new models due to a more comprehensive modelling

All tools need revising post Fukushima accident. There is need to develop additional 'simple' tools and applications for I-Phone, identify new training programmes (e.g. for decontamination teams), to engage stakeholders for dialogue. More information is needed on long term behaviour of many radionuclides. The inadequate calibration of monitoring equipment (aerial surveys) leading to bad management decisions has to be improved.

The NERIS activities will continue in the investigation in the area of social media after Fukushima with plans to include radiation protection and authorities communication departments, and to organise a session at the next NERIS platform workshop.

NERIS Platform will build on the ICRP dialogue initiative, invite Japanese colleagues and stakeholders to share their experience at the NERIS workshop.

Concrete actions were proposed for putting into practice regarding the new ICRP approach regarding social challenges and stakeholder engagement. These cover three directions:

- **Preparedness:** develop input to models and scenarios. Simple scenarios are needed that can be used in dialogues to identify areas of vulnerability and general "social" challenges, as well as foster dialogue between local actors.
- **Emergency:** development of tools and information on self-help actions (e.g., measurements, decontamination), as well as criteria for evaluation of stakeholder engagement
- **Post emergency and existing situations:** use Fukushima (and other accidents/situations) to characterise and analyse the human dimension of the emergency situation. Reduce the gap between local and affected populations and authorities.

The NERIS Platform will continue to encourage European, national, regional and local authorities, technical support organisations, operators, professional organisations, research institutes, universities, non-governmental organisations, and any relevant stakeholder to co-operate to achieve the vision.

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