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Preparedness for Post-Accident Recovery: Lessons from Experience

Workshop Summary Report
Tokyo, Japan
18–19 February 2020

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The mission of the NEA is:

– to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally sound and economical use of nuclear energy for peaceful purposes;
– to provide authoritative assessments and to forge common understandings on key issues as input to government decisions on nuclear energy policy and to broader OECD analyses in areas such as energy and the sustainable development of low-carbon economies.

Specific areas of competence of the NEA include the safety and regulation of nuclear activities, radioactive waste management and decommissioning, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

Foreword

After the Fukushima Daiichi Nuclear Power Plant accident in 2011, the Nuclear Energy Agency (NEA) Committee on Radiological Protection and Public Health (CRPPH) started activities focusing on several important brainstorming analyses covering all the phases of a nuclear accident (i.e. preparedness, response, transition and recovery) with an important cross-cutting focus on stakeholder engagement.

Recommendations and guidance based on the first lessons learnt from the Fukushima Daiichi Nuclear Power Plant accident, and from the Chernobyl accident, where appropriate, were elaborated on the basis of various key activities:

- sharing actions taken by NEA member countries during the early phase in order to cope with the consequences of the accident;
- designing and implementing the INEX-5 preparedness and early response exercise (part of the ongoing NEA International Nuclear Emergency Exercise [INEX] series), to test the value of the changes implemented after the Fukushima Daiichi Nuclear Power Plant accident by member countries to enhance their capabilities of facing a large nuclear accident;
- setting up a dedicated expert group to follow the decisions taken in the intermediate and long-term phases;
- elaborating on a food management framework discussed at the international level;
- participating and learning from the International Commission on Radiological Protection (ICRP) dialogue initiatives in the Fukushima Prefecture.

More specifically, the area of post-accident recovery management has also been of interest within the Committee on Radiological Protection and Public Health (CRPPH) for some time. It has been considered as a complex multidisciplinary process of multi-sectoral dimensions, with a need expressed by NEA member countries to improve recovery preparedness. To explore this further, in 2018 the CRPPH decided to set up a dedicated expert group, the Expert Group on Recovery Management (EGRM), which was officially created in early 2019. The objectives of the EGRM are to assist NEA member countries in planning and improving their recovery preparedness by producing guidance on how to develop a nuclear or radiological post-accident recovery management framework that can be adapted to national conditions. Capturing lessons learnt from the Fukushima Daiichi Nuclear Power Plant accident is of high added value to achieve this goal, although moving from a specific context to a generic one is difficult. This workshop provided a timely opportunity to engage in the in-depth brainstorming necessary for such a task.

Together with the Japanese Nuclear Regulation Authority, the Nuclear Energy Agency decided to organise the workshop on “Preparedness for Post-Accident Recovery Process: Lessons from Experience”, on 18-19 February 2020, at the University of Tokyo, Japan. Eighty-five participants attended the event, with 75% from various organisations or associations in Japan, governmental or non-governmental, national or local, from the private or the public sector, and from the nuclear or the non-nuclear sector. The remaining

25% were experts from outside of Japan, strongly involved in the topic of the post-accident recovery process in their country or at the level of international organisations.

The objective of the workshop was to provide an opportunity to discuss major elements at stake (e.g. food safety, monitoring, waste management, business and well-being) for the structuring of a nuclear post-accident recovery management framework for improving preparedness. This event made possible many interactions with Japanese governmental organisations and non-governmental stakeholders to discuss and analyse successes and remaining challenges in the recovery process, nine years after the accident. For example, lessons drawn from experience tackle key cross-cutting issues such as how to balance radiological, environmental and psychosocial effects of protective decisions, how to efficiently and effectively involve stakeholders, how to improve communication processes, how to revitalise the economic situation, etc.

This report summarises the highlights of the presentations and discussions. It attempts to capture the lessons generated from the various initiatives presented and offers a preliminary discussion about their usefulness for recovery preparedness.

Acknowledgements

This report was prepared by the Secretariat of the OECD Nuclear Energy Agency (NEA) Expert Group on Recovery Management (EGRM) held under the Committee on Radiological Protection and Public Health (CRPPH), with the help of the Nuclear Regulation Authority (NRA) in Japan.

The workshop was operated collectively by the NRA, the NEA and all members of the EGRM chaired by Dr Thierry Schneider from the French Nuclear Protection Evaluation Center (Centre d'étude sur l'Évaluation de la Protection dans le domaine Nucléaire, France), and co-chaired by Mr Homma (NRA, Japan) and Ms DeCair (Environmental Protection Agency, United States).

The NEA and CRPPH EGRM would like to address special thanks to Commissioner Nobuhiko Ban (NRA, Japan), NEA Director-General William D. Magwood, IV, and NEA Deputy Director-General Nobuhiro Muroya, for opening the workshop and setting the scene of the recovery from the Fukushima Daiichi Nuclear Power Plant accident.

This workshop benefited from the assistance and the professional logistical support of the Nuclear Safety Research Association in Japan.

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AIST	National Institute of Advanced Industrial Science and Technology (Japan)
CAA	Consumer Affairs Agency (Japan)
CEPN	Centre d'étude sur l'Évaluation de la Protection dans le domaine Nucléaire (Nuclear Protection Evaluation Centre, France)
CRPPH	Committee on Radiological Protection and Public Health (NEA)
DRZ	Difficult-to-return zone
DSA	Radiation and Nuclear Safety Authority (Norway)
EGNR	Expert Group on Non-radiological public health Aspects of Radiation Emergency Planning and Response (NEA)
EGRM	Expert Group on Recovery Management (NEA)
FMC	Futaba Medical Center (Japan)
FY	Fiscal year
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ICSA	Intensive Contamination Survey Area
IRSN	Institut de Radioprotection et de Sûreté Nucléaire (Institute for Radiological Protection and Nuclear Safety, France)
ISF	Interim storage facility
JAEA	Japan Atomic Energy Agency
MHPS / MHPSS	Mental Health and Psychosocial (Support)
MOE	Ministry of the Environment (Japan)
NRA	Nuclear Regulation Authority (Japan)
SDA	Special decontamination area
TSS	Temporary storage site
WHO	World Health Organization

Executive summary

Nuclear accidents such as those that occurred at the Chernobyl and Fukushima Daiichi Nuclear Power Plants cause major changes that are accident-, environment- and land-specific, and continue to evolve in space and time. These changes impact the lives of a large number of residents of the affected territories by modifying the environment and disrupting the socio-economic fabric of the society, making recovery management an extremely complex, multidisciplinary process. A key aspect that has been identified to improve this recovery process by the Nuclear Energy Agency Committee of Radiological Protection and Public Health (CRPPH) is to advance recovery preparedness, focusing on a holistic multidimensional approach, that will incorporate functional cross-sectoral links between various aspects of emergency impact on a society (e.g. health, environment, economic, social and cultural aspects). This is the challenge that was taken up by the CRPPH Expert Group on Recovery Management (EGRM) in early 2019.

Among the many topical issues at stake for the recovery, the workshop addressed five major themes: radiological monitoring and dose assessment; food safety management; environmental decontamination and waste management; business continuity; and the well-being of affected people and communities. The overall objective of the workshop was to provide an opportunity to discuss those elements at stake with the perspective of using the lessons learnt to help the elaboration of a framework for nuclear post-accident recovery preparedness. Interactions with Japanese governmental organisations and non-governmental stakeholders allowed participants to understand and analyse successes and remaining challenges in the recovery process in Japan. Various initiatives taken to prepare or implement the recovery process were presented and stimulated rich exchanges throughout the audience, thanks to the diverse profiles of participants representing various organisations or associations in Japan (64 participants) or in other countries (21 participants from 6 countries, Canada, France, Germany, Norway, the United Kingdom, the United States), either governmental or non-governmental, national or local, from the private or the public sector, and from the nuclear or the non-nuclear sector.

Dr Nobuhiko Ban, Commissioner of the Nuclear Regulation Authority of Japan opened the workshop and stated that although findings from the recovery process in Japan are primarily accident-, environment- and land-specific, it remains meaningful to draw lessons from these experiences. Most importantly, he made a strong statement regarding unresolved problems for evacuees and returnees, including family issues, community severance, and more globally, well-being and health concerns: "There is no doubt that all these difficulties stem from radiological protective actions, but controlling radiological doses without considering the human dimension will not solve any problems". Mr William D. Magwood, IV, NEA Director-General, highlighted the complexity of the recovery process where "there is no one-size-fits-all approach" and Mr Nobuhiro Muroya, NEA Deputy Director-General concluded that the NEA, as well as its dedicated topical expert group, the EGRM will play a key role in preparedness of member countries by contributing to the collection of the experience of reconstruction in Japan after the nuclear accident, and sharing these experiences with the international community.

To set the scene, Dr Thierry Schneider, Chair of the EGRM, shared the message for recovery preparedness that will drive the development of the EGRM framework. The process for agreeing on the end-state objectives of the reconstruction by involving stakeholders in an inclusive manner, is essential and should integrate: prevailing circumstances, waste management issues, all-hazards consideration of resource limitations and a reasonable level of conservatism, skilled workforce availability, and consideration of behaviour changes needed to successfully manage exposures while providing decent living and working conditions and sustainable environment.

The major findings resulting from each of the five topical sessions of the workshop are summarised hereafter. All were illustrated by meaningful experiences or practical initiatives described by the speakers.

Regarding the issue of the radiation monitoring programme and dose assessment, the Norwegian experience after the Chernobyl fallout, focusing on the issue of the Sami community, evidenced that monitoring programmes, decision of dose criteria and related permissible levels in foodstuffs should all be set up by involving stakeholders with a direct interest in the issue, and allowing knowledgeable discussion where remediation options are evaluated – including strategies where the population may play active roles themselves. It highlighted that it is necessary to prepare for potentially long-lasting monitoring efforts and management, encouraging the elaboration of a roadmap towards the progressive termination of the monitoring and dose assessment strategy as the situation evolves. Experiences from both the Chernobyl and Fukushima Daiichi Nuclear Power Plant accidents showed that there are considerable information needs concerning food safety, including in the long term, and highlighted the need for well-designed and transparently justified monitoring/control programmes as well as a clear approach to integrate independent and supplementary measurements to consolidate validation and trust with regard to the official measurements.

In the event of a nuclear accident, there is a clear need for a national monitoring strategy that is different from the routine strategy. The objectives of the monitoring plan are different in the emergency phase where technical challenges in setting up monitoring dominate, in the transition phases where the radiological situation needs precise characterisation, and in the recovery phase where monitoring results play a key role in indicating the evolution of the radiological situation and help people's understanding and adaptation of their way of life to the situation. The electronic personal dosimeter provides easy-to-understand information for residents to remain aware of the radiological situation in their daily life. Responses to the residents' concerns raised after communicating and sharing the measurement data should be prepared and they should be offered assistance in coping with the situation. Other issues that were discussed regarding monitoring strategies to inform dose assessment dealt with responsibilities among national and local organisations as well as stakeholders, the use of data from various monitoring sources, the financial and material resources for monitoring needs where it is unlikely that any single country will have enough resources for recovery.

The relationships between food safety management and stakeholder involvement was explored and the needs to provide ad hoc information to the public all along the cycle of an emergency situation, including long-term recovery, were highlighted. Food safety management strongly interacts with economic aspects through consumer trust, the issue of loss of image for a region and/or a product, and/or how to secure the market for emblematic food products. Stakeholder involvement is essential to define relevant permissible levels in foods (these levels need to reflect trade-offs/compromises, and must be viewed as only one

part of an overall recovery strategy); identify important/vulnerable/sensitive products; integrate the feedback from experiences. The main aim is to share understanding and not necessarily to reach a consensus since individuals may have different priorities depending on their roles.

The major lesson on decommissioning, environmental remediation and waste management is that clean-up is "accident, site, and local, stakeholders-specific". The remediation processes, tools and resources needed greatly depend on radiological characterisation, landscape use and main geographical features, but are also largely dependent on the trust, understanding and co-operation of local residents. A holistic environmental restoration approach is needed and should incorporate the exploration of clean-up options identified jointly with their consequences for waste management, while considering the impacts of various end-state options, and integrating environmental safety, economic factors and social acceptance. The derivation of the cut-off level between conventional waste and radioactive waste is key to implementing safe recycling options as well as the total amount of radioactive waste to deal with for designing and setting the final storage site. Timely dissemination of transparent and comprehensible information is also a key for success in gaining and maintaining trust between the authorities and stakeholders and ensuring sustainable waste management.

Regarding business continuity, the session discussed how to balance the economic aspects in decision-making throughout the cycle of an emergency situation, with a focus on the essential features necessary for restarting the economy and in boosting its long-term recovery. Faced with the very significant economic disruption created by the accident, there is a need for preservation of activities at the level of the company: the rationale for justification, conditions for maintaining activities, and assistance needed by those concerned, have to be established by taking into consideration worries and expectations as well as the local societal context. Anxiety in the workplace is a factor that can affect both workers and their families. Actions could help to limit this by: i) giving information; ii) monitoring (people, workplace, products); iii) setting actions for protection/vigilance; iv) defining needs and actions for health surveillance; v) thinking about long-term evolution; vi) respecting ethics (e.g. dignity, equity, autonomy). Regarding products from Fukushima, the radiological situation may give rise to concerns and bans, and may require actions to help regain and maintain consumers' trust. The image of the product is essential and approaches to limit discrimination as much as possible should be explored (e.g. preparing communication and promotion, ensuring quality improvement). Globally, preparedness should concentrate on meeting the goal of a self-standing sustainable development through co-operation between stakeholders (both public and private), the establishment of global new projects, the development of assistance to start new initiatives, restart existing activities and help the return to "normal". It is important to think about attractiveness, and to research how to match the long-term wishes and the real needs of territories in the revitalisation process.

It has been almost ten years since the Fukushima Daiichi nuclear accident and various issues concerning well-being still exist, both among the evacuees (e.g. loss of "normal way of life" and of interactions inside their community, stigmatisation and discrimination; suffering from a long-term evacuation and temporary housing) and among the returnees (e.g. loss of livelihood – unemployment, contaminated environment; loss of infrastructure – lack of schools, transports, hospitals). These issues concerning well-being are clinically observed, with a significant increase of various health problems (psychological and mental health issues, lifestyle diseases such as diabetes, cardiovascular diseases, late-stage cancers; anxiety from both affected population and host population). Dialogue and

exchanges with evacuees and returnees revealed the important role of counsellors in building trust-based relationships with the affected population. Individual monitoring devices have played a key role to help people to regain control of their daily life and better understand what is at stake in their own environment. The health care response was progressively developed so that support and services better matched the local needs and ensured the long-term vigilance regarding health of an ageing population and of nuclear workers who are generally newcomers. The most important remaining challenge is to find the appropriate balance between local expectations, in terms of healthcare services to appeal to newcomers and younger generations, and real needs (and funding) to develop facilities dedicated to elderly residents. Issues concerning well-being are evolving over time and space. A long-term strategic action plan is needed and must be built by implementing participatory processes with local populations, while respecting ethical values such as dignity and autonomy of these populations. A multidisciplinary approach with a broader stakeholder involvement is essential to shift from a radiological protection centred strategy to a more holistic view of health protection, including mental health and psychosocial support.

The final session of the workshop was dedicated to looking at the main findings as they apply to the recovery preparedness with a focus on topical issues. The findings highlight the importance of thinking in advance and broadly (i.e. in a holistic and multi-sectoral manner, balancing health, social, cultural, economic, environmental impacts) in order to ensure that the emergency response strategy could tackle the immediate situation and would not delay or impede the recovery process. It was concluded that preparedness for post-accident recovery would benefit from adopting a comprehensive and operational generic framework covering key aspects such as public health, radiological monitoring and dose assessment, risk communication, decommissioning and environmental decontamination (both strongly associated with waste management), food and drinking water management, business continuity, the well-being of affected people and communities. A preparedness strategy should include actions targeting the resilience of societies and engaging local communities. The co-expertise process as defined by the ICRP could largely help in meeting this goal.

1. Introduction

Together with the Japanese Nuclear Regulation Authority, the Nuclear Energy Agency held the Workshop on Preparedness for Post-Accident Recovery Process: Lessons from Experience, on 18-19 February 2020, at the University of Tokyo, Japan. Eighty-five participants attended the event, with 75% from various organisations or associations in Japan, governmental or non-governmental, national or local, from the private or the public sector, and from the nuclear or the non-nuclear sector, attended the event and shared the lessons learnt from nine years of experience. The remaining 25% of the audience were experts from outside Japan, heavily involved in the topic of the post-accident recovery process in their country or at the level of international organisations.

1.1. Objective and format of the workshop

The Fukushima Daiichi nuclear accident, following a major natural disaster, has caused major changes in the living conditions of a large number of residents, as well as in the socio-economic fabric, all over the territories of the Fukushima Prefecture and the neighbouring prefectures. Besides the emergency response, all recovery initiatives that have been implemented since the accident, pinpoint that recovery management is an extremely complex process of multidisciplinary dimensions. Among the topical issues at stake for the recovery, five themes have been selected to structure the agenda of the workshop: radiological monitoring and dose assessment (Session 1), decommissioning and environmental decontamination – both strongly associated with waste management (Session 2) – food and drinking water management (Session 3), business continuity (Session 4) and the well-being of affected people and communities (Session 5). Lessons drawn from experience also tackle key cross-cutting issues: how to balance radiological and psychosocial effects of protective decisions, how to efficiently and effectively involve stakeholders, how to improve communication processes, how to revitalise the economic situation, etc. The objective of the workshop was to provide an opportunity to discuss those major elements at stake for the structuring of a nuclear post-accident recovery management framework for improving preparedness and to interact with Japanese governmental organisations and non-governmental stakeholders to discuss and analyse successes and remaining challenges in the recovery process. The conclusions and perspectives were drawn up during the last session (Session 6).

1.2. Setting the scene: the global picture of the post-accident situation in Japan and the need for enhanced recovery preparedness

The opening session provided the opportunity to share with the audience an overall description of the current post-accident situation in Japan and to express why there is a need for elaborating more guidance for the recovery process.

1.2.1. Key messages from the opening addresses

Almost ten years ago, the Great East Japan Earthquake hit eastern Japan, and the subsequent tsunami paralysed safety functions at the TEPCO Fukushima Daiichi Nuclear Power Plant. As a consequence, three operating reactors overheated, and radionuclides were released into the atmosphere and the Pacific Ocean. Since the accident, tremendous efforts have been made to manage radioactive contamination. A large-scale decontamination project was implemented based on the results on the intensive contamination survey. Monitoring and restriction on foodstuffs keep doses from ingestion of the accident-related contamination at a negligible level. While these measures may have contributed to lower radiological doses than were initially anticipated, people of affected areas have health concerns and still suffer from harmful rumours and stigmatisation that affect their everyday life. Those who evacuated or relocated continue to face unresolved problems, including family issues, community severance and more. "There is no doubt that all these difficulties stem from radiological protective actions, but controlling radiological doses without considering the human dimension will not solve any problems*",* said Dr Nobuhiko Ban, Commissioner of Nuclear Regulation Authority of Japan. Problems, concerns and worries can vary from person to person, from family to family and from community to community. It is useful to draw lessons from experiences even if they are primarily accident-specific, environment-specific and land-specific.

As highlighted by Mr William D. Magwood, IV, NEA Director-General by video, the area of recovery management has been of interest within the Nuclear Energy Agency (NEA) Committee on Radiological Protection and Public Health (CRPPH) for some time, in particular since the 2011 accident at the Fukushima Daiichi Nuclear Power Plant. To go further, the CRPPH launched an Expert Group on Recovery Management (EGRM) in 2019 and since that time NEA member countries through a wide range of discussions clearly have proven that "there is no one-size-fits-all approach to recovery management as each accident and each situation is very different*"*. The exercise of moving from a specific context to a generic context is certainly difficult and requires in-depth brainstorming such as was made possible by this workshop. "By contributing to the collection of the experience of reconstruction in Japan after the nuclear power plant accident, and sharing these experiences with the international community, the NEA would like to play a key role in preparedness of member countries" concluded Mr Nobuhiro Muroya, NEA Deputy Director-General.

1.2.2. Improving country readiness for post-accident recovery by using lessons learnt from past accidents and past activities of CRPPH

(Based on presentations from T. Schneider and T. Homma, respectively Chair and Vice-Chair of the Expert Group on Recovery Management)

The CRPPH activities after the Fukushima Nuclear Power Plant accident included several important brainstorming analyses covering all the phases of an accident (from the planning or preparation to the emergency phase, the transition phase and recovery) with a large cross-cutting focus on stakeholder engagement including lessons from the Chernobyl accident:

- sharing of actions taken in the early phase by member countries to cope with the consequences of the accident;
- setting up a dedicated expert group to follow the decisions taken in the intermediate and long-term phases;
- elaborating on a food management framework discussed at the international level;

- participating and learning from the ICRP dialogue initiatives in the Fukushima Prefecture.

In 2018, a decision was made to set up a dedicated expert group, EGRM. The objectives of EGRM are to assist NEA member countries in planning and improving their recovery preparedness by producing guidance on how to develop a nuclear and radiological post-accident recovery management framework that can be adapted to national conditions. This framework will be delivered in 2021 and will cover major topical issues (e.g. monitoring and dose assessment, food and drinking water management, trade issues, harmonisation-co-ordination issues, remediation including decontamination, waste management, wider economic consideration including compensation, welfare issues, stakeholder engagement/community engagement, communication, and education and training), and cross-cutting issues (e.g. process of sharing experiences, governance, roles and responsibilities, co-ordination, legal requirements).

The development of the EGRM reflection relies on the following considerations. The driving objective for managing the situation depends on the phase of the accident and post-accident management (i.e. radiological protection for emergency phase, radiological characterisation for intermediate phase, and achieve sustainable living and working conditions in recovery phase). Most importantly, protective actions in all phases should be harmonised as reasonably achievable and decisions taken by integrating their potential medium to long-term consequences in a holistic way (i.e. within each phase, from phase to phase, nationally and internationally).

In Japan, prior to the Fukushima Daiichi Nuclear Power Plant accident, the legal system of Emergency Preparedness and Response (i.e. Basic Act on Disaster Management – Act No. 223 of 15 November 1961, revised June 1997; Basic Disaster Management Plan – 1963; Act on Special Measures Concerning Nuclear Emergency Preparedness – No. 156 of 17 December 1999; Regulatory Guide on Emergency Preparedness for Nuclear Facilities – June 1980, revised August 2010), had not fully taken into account situations requiring long-term recovery management over wide areas. Therefore, specific policies, guidelines and criteria as well as overall arrangement were developed in the intermediate phase of the emergency response to the accident. A "Roadmap for Immediate Actions for the Assistance of Nuclear Sufferers" was established in May 2011 by the Nuclear Emergency Response Headquarters, and triggered subsequent activities such as detailed environmental monitoring plans, long-term health surveillance, formalisation of lifting protective actions being taken and the establishment of long-term plans for remediation. The application of a graded approach using the establishment of the roadmap was proved to be effective in preparing for long-term recovery operations.

The message for recovery preparedness driving the development of the EGRM framework is that the process for agreeing (involving stakeholders in an inclusive manner) on the end-state objectives of the reconstruction is essential and must integrate: prevailing circumstances, waste management issues, all-hazards consideration of resource limitations and a reasonable level of conservatism, skilled workforce availability, and consideration of behaviour changes needed to successfully manage exposures providing decent living and working conditions and a sustainable environment.

2. Monitoring and dose assessment

The topic of monitoring and dose assessment remains important throughout all phases of an accident, including transition and recovery. The main findings and their meaning in terms of recovery preparedness are based on several presentations. L. Skuterud (the Norwegian Radiation and Nuclear Safety Authority [DSA], Norway) recalled the Norwegian experience after the Chernobyl fallout, focusing on the issue of the Sami community. T. Oguchi (Nuclear Regulation Authority [NRA], Japan) reported on the current radiological monitoring activities in Japan. This was completed by an overview of the variability and uncertainties in assessing the external doses to the public (S. Takahara, Japan Atomic Energy Agency [JAEA], Japan), and a summary of the major lessons from experience of individual dose measurements by residents (W. Naito, National Institute of Advanced Industrial Science and Technology [AIST], Japan). The issue of specific situations of workers and users of infrastructures in relation to remediation and restoration activities in the Fukushima Prefecture was also discussed (I. Otsuka, Nuclear Regulation Authority [NRA], Japan).

2.1. Radiation monitoring programmes should consider the human element first and remain very flexible – the Norway example

The well-known story of the consequences of the Chernobyl fallout in Norway for reindeer husbandry, and more precisely for the indigenous Sami population, highlights a major lesson on the importance of identifying in advance vulnerable environments and/or groups of people most at risk (due to mode of life and habits) in the case of a nuclear accident.

The first decision of the authorities was to adopt a permissible level of (Cs-134 + Cs-137) in foodstuffs of 600 Bq/kg in June 1986 in accordance with the European Commission; a trade ban on reindeer and sheep based on animal sampling was established. In autumn 1986, levels in reindeer meat approached 100 times the permissible level and due to the estimated effective biological half-life of radiocaesium in reindeer of approximately 7 years, the conclusion was that reindeer herding might be affected for generations. As a result of discussions between the government and stakeholders, this led the authorities to increase permissible level for reindeer meat to 6 000 Bq/kg for the market only, justified by low consumption of reindeer meat by average citizens (approximately 0.5 kg/y vs. 100-150 kg/y for herders). The level was reduced to 3 000 Bq/kg in 1994 on the basis of the reduction in contamination levels in reindeers. Various remediation strategies were implemented thanks to the joint involvement of local authorities and of herders and farmers, such as producing reindeer meat from less contaminated areas, financial compensation for clean feeding of animals for their own consumption and for purchase of alternative foodstuffs, or use of caesium binders for decorporation in animals (Skuterud and Thørring, 2012).

Box 1: Monitoring programmes and decision of criteria

Based on this experience, monitoring programmes and decision of dose criteria and related permissible levels in foodstuffs, should be set up in an appropriate way involving affected stakeholders, and allowing knowledgeable discussion where remediation options are evaluated – including strategies where the population may play active roles themselves. The aim is to identify priorities of various stakeholders and measures that are the most acceptable or preferable for all.

It is necessary to be prepared for potentially long-lasting monitoring efforts and management. In Norway, some of the various post-Chernobyl actions to support the affected population and their businesses, were still in effect, 34 years later. This observation encourages consideration of the elaboration of a roadmap towards the progressive termination of the monitoring and dose assessment strategy as the situation evolves. Such a roadmap should be a key aspect of any preparedness strategy.

2.2. Linking radiation monitoring programme and dose assessment – the Comprehensive Radiation Monitoring Plan in Japan and the assessment of the public external dose

In Japan, the Monitoring Coordination Meeting was set up under the Nuclear Emergency Response Headquarters, and developed the Comprehensive Radiation Monitoring Plan on 2 August 2011, which has been implemented by all relevant ministries, agencies and others. The NRA ensures the co-ordination with all the organisations for a comprehensive environmental radiation monitoring, and assesses quality and consistency of monitored data from various sources. There was a large monitoring effort with ambient dose rate measurements using a combination of air-borne and car-borne monitoring, deployment of a real-time dose measurement system with approximately 3 600 monitoring stations in the Fukushima Prefecture, portable survey dosimeters, and environmental sampling to assess the evolution of the contamination levels in soil, biota, water, sediment in the terrestrial, freshwater and marine environment. In recent years, the results from the Comprehensive Radiation Monitoring Plan are consistently lower compared to at the time of the accident. For example, the ambient dose rate over land halved due to the physical decay of the radiocaesium and the decontamination process; sea water concentration for ^{137}Cs 20 km off-site has now returned to the order of magnitude existing before the accident (0.001 Bq/L). For the marine sediments, the decrease rate is slower but concentrations have been divided by a factor ranging from 10 to 100 over the 9-year period. In addition to the environmental monitoring, food survey including fish is still going on (see Chapter 4). Most importantly, all monitoring data are made publicly available on the NRA website (https://radioactivity.nsr.go.jp/en/).

Interestingly, the monitoring real-time stations set up in the evacuation areas have become an essential data provider for local populations. In areas where decontamination lowered contamination to a level where the evacuation order could be lifted, real-time radiation monitoring stations were removed except in some municipalities, due to worries expressed by local people.

External dose assessment is key to the protective strategy and recovery process where decontamination impacts must be evaluated. Individual dose received by people in a certain area varies with spatial variability of radioactivity and inter-individual difference in behavioural pattern (Figure 1). Quantifying this variability is important to help decision-making on exposure management. This was done via an exposure assessment model taking into account Japanese lifestyle and the effects of decontamination after the Fukushima Daiichi accident, validated by actual measurements collected by dedicated studies performed from 2011 to 2018 for outdoor/indoor workers in Fukushima city. The influence of uncertainty (e.g. dose coefficients) could double or halve individual dose assessments. Explaining the model and the factors influencing the dose distribution in a given area such as heterogeneity of environmental contamination, daily behaviour, and uncertainty due to the unknown appeared useful for radiation risk communication with inhabitants.

Agreement between modelled data and measurement helps to build confidence among stakeholders, to understand how the situation evolves, to explain the dose distribution of the population and to aid in determining the need for additional protection measures. As proposed by the government for evacuees to return to their homes, the use of electronic personal dosimeter (e.g. D-shuttle from Chiyoda Technol Corporation), along with the Global Positioning System and Geographic Information System has been adopted by approximately 300 Fukushima residents to date via a study conducted from 2013 until 2020, approved by the Committee for Ergonomic Experiments of the AIST. This demonstrated that the individual external doses measured by personal dosimeters are generally much lower than those determined using a simple model with ambient dose data (Naito et al., 2016). It also contributed to the empowerment of local residents by interpreting such data for self-protection or making lifestyle choices. However this experience demonstrated that the effective use of individual dose measurement during the post-accident recovery phase requires a good understanding of the meaning of measurement data, and when measurement raises concerns (e.g. if an individual dose exceeds a reference level), the appropriate mechanism has to be prepared and implemented to respond to the residents' concerns. This versatile role of the use of personal dosimeters in post-accident recovery for residents and authorities in the affected areas was referred as a "double-edged sword".

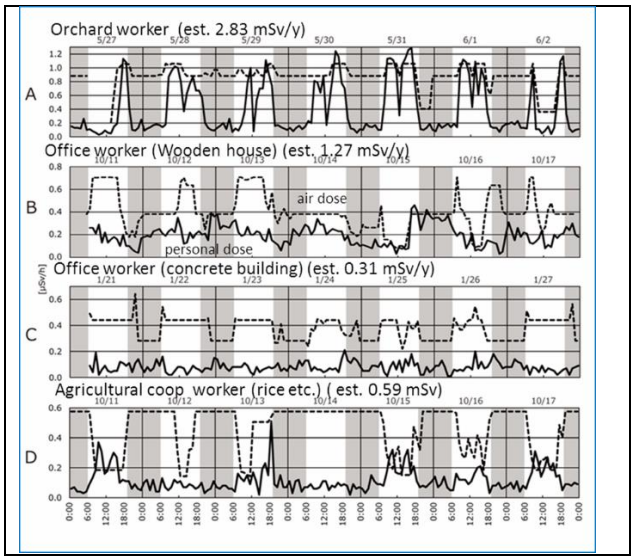
Box 2: Post-accident monitoring strategies

In the event of an accident, there is a clear need for a national monitoring strategy different from the routine one. The objectives of the monitoring plan are different in the emergency phase where technical challenges in setting up monitoring dominate, in the transition phases where the radiological situation needs precise characterisation, and in the recovery phase where monitoring results play a key role in indicating the evolution of the radiological situation and help people to understand and adapt their way of life to the situation.

Personal dosimeters provide easy-to-understand information for residents to know the radiological situation in their daily lives. However, consideration should be given to it in relation to their possible role as a "double-edged sword". If an individual dose exceeds a reference level, there can be undue stress specifically caused by monitoring. It is important to prepare responses to any concerns that might arise from communicating the measurement data and to provide residents with assistance in coping with the situation.

Monitoring strategies are to be consistent, e.g. with food restrictions and lifting of evacuation orders, to inform dose assessment. Aspects of the recovery process that should be planned for in advance are varied and deal with: responsibilities among stakeholders including national and local organisations, the use of data from various monitoring sources, the process to re-evaluate the monitoring strategy as the situation evolves, the elaboration of criteria that would help to define the termination of monitoring, the financial and material resources for monitoring needs where it is unlikely that one single country will have enough resources for recovery.

Figure 1 – Individual external dose profiles as measured by personal dosimeters



Note. Profiles vary depending on activity patterns and locations of individuals; their analysis provides an easy-to-understand information for residents to know more about how to manage radiological exposure in their daily lives.

Source: adapted from Fig 3 in Naito et al., 2015.

2.3. Needs for specific dose assessment for workers and users of infrastructures in relation to remediation and restoration activities inside and outside the Fukushima Daiichi Nuclear Power Plant evacuation zone

After evacuation within a 20-km radius from the Fukushima Daiichi Nuclear Power Plant, various countermeasures or restructuring operations were undertaken: decontamination of lands, houses, roads, remediation of infrastructures (e.g. Joban Expressway, National Highway, Prefecture road, railroad, combustible waste treatment facilities, sewage water treatment facilities), firefighting, carrying out of hazardous materials from the evacuated area, assessing the contamination level of a large amount of wastes generated by the tsunami, or cars passing through the area, etc. It was necessary to assess exposure doses for workers and users of infrastructures (e.g. driver passing through the area, firefighters) due to remediation and restoration activities inside and outside of the evacuation zone, which could potentially cause secondary dispersion of radioactive materials. Dose assessment based on "reliable" data was key for decision-making and communication with workers and users. Lessons from this experience and the methodology/tools developed (e.g. a manual describing an investigation plan for dose assessment in the case of road restauration or hazardous materials contamination assessment), as well as the development of a communication plan with users, is beneficial for preparedness when helping people cope with radiological protection issues in a post-accident recovery process.

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3. Waste and decommissioning

This topical session focussing on waste and decommissioning highlighted the extreme complexity and the challenging aspects of radioactive waste management in the event of an accident. The main lessons learnt are based on several presentations: C. Mogg (Environment Agency, United Kingdom) and A. Lang (Defra, United Kingdom) who explained the United Kingdom's flexible approach described in various recent preparedness guidance on waste management; S. Ozawa (Ministry of the Environment [MOE], Japan) who shared the advances of the extensive decontamination programme since it was started in August 2011; this was completed by an overview of the R&D effort on-site and off-site for decommissioning and decontamination, as well as the approach to reduce the waste volume via recycling and communication to the public by the JAEA (respectively by S. Nakayama and S. Takeda). Finally, T. Yasutaka (National Institute of Advanced Industrial Science and Technology [AIST], Japan) explained what factors are to be considered to ensure a sustainable management of decontaminated soil and waste in Fukushima.

3.1. Preparedness for radioactive waste management in emergencies – flexibility is essential as illustrated through the United Kingdom's recent guidance

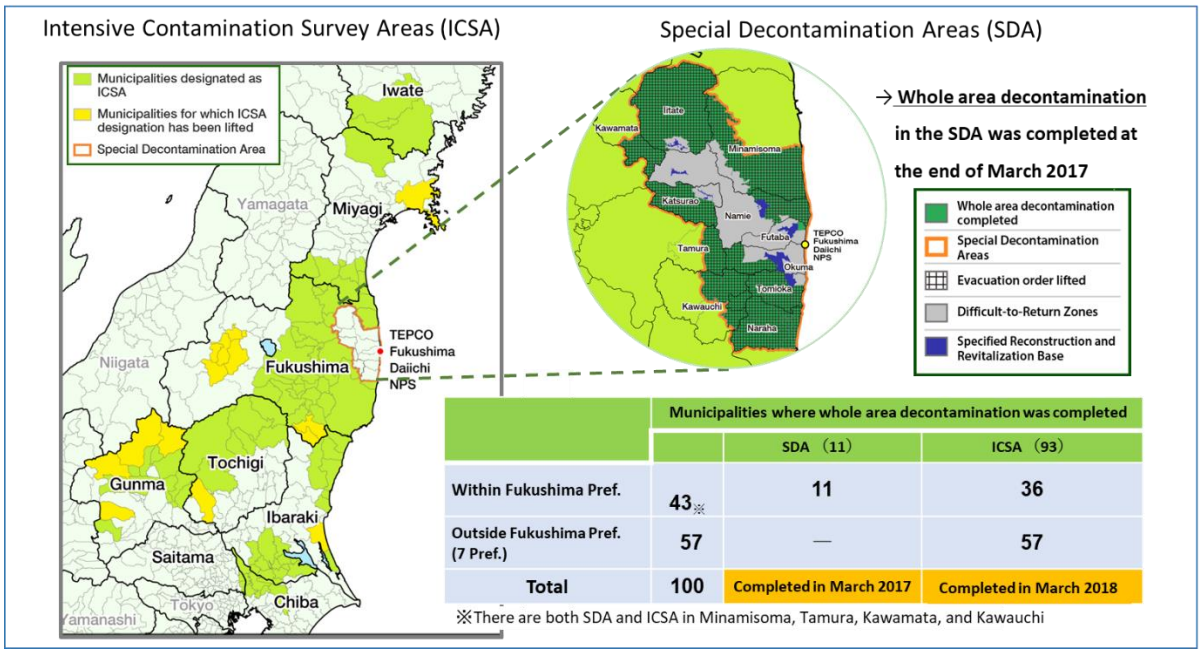
The International Atomic Energy Agency's (IAEA) Generic Safety Requirements – Part 7 (IAEA, 2015) stipulates that "The government shall ensure that radioactive waste is managed safely and effectively in a nuclear or radiological emergency" in its requirement 15. This requirement also underlies the need for an ad hoc national policy and strategy for radioactive waste management by taking account of the protection strategy and its impact on the waste management, the characterisation and categorisation of generated wastes, the issue of predisposal storages, etc. This is particularly notable for countries that have yet to make the distinction between the arrangements for managing wastes from routine operations and those required in emergencies. At present, the United Kingdom is developing a radioactive waste management plan that will involve a review of guidance and lessons learnt from previous incidents, updates to policy, strategy and legislation, and will build upon the United Kingdom's current operational arrangements (e.g. the UK Recovery Handbooks for Radiation Incidents [Public Health England, 2015]). The key message from this experience is that although the radioactive waste management plan is inherently complex, it needs to be flexible so that it can be adapted to significantly different types and scales of a radiological or nuclear accident. The plan should integrate the analysis of the factors influencing recovery and development of the decision-making process.

3.2. Present status of environmental decontamination off-site of the Fukushima Daiichi Nuclear Power Plant - completed on 19 March 2018, excluding the difficult-to-return zones

Early after the Fukushima Daiichi Nuclear Power Plant accident, the MOE released the "Act on Special Measures concerning the Handling of Environmental Pollution by

Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District – Off the Pacific Ocean Earthquake that Occurred on March 11, 2011" (Act No. 110 of 2011) to drive: i) the decontamination strategy for contaminated territories; and ii) the treatment and management of generated radioactive wastes. Contaminated territories in the Fukushima Prefecture and neighbouring prefectures were classified as Special Decontamination Areas (SDAs, where within a 20-kilometer radius from the Fukushima Daiichi Nuclear Power Plant, or the annual cumulative dose was estimated to be more than 20 mSv and the decontamination process was designated as government responsibility), and Intensive Contamination Survey Areas (ICSAs, where annual doses could be in the range of 1 to 20 mSv and identification of zones to decontaminate as well as the implementation of decontamination designated as the responsibility of municipalities, with national technical and financial support). The whole area decontamination in the SDAs was completed in March 2017, and in the ICSAs on 19 March 2018, excluding the difficult-to-return zones (DRZs) (Figure 2). Environmental clean-up has been initiated in the difficult-to-return zones, to enable lifting of the evacuation order in the future. Partial reopening was implemented in Futaba Town on 4 March, in Okuma Town on 5 March and in Tomioka Town on 10 March in 2020. In March 2020, JR Joban Line reopened 9 years after its closure.

Figure 2 – Main features of the classification of the contaminated territories in the Fukushima and neighbouring prefectures as Special Decontamination Areas (SDAs) and Intensive Contamination Survey Areas (ICSAs).



	Municipalities where whole area decontamination was completed		
		SDA (11)	ICSA (93)
Within Fukushima Pref.	43※	11	36
Outside Fukushima Pref. (7 Pref.)	57	—	57
Total	100	Completed in March 2017	Completed in March 2018

Note: Off-site decontamination, as based on the "Act on Special Measures Act on Special Measures concerning the Handling of the Environmental Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District – Off the Pacific Ocean Earthquake that Occurred on 11 March 2011", was completed on 19 March 2018, excluding the difficult-to-return zones (DRZs).

Source: adapted from Ministry of the Environment (Government of Japan), 2018.

JAEA launched the environmental decontamination projects to examine the applicability of various environmental decontamination technologies and radiation measurements for a wide range of areas including both contaminated areas within the Fukushima Prefecture

(car-borne radiation surveys) and also the entire land of Japan (air-borne monitoring technologies). Note that this led to the construction of new infrastructures (e.g. JAEA Fukushima Environmental Safety Center, Okuma Analysis and Research Center).

The air dose rates in residential areas, farmlands, forests and roads have decreased by 60%, 59%, 30% and 44% respectively, through the decontamination processes. Specific post-decontamination monitoring confirmed that the results of the whole area decontamination are maintained. Decontamination works generated approximately 17 million m^3 of contaminated soils and wastes (Table 1). The MOE had budgeted approximately JPY 2.9 trillion (USD 27 billion) for decontamination by the end of March 2019. Decontamination led to the creation of 1 328 temporary storage sites (TSSs) over the various municipalities concerned. By the end of March 2019, approximately 550 temporary storage sites had been rehabilitated, i.e. the waste had been evacuated either to treatment centres (e.g. incinerators, recycling), or to the Interim Storage Facility (ISF) created by the Japanese government around the Fukushima Daiichi Nuclear Power Plant. This ISF, which has a planned operation period of 30 years (2015-2045), is intended to receive, after treatment, the most contaminated waste – mostly soils with more than 100 000 Bq/kg, as well as specified wastes. The ISF is currently in progress by way of land acquisition (total surface = 1 600 ha, with 79% private lands). Soil separation began and storage facilities started operating in late 2017 in Okuma and in Futaba. By the end of FY 2021, MOE aims to complete the transportation of most of the removed soil and waste (except in DRZ), which are temporarily stored in Fukushima Prefecture.

A site located outside the Fukushima Prefecture must be identified by the Japanese government for the final storage of this waste after 2045.

Table 1- Estimated volumes of waste generated by decontamination operations in the contaminated areas (SDAs and ICSAs), associated costs and estimated amount of waste evacuated to temporary storage sites (TSSs), to the Interim Storage Facility (ISF) or recycling or incineration (end of March 2019)

Classified area	Volume of generated waste (million m^3)	Decontamination cost (billion EUR)	Volume evacuated to TSS (million m^3)	Volume evacuated to ISF (million m^3)	Volume evacuated by recycling or incineration (million m^3)	Number of temporary storage sites rehabilitated
SDA	9.1	12.6	1.9	0.28	1.62	120~130
ICSA	7.9	11.8	1.7	0.5	1.2	420~450
Total	17	24.4	3.6	0.78	2.82	540~580

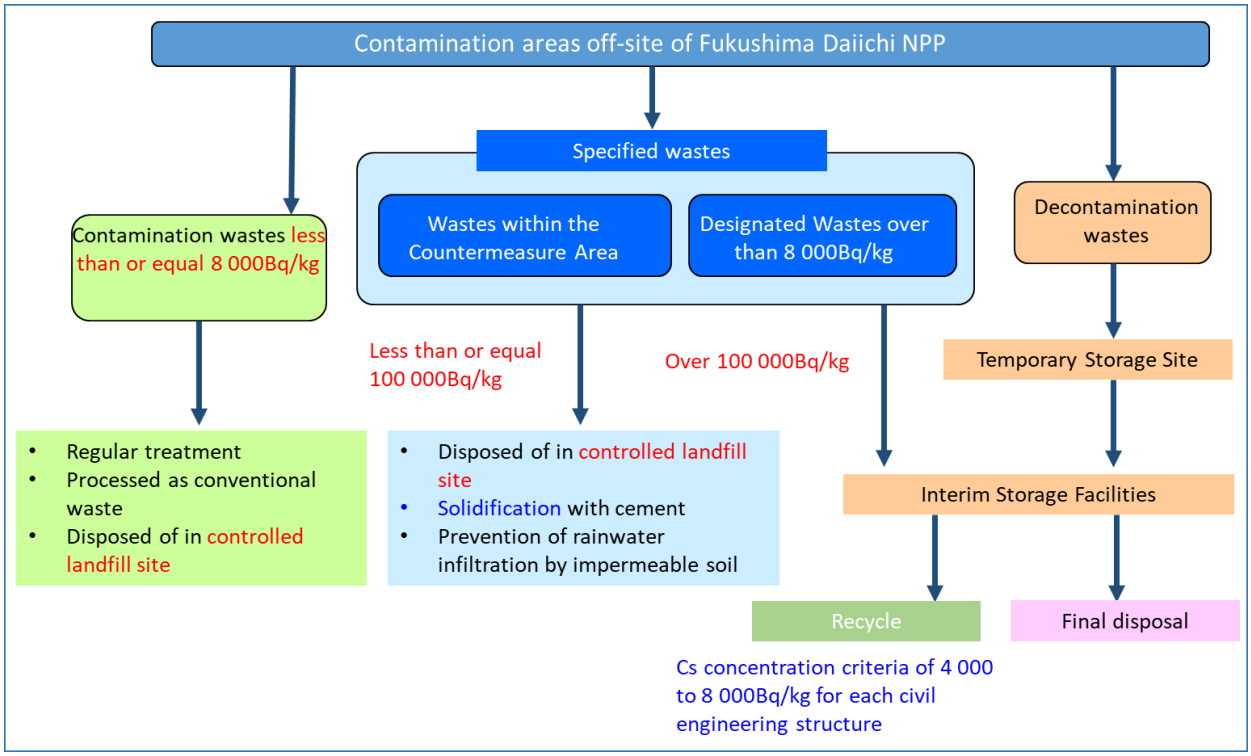
Source: adapted from Ministry of the Environment (Government of Japan), 2018.

3.3. The issue of reducing the volume of waste and recycling of removed soils

To reduce the volume of removed contaminated soil to be relocated to the final disposal site, the MOE has discussed reusing low-level contaminated soil as recycled materials, ensuring environmental safety by applying volume reduction technologies, such as soil washing and incineration. The basic concept of safe use of removed soil by recycling was established in 2016. Expected uses would mainly involve public projects using soils after obligatory treatment with a radioactivity level below 8 000 Bq/kg (total radiocaesium activity) so that the additional exposure dose should be below 1 mSv/y during the construction and below 0.01 mSv/y at the time of service. More precisely, radiocaesium concentration criteria of 4 000 to 8 000 Bq/kg were derived for each civil engineering structure to ensure the safety of recycling treated soil. Some typical expected uses are embankment materials for roads, cover soil for waste disposal sites, landfill materials, etc. Demonstration projects are in progress (e.g. Minamisoma City, Iitate village).

Figure 3 describes the flowchart that was developed for waste classification. The adopted criterion to distinguish between regular treatment and radioactive waste management in a recovery phase was based on the radiocaesium concentration in the wastes, and derived from dose estimation resulting from regular treatments applied to waste, e.g. transport, temporary storage, processing and/or incineration, controlled landfill.

Figure 3 – Simplified flowchart for waste classification as developed and implemented in Japan



Source: adapted from Kuroda, 2016,

3.4. The issue of communication to the public and selection of the final storage site

Decontamination is almost complete, except within the difficult-to-return zones (MOE, 2018). Consequently, the focus of environmental remediation has shifted to transporting and storing soils and wastes removed during decontamination to the Interim Storage Facility where the total quantity of decontaminated soils and wastes to be stored is approximately 14 million tonnes. By law, these materials must be disposed of outside of the Fukushima Prefecture by 2045. The selection of final disposal sites outside Fukushima is expected to be a very difficult process. Given the time frame for disposal, it is necessary to involve the next generation as well as the current generation in this decision-making process.

The issue of communication to the public is essential for informing and discussing about all the decontamination and restoration processes. This requires the development of ad hoc skills by involved staff members in communicating radiation issues and underlying science to the public. JAEA listed this issue as a major lesson learnt. Interestingly, approximately 250 sessions of public hearing/dialogue have been held since July 2011 thanks to the contribution of JAEA experts, for a total of about 21 000 residents.

Finally, regarding the issues of recycling low-level radioactive soils and of final storage site selection, a sustainable remediation approach should be implemented where assessment of various options should incorporate environmental safety but also social and economic factors in order to develop balanced decision-making process/framework with stakeholder. The initiative named Decontamination Information Plaza (Environmental Regeneration Plaza at present) was established to provide information on decontamination projects, the Interim Storage Facility and activities of environmental regeneration in January 2012. "Reprun Fukushima" began in August 2018 to introduce the landfill disposal project of specified waste in Tomioka Town. The ISF Information Center opened in January 2019 in Okuma Town to transmit progress of the ISF and the safety efforts. These projects can play a role not only in aiding with environmental recovery but also in shaping the future of the region.

Box 3: Environmental remediation

The major lessons learnt from the environmental remediation after a major accident is that clean-up is "accident- -site-and-local stakeholders-specific".

Remediation processes, tools and resources needed highly depend on radiological characterisation, landscape use and main geographical features, but also largely necessitate gaining the trust, understanding and actions of local residents.

A holistic environmental restoration approach is needed and should incorporate the exploration of clean-up options identified jointly with their consequences for waste management, while considering the impacts of various end-state options, and integrating environmental safety, economic factors and social acceptance.

The derivation of the cut-off level between conventional waste and radioactive waste is key to implementing safe recycling options as well as the total amount of radioactive waste to deal with for designing and setting the final storage site.

Timely dissemination of honest and understandable information is also a key for success in gaining and maintaining trust between the authorities and stakeholders and ensuring a sustainable waste management. This process must be implemented at the local and the national levels in a complementary and harmonious way and should demonstrate national solidarity.

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4. Food-related issues

This topical session about food-related issues focused on the relationships between food safety management and stakeholder involvement, highlighted the needs to provide ad hoc information to the public all along the cycle of an emergency situation, including long-term recovery. The presentations illustrated that food safety management strongly interacts with economic aspects through consumer trust, the issue of loss of image for a region and/or product, and/or how to secure the market for emblematic food products. The main lessons captured are based on several presentations: J.F. Lecomte (Institute for Radiological Protection and Nuclear Safety [IRSN], France) shared the lessons learnt from a dedicated European Commission (EC)-funded project; Successful initiatives to inform Japanese consumers and regain trust among them were described by A. Kurihara from the Consumer Affairs Agency and K. Hino from cooperative (COOP) Fukushima; The still challenging situation of the Fukushima fishing industry was discussed by K. Ookawa from Ookawa Uoten (Japan).

4.1. Food control and consumer attitudes regarding food safety

Safety of food and drinking water is a highly sensitive issue that requires: i) better preparedness for "information crisis"; ii) a process to manage or properly balance conflicting interests or aspects (e.g. socio-economic concerns vs. private/individual/consumer health, culture and traditions); iii) integration of the consumer focus on food origin – at the local, national and international levels; and iv) more elaboration on whether stronger/clearer international guidance on permissible levels would be useful for improving consumer confidence.

On the basis of the governmental limits for marketing restrictions on food products (taking into account the presence of caesium 134 and 137 and other radionuclides), 17 prefectures have undertaken sample measurements since the accident on a wide variety of agricultural and processed goods produced on their territories (Ministry of Health, Labor and Welfare, 2012). Since approximately 2015, the evolution of the number of products exceeding the value of 100 Bq / kg is around 0.1% for a number of about 300 000 samples per year. These products are currently limited to berries, game and wild mushrooms. Approximately 10 million rice bags (30 kg each) have been inspected every year and no bag has exceeded the permissible level since 2015. With regard to freshwater and marine fishery products, there are, at present, a few rare exceedances observed for freshwater fish only.

Since the Fukushima Daiichi Nuclear Power Plant accident, food safety regarding radioactive contamination has been one of the major topics addressed by the Japanese Consumer Affairs Agency (CAA), established in 2009 to deal with the broad area of food safety and related communication with various stakeholders. Even though food inspections were continuously performed to check the levels of radioactive contamination of food were below the permissible levels before distribution, consumer attitudes to food produced in the affected area appear to be very complex. To understand this, the CAA has been conducting a large-scale survey since 2013 with a total of 62 112 consumers aged from 20 to 60. In 2019, more than half of participants were concerned with the food production

location mainly due to quality (taste), which usually depends on the origin. Among the responders, the reason "to buy the food where radioactive material is not present" has been decreasing constantly (from approximately 30% in 2013 to 15% in 2019). Interestingly, the trend of consumer consciousness for the low-dose radiation risk to human health has remained constant over the years with approximately 17% thinking that risk was not acceptable, 30% thinking that they are not sufficiently informed and 53% thinking acceptable (Consumer Affairs Agency, 2019). Within this context, the best practice appeared to be to provide the necessary information to consumers so that they can make their own judgement and food choices.

Food safety and risk communication is a long-term issue that needs to involve all the players in order to be efficient (i.e. collaboration with local governments, consumer organisations, trade associations). These initiatives and observations in Fukushima are consistent with the views from large panels of stakeholders in Europe (consumers, associations, producers, retailers, experts, authorities, administrations, industries, universities) convened in the framework of the EC-funded project PREPARE (2013-2016): the consumer should have confidence, the producer should be committed to accountability, maximum permissible levels are useful but the approach to set them needs to be transparent, adapted to the specific situation and well understood, and flexibility is required for managing food to cope with the complexity of the post-accident situation (Charron et al., 2016).

4.2. The need for supplementary measurements at the local level

The COOP Fukushima initiative is an excellent illustration of how to understand and meet needs from the consumer perspective at the local level. This also facilitates the understanding of food safety regarding internal exposure via food ingestion. The major initiative implemented was to measure radioactivity levels in meals via a massive survey of 1 100 households from 2011 to 2019 (Hirokawa et al., 2016). Although it was conducted 9 years after the accident when all results from the meal survey were below the detection level, there was still an interest to conduct the survey for local needs, as part of the mechanism to decrease anxiety. Radioactive whole-body monitoring was also performed as well as radioactivity or dose measurements (e.g. use of electronic personal dosimeter) to help the understanding of exposure levels in daily life, to help people make choices concerning their day-to-day habits in order to reduce their exposure when necessary and therefore, to decrease the level of anxiety. All of these independent and supplementary measurements conducted by NGOs, businesses and cooperatives, for example, have proved to be important for "validation" and trust.

The situation for coastal fishermen in Fukushima Prefecture is still very difficult. Even today, in early 2020, commercial fishing in Fukushima has not returned to "normal". The fishing industry is still suffering 9 years after the accident from loss of reputation and requires a deep analysis to understand the reasons for this failure. Although an effort was made to communicate about the situation via social media platforms (e.g. Facebook, Instagram) – mainly to regain local consumer acceptance and trust with Fukushima marine products – consumer behaviours have changed over time inside and outside the Fukushima Prefecture. Currently, efforts are being made to publicise the increasing fishery resources and resource management in the waters off Fukushima, with trial fishing adding value to Fukushima coastal fisheries by raising consumer confidence. Approximately 50% of previous consumers returned, but the majority of them are not from the Fukushima

Prefecture. More remains to be done locally but the fear expressed by professionals is now directed to the management of tritiated water stored on site.

Box 4: Food safety management

Food safety management strongly interacts with economic aspects through consumers trust, the issue of loss of image for a region and/or a product, and/or how to secure the market for emblematic food products.

Stakeholder involvement is essential to:

- define relevant permissible levels in foods (these levels need to reflect trade-offs/compromises, and must be viewed as only one part of an overall recovery strategy);
- identify important/vulnerable/sensitive products;
- integrate feedback from experiences.

The global aim is to share understanding – and not necessarily to reach a consensus since individuals may have different priorities depending on their roles – and to improve the dialogue among stakeholders.

Experiences from the Chernobyl or Fukushima Daiichi Nuclear Power Plant accidents show that there are widespread and long-lasting information needs concerning food safety. This highlights the need for well-designed and transparently justified monitoring/control programmes that allow: i) to take into account spatial heterogeneous uptake in crops (e.g. rice) and changes with time; and ii) to elaborate a clear approach to integrate independent and supplementary measurements to consolidate validation and trust.

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Shokuhin Eiseigaku Zasshi (Journal of the Food Hygienic Society of Japan), 57(1), 7-12, DOI: 10.3358/shokueishi.57.7.

5. Business interest in emergency and recovery phases

This topical session on business interest in emergency and recovery phases focused on how to balance the economic aspects in decision-making throughout the cycle of an emergency situation, with a focus on the essential features to meet for restarting the dynamics and boost long-term recovery. The presentations provided several examples of the interconnectedness of daily life with business activities and more broadly with economic consideration. M. Maitre (Nuclear Protection Evaluation Centre [CEPN], France) described the scope of the International Commission on Radiological Protection (ICRP) dedicated working party on business affected by emergencies, which aims to provide insights on the main challenges for the implementation of the radiological protection system with regards to economic activities in emergency and post-accident situations. The learnings from Japanese initiatives to support and promote community revitalisation were based on several examples: the Public-Private Fukushima Soso region Revitalization Joint Team demonstrating efforts to match business needs and job seekers (presented by Y. Nii from the Organization for Fukushima Soso region Revitalization, Japan); the plan implemented by the Alps Alpine Co. Ltd. company to fully engage in the regional reconstruction (T. Yoshioka, Alps Alpine Co. Ltd., Japan); the strategy to recover the market for Fukushima products from Y. Igarashi (University of Tsukuba, Japan).

5.1. Integrating economic activities into the implementation of the radiological protection system

Both direct and indirect economic impacts have been experienced in the whole region of Fukushima and beyond due to the global disruption triggered by the Fukushima Daiichi Nuclear Power Plant accident.

On the basis of these learnings, the ICRP has set a working party in 2017 to better identify the main issues at stake for economic activities through the analysis of a series of case studies located in different areas and covering different sectors. Some of the most important challenges were identified for companies where activities were maintained or restarted after the evacuation orders. These challenges deal with diverse topics as listed below.

- Decision about the preservation or not of the economic activities in an evacuated area should result from the implementation of the principle of justification. The justification process may explore how far the maintenance and recovery of economic activities should be favoured in evacuated areas and whether arguments to sell products made in contaminated environments could be defensible, acceptable.
- Another challenge is to implement the principle of optimisation that needs to well-characterise the radiological situation, and to set up radiological criteria that will define the conditions allowing: i) life/work in contaminated areas; and ii) sale of good-quality products from contaminated areas. A related difficult task would be to define the trajectory of evolution of these criteria over time.

- Radiological protection management of employees and their family members must be set by the employers and would require ad hoc skills and capacities that could be facilitated by a pre-existing radiological protection culture in the company (e.g. developing devices and information for monitoring workers' exposure and health, ensuring their training, making clear the employer's responsibility).
- The effectiveness of radiological protection implementation must be evaluated by appropriate radiological monitoring/surveillance: i) for protecting the public, notably concerning the use/consumption of products from the contaminated areas; ii) for workplace management; iii) for health surveillance of employees.
- Moreover, a continuation is needed regarding the quality insurance process for products, complemented notably by radiological criteria for managing the materials potentially affected by the contamination. These elements are essential to fight against consumer boycott, rumours and loss of image of local products.
- Finally, ethical considerations are to be developed to ensure access to information for all the concerned actors and promote informed decision-making processes.

Undertaking a joint assessment of the situation involving all stakeholders combined with ad hoc long-term vigilance has been illustrated by the example of Alps Alpine Co. Ltd. (Alps Alpine Co., Ltd. Iwaki-office, located approximately 40 km south of the Fukushima Daiichi Nuclear Power Plant develops, manufactures, and sells audio products for automobiles and information and communication products). This company explained the actions taken to cope with worker concerns regarding radiation exposure that lead to increase the number of voluntary departures of employees from the company after the accident. A plan was adopted by the company to build and disseminate relevant and persuasive information on radiological protection and safety via a series of science-based lectures provided by experts from Nagasaki University and individual private counselling to answer post-lecture questions. This was complemented by disclosing the results of ambient dose rate measurements and canteen food inspection on the intranet, by proposing whole-body counting to check internal contamination of employees and their families (note that people accepted to stop these measurements in 2019 in view of results being systematically below the detection level). The company also had to restore trust with customers worldwide and avoid harmful rumours since their overseas orders drastically decreased after the Fukushima Daiichi Nuclear Power Plant accident. A certification process was set by a well-established authoritative third party organisation in Germany (TÜV Rheinland). In addition, the company engaged in regional reconstruction in several ways. They contributed to the establishment and operation of the non-profit organisation "Iwaki Environmental Systems", as well as to events involving local communities. The key message from this example was twofold: "Engage in revival actions ourselves" as soon as possible and co-operate with local administration, and inhabitants; and "Act to widely convey that Fukushima has already recovered!".

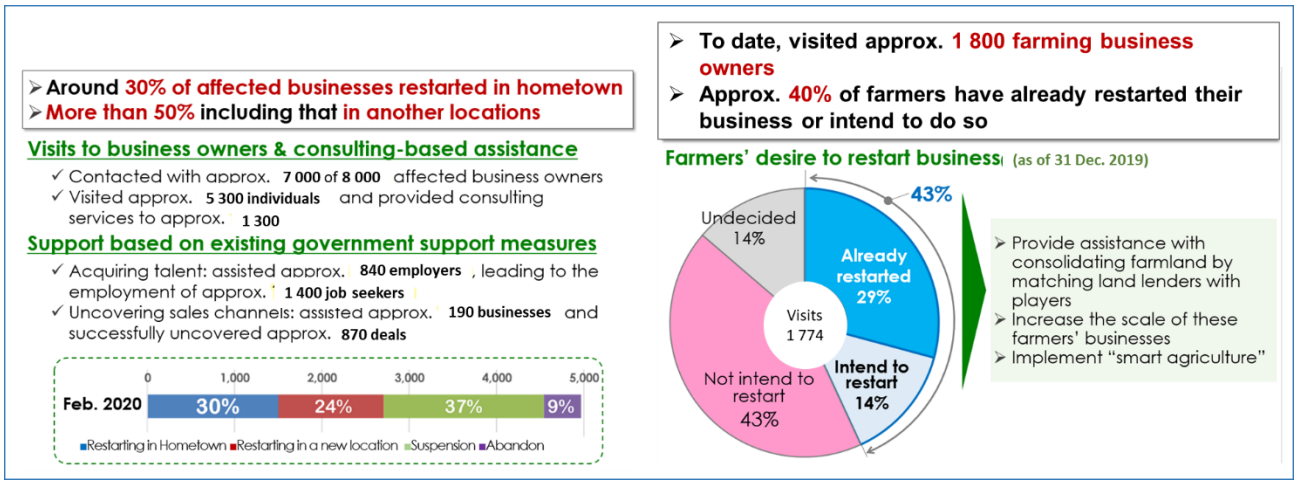
5.2. Lifting evacuation orders and restarting business: the revitalisation process

After the Fukushima Daiichi Nuclear Power Plant accident in 2011, residents, businesses and farmers were forced to evacuate from 12 cities, towns, and villages, and industry disappeared from the Fukushima Soso region. In 2014, the Japanese government began lifting evacuation orders, but without industry or employment, residents were unable to return even if they desired to. In response, in 2015 the government established the Public-Private Fukushima Soso region Revitalization Joint Team to assist in restarting affected

businesses. The Joint Team began by individually visiting each business (approximately 5 300 businesses were visited). Around 30% of those businesses had restarted in their hometowns, and more than 50% including those that reopened in another location. They also provided help to farmers through farmland consolidation and "smart agriculture" initiatives (Figure 4); they are currently acting to rebuild the business environment by attracting companies from outside the region and matching local businesses based around the Fukushima Innovation Coast Framework. The main lessons the Joint Team have drawn is to gather information locally, to build "trust" with all economic actors, to co-operate with professionals when responding to the various issues and to reflect local needs in government support measures.

Although some businesses have restarted, there still remain many issues to be tackled, for example, business continuity or deep-rooted reputational damage caused by harmful rumours.

Figure 4 – Some key figures to illustrate the support provided by the "Public-Private Fukushima Soso region Revitalization Joint Team" to restart affected businesses



Source: adapted from Organization for the Fukushima Soso region Revitalization.

The examples were shared of two contrasted market situations for two major crops originating specifically from Fukushima, cucumber and rice. Where Fukushima cucumber did not suffer any serious price drop in the Tokyo market after the disaster except in 2012, the market for rice from Fukushima exhibited another pattern with drastic price decreases. The main reasons are twofold: i) rice production and harvest are assured by all Japanese prefectures in the same season, and distribution and consumption occurs all year; ii) many rice brands from various prefectures are available, even in small supermarkets, so that consumers and distributors usually have numerous options for rice. In other words, the determining factor in the market is the presence of alternatives rather than the degree of radioactive inspection and countermeasures. The strategy to make Fukushima agriculture products less vulnerable to distributors' and consumers' avoidance and reputational damage, is to continue the social dialogue with those wary of eating food from the area affected by the nuclear disaster and to find alternatives, even temporary, to re-establish a market for suffering products like rice. One adopted pragmatic strategy was to accept the absence of visible Fukushima branding on rice by specialising in onigiri and bento use in convenience stores and ensuring more stable sales contracts with distributors (even at lower price).

Box 5: The business perspective

Faced with the very significant economic disruption created by the accident, there is a need for preservation of activities at the company level: the rationale for justification, conditions for maintaining activities and assistance needed by those affected, must be established by taking into consideration worries and expectations as well as the local societal context.

Anxiety in the workplace is a factor that can affect both workers and their families. Actions to limit this could include: i) providing information; ii) monitoring (people, workplace, products); iii) setting actions for protection/vigilance; iv) defining needs and actions for health surveillance; v) thinking about the long-term evolution; vi) respecting ethics (e.g. dignity, equity, autonomy).

Regarding Fukushima products, the situation may give rise to concerns and bans; it is important to restore consumer trust; actions that can help regain and maintain trust are varied and often case-specific (e.g. cleaning certificates; the specific case of agriculture). The image of the product is essential and approaches to limit discrimination as much as possible should be explored (e.g. preparing communication, ensuring promotion, ensuring quality improvement, maintaining or developing networks of all the players).

Globally, preparedness should concentrate to meet the goal of a self-standing and sustainable development through co-operation between stakeholders (public/private), establishment of global new projects, development of assistance to start new initiatives, restart existing activities and help return to "normal". There is a need to think positively about attractiveness, and to research how to match the long-term goals with the real needs of territories in the revitalisation process.

6. Well-being

This topical session focused on the well-being of evacuees and returnees in the Fukushima evacuation areas and the way mental health and general health issues in the affected communities have evolved with time and location. The session was introduced by a brief description of the goal and programme of work of a Nuclear Energy Agency (NEA) dedicated expert group, the Expert Group on Non-radiological Public Health Aspects of Radiation Emergency Planning and Response (EGNR) (J. Garnier-Laplace, NEA) to construct tools and solutions to mitigate mental health and psychosocial impacts of decision-making in nuclear emergency situations. The main lessons from Japanese experiences discussed during the session focused on the effectiveness of the support measures from the government to assist recovery of evacuees and returnees as presented by N. Mizuno (Cabinet Office, Japan); the challenges to re-establish an appropriate medical system with the example of the Futaba Medical Center given by K. Tanigawa (Futaba Medical Center, Fukushima Prefecture, Japan); and the support needs revealed by observations of health and well-being of Fukushima returnees presented by M. Tsubokura (Minamisoma City General Hospital, Fukushima, Japan).

6.1. Measures to mitigate mental health and psychosocial consequences must be integrated into decision-making for response and recovery; these measures are also key for efficient preparedness

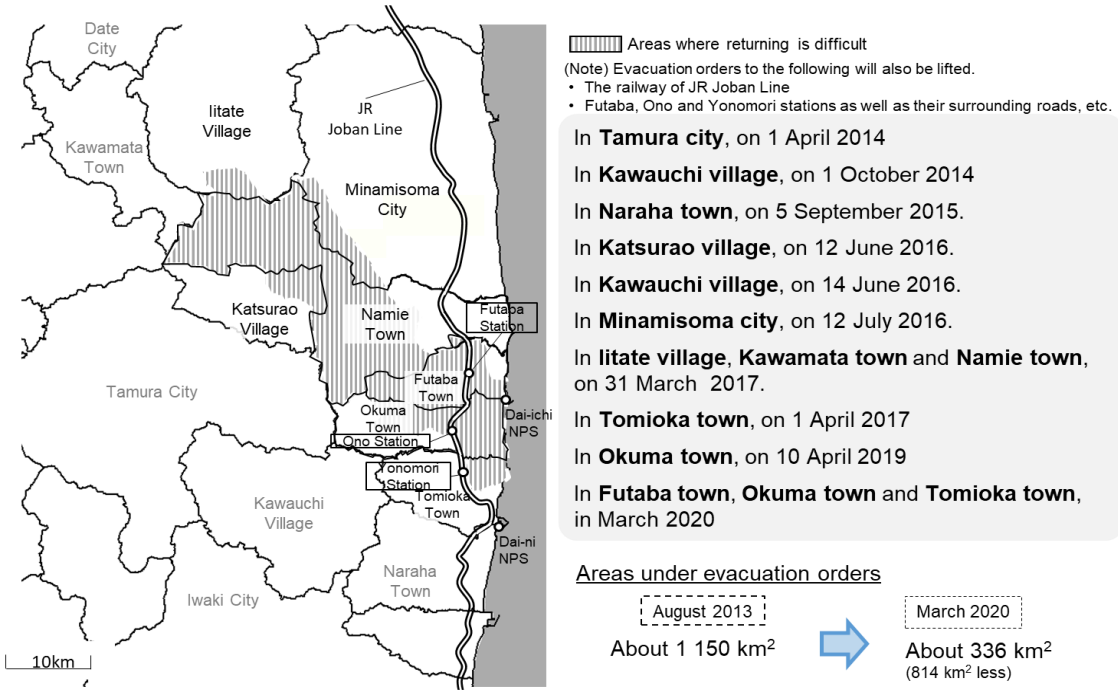
Taking into consideration non-radiological health aspects of nuclear or radiological incidents is not new and is among the requirement of the International Atomic Energy Agency (IAEA) International Standards GSR Part 7 (IAEA, 2015). However, it is unclear how to integrate mental health and psychosocial (MHPS) impact mitigation in the decision-making process throughout the entire emergency preparedness, response and recovery cycle. This is the reflection undertaken by an NEA dedicated expert group, the Expert Group on Non-radiological Public Health Aspects of Radiation Emergency Planning and Response (EGNR). As such, the EGNR's primary goal is to develop practical tools and approaches derived from the World Health Organization's (WHO) new Framework for managing MHPS impact of radiological or nuclear emergencies in order to support decision-making by emergency response planners, managers, responders and other relevant professionals (WHO, 2020). Such tools and approaches are greatly needed since MHPS consequences are generally associated with protective actions taken during any of the phases of an emergency, including recovery, and could benefit from experiences gained in non-nuclear fields. Any decisions made introduce drastic changes in daily life and may be more or less disruptive for individuals and communities according to the level of preparedness, the support provided and the local and specific conditions. The EGNR will deliver such tools and approaches in 2021-2022.

6.2. To accompany evacuees and returnees to affected territories, counsellors are key players to building trust and assuring that well-being support measures match local needs

The evacuation orders issued after the accident on the basis of the estimated annual dose above 20 mSv/y (i.e. in the so-called Special Decontamination Area (SDA) – see Chapter 3) concerned about 95 000 people with resident status in March 2011. Temporary housing was provided by the government, usually for two years, but was still continuing in some parts of the evacuation areas as of January 2020. Compensation from TEPCO for temporary housing and rent gradually phased out in municipalities of the evacuation areas, except for Futaba and Okuma town (1 139 people were still living in temporary housing in 2020). Support was provided by the government by sending staff to visit evacuees door-to-door to assess their mental and physical condition and to make the arrangements necessary for them to receive the services required. These counsellors were mainly medical doctors, nurses, retired administrative officers, retired teachers and radiation experts/workers.

Progressively, almost all orders of evacuation in restricted areas were lifted by spring 2020 once conditions fixed by the Nuclear Emergency Response Headquarters were met (Figure 5). The government transferred the necessary budget to the municipalities so that their deployed counsellors could provide comprehensive support for the evacuees who made the decision to return home. The counsellors became essential to building relationships of mutual trust with local people and communicating their concerns and needs to experts or local administrative officers. However, the situation for returnees remains challenging in various ways. Globally, the return rate in the different cities and towns from the SDA is approximately 20% (approximately 19 000 people out of 95 000) and is very contrasted, e.g. 75% for Hirono (where the evacuation order was lifted in September 2011) and 0% for Futaba, located in the difficult-to-return area (Crouail et al., 2020). Relevant ministries reinforced the role of the "Support Team for Residents Affected by Nuclear Incidents" to help evacuee's recovery by way of door-to-door visits, by supporting them in their move to a permanent residence, and even by connecting them with specialists (e.g. attorneys, psychiatrists) in order to solve specific individual issues.

Figure 5 – Sequence of lifting of evacuation orders and status by spring 2020



Note: Lifting of evacuation was possible where conditions fixed by the Nuclear Emergency Response Headquarters were met: i) an annual cumulative dose less than 20 mSv/y; ii) advancement in reconstruction of infrastructure and living services, and decontamination with a focus on children's living environments, iii) dialogue with local governments and residents.

Source: adapted from Nuclear Emergency Response Headquarters, Cabinet Office, Copyright Niriyuki Mizuno, 3 August 2020.

6.3. Challenges to re-establish appropriate medical services in regions where the healthcare system was lost – example of the Futaba region and health side effects observed in Fukushima returnees

The challenges met to reconstruct an appropriate healthcare system in an evacuated region, as demonstrated for the Futaba region, exhibit similarities with those described for the revitalisation process for businesses. Social and economic revitalisation and public health and community well-being are strongly interconnected. These two aspects can be successful only if supply fits societal or communities demand. This is a continuous challenge since both supply and demand exhibit dynamic changes influenced by actions or measures taken (e.g. evacuation order or lift).

Due to evacuation orders after the Fukushima Daiichi Nuclear Power Plant accident, only one (of eight) hospitals dedicated to psychiatric disorders, remained operational in the Futaba region, with no structure able to deal with health emergencies. Globally, 20 000 people are living in the affected area and require medical services whose work includes responding to the increased number of calls for health emergencies, in particular for decontamination of workers' injuries (note that during the daytime, approximately 20 000 personnel are engaged in decontamination/reconstruction projects, and decommission of

the plant). Poor access to medical services is the first reason cited by evacuees to not return. To meet this need, the Futaba Medical Center (FMC) was opened in 2018. Issues in re-establishing the medical system in Futaba region are many and varied, as shown in Table 2. Globally, the role of the FMC is to respond to disasters and nuclear emergencies, and to promote and support the health of residents and workers. The major challenge faced is to ensure staffing needs are met by: i) collaborating with academic institutions and other hospitals to allow personnel training and human resource development; ii) making the offer attractive to medical/nursing students by maintaining a high reputation and offering good teaching and living conditions; as well as iii) featuring FMC and Futaba to attract personnel by offering an improved living environment. Interestingly, to counteract depopulation and an ageing society – both very common in Japan – tele-medicine, and proactive approaches to attract and maintain excellent staff such as those mentioned previously that have been implemented in the Futaba region, are suitable for regions with similar problems.

Table 2: Issues in re-establishing the medical system in Futaba region illustrated by the causal relationship between the main features driving the evolution of the situation and the expected consequences in terms of public health

Main features of the evolution of the situation	Consequences
Marked increase in traffic as well as decontamination and reconstruction projects.	Increase in motor vehicle and occupational accidents.
Shortage of medical resources after the accident.	Significant difficulties in securing human resources due to loss of living environment.
Acceleration of population ageing after the accident.	Increase proportion of elderly residents with multiple pathologies requiring multiple medications (polypharmacy).
Increase of middle and old aged workers in reconstruction and decontamination projects.	Focus of Health management and prevention of illnesses on decontamination workers.
Staggered development of public transportation system over a large area.	Poor access to medical facilities.

Source: adapted from presentation given at the workshop by Dr Tanigawa, Director, Futaba Medical Center, Japan. Copyright Koichi Tanigawa, 11 August 2020.

In addition to health risks associated with radiation exposure, a wide spectrum of socio-economic-related health problems has been observed among evacuees and returnees. These non-radiological health risk issues are triggered by drastic changes in society and in daily life for the affected people and depend on each individual's mental resilience, relationships with family or friends, and the structure of the "new" community after any change has occurred. Overall, temporary long-term housing, as well as home return, led to increased isolation and decreased social network. This situation led to an ageing population, depopulation and a falling birth rate, which provoked the decline of local communities, and finally enhanced feelings of helplessness, sometimes triggered by conflicts between family members/generations.

When considering the health issues of returnees in the former evacuation zone, there should be increased awareness of the fact that most returnees are elderly, and that changes during the evacuation period will have aggravated their health conditions (e.g. hypertension, diabetes, obesity and other lifestyle-related diseases). For example, in Minamisoma City, the average public expenditure on nursing care per older person increased by 30%. (USD 2 210 vs. USD 1 693 prior to the Fukushima Daiichi Nuclear Power Plant accident)

(Morita et al., 2016). Actions to be implemented must: i) address local medical needs by providing outpatient rehabilitation, care of patients with multiple medical problems, home-visit medical care/nursing for those with poor medical access; and ii) prevent deterioration of pre-existing diseases by use of proactive approaches targeting high-risk residents with untreated and/or multiple medical problems in collaboration with local health professionals.

Clinical observations revealed a wide spectrum of socio-economic-related health problems among evacuees and returnees. Some examples are listed below.

- Psychological distress among returnees was lower than among evacuees, but was still higher compared to the national average (Murakami et al., 2019).
- The risk of delay in breast cancer diagnosis was significantly higher for those who are living without adequate family and social support. It is difficult to receive adequate treatment in the former evacuation zone for end-stage cancer patients, psychiatric patients and those with disabilities (Sawano et al., 2019).
- Many decontamination workers who are generally among new residents from outside Fukushima Prefecture are in poor health, possibly due to lower social status (Sawano et al., 2016).
- In cases where host residents received evacuees, host residents also expressed depression disorders, often linked to the empathy they felt towards the evacuees' situations. Any stigmatisation and discrimination towards evacuees was due to a lack of knowledge as well as a lack of interaction among the community (Tsubokura et al., 2018).

Box 6: Well-being concerns

It has been almost ten years since the Fukushima Daiichi nuclear accident and various issues concerning well-being still exist, both among the evacuees (e.g. loss of "normal way of life" and of interactions inside their community, stigmatisation and discrimination; suffering from a long-term evacuation and temporary housing) and among the returnees (e.g. loss of livelihood – unemployment, contaminated environment; loss of infrastructures – lack of schools, public transportation, hospitals).

These issues concerning well-being are clinically observed with a significant increase in various health problems (e.g. psychological and mental health issues, lifestyle diseases such as diabetes, cardiovascular diseases, late-stage management of cancers; anxiety from both affected population and host population, etc.).

Dialogue and exchanges with evacuees and returnees revealed the important role of counsellors in building a trust-based relationship with the affected population (e.g. individual visits in temporary houses, public meetings, etc.). Individual monitoring devices have also played a key role to help people to regain control of their daily lives and better understand what is at stake in their own environment.

The healthcare response was progressively developed so that support and services better matched local needs (e.g. nursing care for evacuees; implementation of the Futaba Medical Center Hospital) and ensured the long-term vigilance regarding the health of an ageing population and of nuclear workers (who were generally newcomers).

The most important remaining challenge is to find the appropriate balance between local expectations, in terms of healthcare services to appeal to newcomers and younger generations, and real needs (and funding) to develop facilities dedicated to elderly residents.

Issues concerning well-being are evolving over time and space. A long-term strategic action plan is needed and must be built by implementing participatory processes with local populations, while respecting ethical values such as dignity and autonomy of local populations. A multidisciplinary approach with a broader stakeholder involvement is essential to shift from a radiological protection strategy to a more holistic view of health protection, including mental health and psychosocial support.

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7. Conclusion and preliminary recommendations for preparedness for post-accident recovery process

Before concluding the workshop, the International Commission on Radiological Protection (ICRP) Scientific Secretary, Mr C. Clement, was invited to present the main points of the upcoming publication dealing with radiological protection of people and the environment in the event of a large nuclear accident (ICRP, 2020). S. DeCair, Vice-Chair of the Nuclear Energy Agency (NEA) Expert Group on Recovery Management (EGRM), shared the novel idea of a recovery process exercise and its importance. A wrap-up portion from each topical session of the workshop served as the basis for the conclusions and discussion with the audience about preliminary recommendations for post-accident recovery preparedness under the lead of the EGRM chair and vice-chairs.

The ICRP, through its forthcoming publication on the subject of radiological protection of people and the environment in the event of a major nuclear accident, underlined the added value of the co-expertise approach to assist the optimisation process and related decision-making. The co-expertise is defined as "a process of co-operation between experts and local stakeholders to exploit local knowledge and scientific expertise for the purpose of understanding the radiological circumstances, and developing actions by themselves or by others to improve living conditions." (ICRP, 2020). Various initiatives presented during the workshop illustrated the benefit from stakeholder involvement and dissemination of radiological protection culture among local people to allow informed protection decisions. Globally, this workshop enabled the sharing of experiences and lessons learnt related to various aspects of the Fukushima Daiichi nuclear accident recovery process, the collecting of insights and understanding of the current state of recovery in Japan and of the extraordinary effort deployed by a wide spectrum of actors (e.g. local and national authorities, experts, research organisations, universities, public or private laboratories or institutes, non-governmental organisations, local stakeholders, nuclear operators, etc.). As such, it provided a unique opportunity to discuss strategies that will help avoid hindrances and may accelerate recovery. It also gave food for thought to improve preparedness for post-accident recovery.

The concluding session of the workshop was mainly dedicated to putting the main findings into perspective of the recovery preparedness process dealing with topical issues. How thinking in advance globally (i.e. in a holistic and multi-sectoral manner, balancing health, social, cultural, economic, environmental impacts) aims to ensure that the emergency response strategy would tackle the emergency situation and would not delay or impede the recovery process. Preparedness for post-accident recovery would benefit from adopting a comprehensive and operational generic framework covering key aspects such as public health, radiological monitoring and dose assessment, risk communication, decommissioning and environmental decontamination (both strongly associated with waste management), food and drinking water management, business continuity, and the well-being of affected people and communities. Preparedness strategies should include actions targeting the resilience of societies and engaging local communities; the co-expertise process could largely help in meeting this goal.

Finally, the idea of exercising post-accident recovery management to practice and evaluate the effectiveness and efficiency of stakeholder involvement, and/or of any other issues at stake for recovery, was introduced and will be developed in the EGRM upcoming deliverable. Exercising the national recovery plans and procedures in place should be enable assessment of the plan's fit-for-purpose quality and its flexibility across a range of more or less severe scenarios. Preparedness for any scenario and scale is necessary but should be proportionate by thinking about "generic" arrangements scalable/flexible to a range of potential events.

A one-page summary key recommendations per topical issue for preparedness is provided below to give a preliminary overview of the content of the deliverable under development by the NEA dedicated ongoing expert groups, namely the EGRM and, to a lesser extent, by the Expert Group on Non-radiological public health Aspects of Radiation Emergency Planning and Response (EGNR), which focusses on mental health and psychosocial support.

TIPs (Topical Insights for Preparedness) for post-accident recovery

Monitoring and dose assessment

- An opportunity for stakeholder involvement. Discussion during "peace time" could help to share technical information (e.g. surveillance, food management, estimated doses vs. doses received, derivation of reference levels) and disseminate practical knowledge on radiological protection culture.
- A clear and meaningful link is needed between monitoring and dose assessment for both people and the environment; as well as environmental surveillance to inform human health, the issue of monitoring of the environment per se should be developed, since biodiversity preservation is also a protection goal.
- Development of the co-expertise process (e.g. by training experts to implement exchange with stakeholders using methods for pluralistic approaches).
- Elaboration of the evolution/termination process of a monitoring strategy. Plans for monitoring thought out in advance, should focus on links with food or drinking water restrictions and lifting, responsibilities among national, local organisations and stakeholders, use of data from various monitoring sources, process to re-evaluate the monitoring strategy as the situation evolves, elaboration of criteria that would help to define the termination, resources for monitoring needs, etc.

Environmental remediation and radioactive waste management

- Exercises for waste management to check whether there is an adequate planning depth and level of involvement of authorities other than radiological/nuclear safety authorities.
- Existing waste estimation tools to compare different options for remediation on the basis of case studies.
- Among options to reduce the amount of waste, exploration of recycling of low-level contaminated materials as considered in Japan. This demands: i) the adoption of a threshold below which the waste is considered as a conventional one; and ii) the analysis of the possibilities to reuse weakly contaminated materials for specific purposes where low-dose impact is expected.
- Communication to the public of all waste-related issues, needs for stakeholder involvement and risk communication.
- Development of guidance for a sustainable remediation approach, taking into account holistically environmental/radiological aspects, economic aspects, social aspects, etc.

TIPs (Topical Insights for Preparedness) for post-accident recovery *(cont'd)*

Food issues

- Strong overlap with many others (e.g. trade and economic situation, monitoring, waste management, stakeholder involvement, termination of a monitoring strategy).
- A specific public concerns with water usage (drinking water, irrigation, recreation) and should be addressed proactively.
- Food controls and more flexible criteria are needed to manage food safety. Regarding the regulatory strategy, any changes in the situation leading to release new radiological criteria should be explained and understood to avoid negative perception when values change. More than the issue of establishing those criteria, the regulation strategy needs to reflect and allow flexibility by entraining diet and cultural features. The goals of such strategy should be to: ensure the quality of the products; ensure consumer confidence; maintain the economy.
- New approaches are needed to cope with the issue of loss of image and/or for emblematic food products; consumers at risk (e.g. sensitive food, dietary habits).

Business issues

- Developing policy and regulation strategies to avoid barriers to trade, for commodities in general – and fresh foods in particular (due to time/storage limitations). Certification for importing/exporting: recommendations about exemptions should be explored further in the preparedness phase.
- Entraining industry, other activities and people into a sustainable economic model for recovery. Economic considerations go well beyond the responsibilities of regulatory authorities and concerns a myriad of business activities.
- Developing a collaborative framework for national and local regulators in assisting with sustainable development; consideration of an all-hazards approach.

Well-being

- Approaches/tools to develop for integrating mental health and psychosocial support (MHPSS) into decision-making to include e.g. well-being indicators, health surveillance strategy, training of healthcare professionals, mapping and adapting existing infrastructures and related available human resources at the local, regional and national levels.
- Definition of indicators for rating well-being levels and assessing the efficiency of MHPSS actions. These indicators should also integrate more logistical aspects, e.g. access to healthcare, public services for citizens, relationship of the community or groups to the natural environment.
- Develop guidance in connection with economic issues and the participatory process. Future guidance should consider how to engage participatory processes with the local population to agree on indicators of well-being/welfare, and to agree on the trajectory towards sustainable living conditions, while considering the respect of ethical values (autonomy, dignity, control and privacy, justice).

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Appendix: Programme of the NEA Workshop on Preparedness for Post-Accident Recovery Process: Lessons from Experience

Co-organised with the Nuclear Regulation Authority, hosted at the University of Tokyo (Japan)

Day 1: Tuesday, 18 February 2020

OPENING SESSION (10:00–10:45)
Chair: Jacqueline Garnier-Laplace, OECD/Nuclear Energy Agency

10:00–10:15	Opening Remarks *Nobuhiko Ban (Commissioner, Nuclear Regulation Authority, Japan)* *William D. Magwood, IV (NEA Director-General) by video* *Nobuhiro Muroya (NEA Deputy Director-General)*
10:15–10:30	Overview on the CRPPH Expert Group on Recovery Management (EGRM) *Thierry Schneider (EGRM Chair, Nuclear Protection Evaluation Centre – CEPN, France)*
10:30–10:45	Activities for Recovery Management in Response to the TEPCO Fukushima Daiichi Nuclear Power Plant Accident *Toshimitsu Homma (EGRM Vice-Chair, Nuclear Regulation Authority, Japan)*

SESSION 1: MONITORING AND DOSE ASSESSMENT (10:45–12:45)
Chair: Hiroshi Yasuda, Hiroshima University, Japan

Rapporteur: Daniel McDonald, Canadian Nuclear Safety Commission, Canada

10:50–11:10	Norwegian Experiences after the Chernobyl Fallout and Perspectives for the EGRM Guidance *Lavrans Skuterud (Norwegian Radiation and Nuclear Safety Authority – DSA, Norway)*
11:10–11:30	Current Radiation Monitoring Activity on Fukushima Daiichi Nuclear Power Plant Accident *Takuro Oguchi (Nuclear Regulation Authority, Japan)*
11:30–11:50	Radiological Effect on Workers and Residents during Post-accident Recovery Phase Studied by JNES *Ichiro Otsuka (Nuclear Regulation Authority, Japan)*
11:50–12:10	Assessment of External Doses to the Public after the Fukushima Daiichi Nuclear Power Plant Accident Considering Variability and Uncertainty *Shogo Takahara (Japan Atomic Energy Agency, Japan)*

12:10–12:30 Experiences and Lessons Learnt from Measuring and Assessing Individual External Doses during Post-Accident Recovery in Fukushima
Wataru Naito (National Institute of Advanced Industrial Science and Technology – AIST, Japan)

12:30–12:45 Discussion

12:45–14:00 **LUNCH BREAK**

SESSION 2: WASTE AND DECOMMISSIONING (14:00–16:00)
Chair: Sumi Yokoyama, Fujita Health University, Japan

Rapporteur: Tobias Schlummer, Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety – BMU, Germany

14:05–14:25 The UK Approach; Input and Perspectives for the EGRM besides the Contribution of Other Member Countries
Christopher Mogg (Environment Agency, United Kingdom)

14:25–14:45 Decontamination Outside the Plant in Fukushima
Seiji Ozawa (Ministry of the Environment, Japan)

14:45–15:05 Reflections on 9-years of JAEA R&D activities in Fukushima
Shinichi Nakayama (Japan Atomic Energy Agency, Japan)

15:05–15:25 Dose Estimation for Treatment of Contamination Wastes Generated from Fukushima Daiichi Nuclear Power Station Accident
Seiji Takeda (Japan Atomic Energy Agency, Japan)

15:25–15:45 Towards the Sustainable Management of Decontaminated Soil and Waste in Fukushima - What Factors to be Considered for Our Future?
Tetsuo Yasutaka (National Institute of Advanced Industrial Science and Technology – AIST, Japan)

15:45–16:00 Discussion

16:00–16:20 **COFFEE BREAK**

SESSION 3: FOOD (16:20–18:20)
Chair: Itsumasa Urabe, Fukuyama University, Japan

Rapporteur: Lavrans Skuterud, Norwegian Radiation and Nuclear Safety Authority – DSA, Norway

16:25–16:45 Lessons from the EC-funded PREPARE Project (Management of Food, Stakeholder Involvement)
Jean-François Lecomte, Vanessa Durand, Sylvie Charron (Institute for Radiological Protection and Nuclear Safety – IRSN, France)

16:45–17:05	Initiatives to provide a better knowledge for Japanese Consumers about the radioactive materials in food after the Fukushima Daiichi Nuclear Power Plant Accident *Ayako Kurihara (Consumer Affairs Agency, Japan)*
17:05–17:25	Concentrations of Radiocaesium, ^{90}Sr and ^{129}I in Agricultural Crops Collected from Fukushima Prefecture and Reference Areas *Hirofumi Tsukada (Fukushima University, Japan)*
17:25–17:45	Initiatives to Deal with Radioactivity in Fukushima after the Earthquake and Nuclear Accident *Kimiyo Hino (COOP Fukushima, Japan)*
17:45–18:05	Footsteps from the Great East Japan Earthquake - Experiences of Fukushima fishery industry and a fish shop in Iwaki. *Katsumasa Ookawa (Ookawa Uoten, Fukushima, Japan)*
18:05–18:20	Discussion
18:30-20:00	**Reception** ***Co-op Second Refectory (Seikyo Daini Shokudo)***

Day 2: Wednesday, 19 February 2020

SESSION 4: BUSINESS INTEREST IN EMERGENCY AND RECOVERY PHASES (9:15–10:55)
Chair: Michiaki Kai, Oita University of Nursing and Health Sciences, Japan

Rapporteur: Astrid Liland, Norwegian Radiation and Nuclear Safety Authority – DSA, Norway

09:20–09:40 Outcome from the ICRP Working Party on Business affected by Emergencies
Mélanie Maitre (Nuclear Protection Evaluation Centre - CEPN, France)

09:40–10:00 How to Restart Affected Businesses – Four-Year Experience by a Public-Private Joint Team - Presentation from Japan
Yasuhito Nii (Organization for Fukushima Soso region Revitalization, Japan)

10:00–10:20 What should be done after 9 years? - The current situation of Fukushima food products from a market point of view
Yasumasa Igarashi (University of Tsukuba, Japan)

10:20–10:40 Efforts Towards Erasing Anxiety over Radiation and Regional Recovery by Alpine
Tadashi Yoshioka (Alpine, Japan)

10:40–10:55 Discussion

10:55–11:15 **Coffee Break**

SESSION 5: WELL-BEING (11:15-12:55)
Chair: Takeshi Iimoto, The University of Tokyo, Japan

Rapporteur: Mélanie Maitre, Nuclear Protection Evaluation Centre - CEPN, France

11:20–11:40 Activities of the Expert Group on Non-radiological Public Health Aspect in EPR (EGNR) including the WHO Framework on Mental Health and Psychosocial Impact Support in case of Radiological or Nuclear Emergency
Keiko B. Shimazu (National Center of Neurology and Psychiatry, Japan)

11:40–12:00 Support Measures for Evacuee's Recovery in the Evacuation Areas in Fukushima

Noriyuki Mizuno (Cabinet Office, Japan)

12:00–12:20	Medical system in Futaba region after the Fukushima Daiichi Nuclear Power Plant accident - Moving forward towards the recovery of Fukushima - *Koichi Tanigawa (Futaba Medical Center, Fukushima Prefecture, Japan)*
12:20–12:40	Health and Well-being of Fukushima Returnees: What does the Future Hold? *Masaharu Tsubokura (Minamisoma City General Hospital, Fukushima, Japan)*
12:40–12:55	Discussion
12:55–14:00	**Lunch Break**

SESSION 6: GENERAL DISCUSSION (14:00-16:30)
LESSONS LEARNT FOR PREPAREDNESS FOR RECOVERY MANAGEMENT
Chairs: Thierry Schneider and Sara DeCair, Chair and Vice-Chair of the EGRM

14:05–14:25	Overview of the Framework for Preparedness for Post-Accident Recovery under Preparation – Expectations from the Workshop *Sara DeCair (Environnemental Protection Agency, USA)*
14:25–14:45	Views from ICRP for Preparedness for Recovery and Introduction of the ICRP Workshop in December 2020 *Christopher Clement (ICRP, Scientific Secretary)*
14:45–15:15	Summary of Workshop Sessions *Each rapporteur from sessions 1-5 will identify the lessons for preparedness captured during the workshop and will introduce the topics for discussions (5 min each)*
15:15–16:15	General Discussion
16:15–16:30	**CLOSING REMARKS**