ESI-CIL Nuclear Governance Project
*A multidisciplinary research project by the Energy Studies Institute & Centre for International Law*

# Post-accident Management of Radioactive Waste

## Regulatory and Policy Aspects

**By Patrick Reyners**

# Post-accident Management of Radioactive Waste: Regulatory and Policy Aspects

- The nuclear accident at the Fukushima Daiichi NPP (11 March 2011) generated a large volume of solid debris, contaminated water on-site, and released airborne radioactive material. This resulted in population evacuation in affected areas.
- The nuclear operator (TEPCO) and the Japanese authorities are still struggling with the consequences – particularly with the uphill task of controlling the high level of radioactive waste (RW) generated by the accident.
- Defining and implementing sound regulatory policy in such extraordinary circumstances is the topic of this presentation.

# When safety regulations have failed…

- The paradox of formulating management policies in place of existing safety regulations that have failed to prevent an accident from happening.
- The Regulator must adapt its policy to “prevailing circumstances” and to challenges resulting from the accident, adapting it again with every new development, as has been the case for Fukushima. It is an iterative process.

# Challenges for the Japanese Authorities

**On-site**

- To stabilize the remaining damaged nuclear fuel rods in the damaged reactors (units 1, 2, 3 and 4) and the spent fuel in storage pools (adding the risk of criticality to radiological hazards).
- To clear the solid debris on-site caused by the explosions in the reactors.
- To contain and store spilled water to ensure the cooling of damaged reactor vessels.

**Off-site**

- To assist evacuated population (some 100,000 persons) and to facilitate relocation.
- To decontaminate the environment to all extent feasible.
- To find a storage solution for the removed contaminated soil.

# The International Regulatory Context (I)

*"Legislation by catastrophe is a hallmark of* [the] *nuclear power industry."* (Prof. Gunther HANDL)

Two Post-Chernobyl Instruments:

- The 1994 Convention on Nuclear Safety.
- The 1997 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

# The International Regulatory Context (II)

Both “incentive” Conventions:

- Aim to prevent accidents and mitigate their consequences.
- Require the establishment of a comprehensive national regulatory framework.
- Provide for an assessment method of safety policies and the performance of participating countries through reporting and peer review exercises.
- Require the development of emergency preparedness plans.

# The International Regulatory Context (III)

Article 25 of the Joint Convention: *" Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency."*

In sum: *" An ongoing, gradual, sustained process that seeks to continually promote and improve safety worldwide."* ( IAEA source ).

**BUT,** some criticize the "motherhood and apple pie" tone of those Conventions.

# The International Regulatory Context (IV)

- A Post-Fukushima Ministerial Conference on Nuclear Safety held in Vienna (June 2011) recommended that an IAEA Action Plan on Nuclear safety should include, inter alia, EMERGENCY PREPAREDNESS.
- An indirect admission of Japan's inadequate preparation for the accident.

# The International Regulatory Context (IV)

Two IAEA relevant programmes:

**1. The Inter-Agency Committee for Response to Nuclear Accidents ( IACNRA)**

Defines the goal of Emergency Preparedness as *"to ensure that arrangements are in place for a timely, managed, co-ordinated and effective response at the scene and at the local, regional, national and international level, to any nuclear or radiological emergency."*

[IAEA GS-R-2 (2002)]

**2. The IAEA Emergency Response Network ( ERNET )** whose purpose is *"to provide worldwide assistance in a range of situations necessitating rapid response in order to mitigate the consequences of a nuclear or radiological emergency."*

[IAEA EPR-ERNET (2002)]

# The Japanese Regulatory Framework

- Fukushima: An accident made in Japan (government statement).
- The accident led to the creation of a new regulatory body: the Nuclear Regulatory Authority (NRA).
- The relevant legislation for normal operating conditions is the *Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors,* which provides, in particular, for the licensing and control of waste processing and disposal facilities.
- Following the accident, the Fukushima NPP is designated as a "Specified Nuclear Power Facility". As a result, the various remedial actions on the site are in substance treated as a derogation to the provisions of the above Act, while allowing for a continuation of regulatory supervision by the NRA.
- The regulatory policy situation is still subject to change.

# Classification of Radioactive Waste and Regulatory Implications (I)

An international classification of RW is found in the **IAEA Guide GSG-1 (2009):**

- Very Low-Level Waste (VLLW).
- Low-Level Waste (LLW).
- Intermediate-Level Waste (ILW).
- High-Level Waste (HLW).

Apart from short-lived waste, the norm is that all types of RW must be processed and disposed of in a manner consistent with the applicable safety standards of the Vienna Agency:

- Fundamental Safety Principles (2006-SF1).
- Predisposal Management of RW, in General Safety Requirements, 2009.

# Classification of Radioactive Waste and Regulatory Implications (II)

- The radiological, chemical, physical and biological properties of RW need to be taken into account as they will influence their further management.
- Careful planning and implementation of RW characterization may contribute to a significant reduction in processing time, cost and management efforts in the event of an accident.
- **HOWEVER**, experience (TMI-2) shows that RW generated by an accident may not fit easily with current classification (”abnormal waste”).

# Some Prior Experiences: TMI-2

In the case of the Three Mile Island NPP accident (1979):

With no off-site contamination and the main problem being the damaged fuel in the reactor vessel, the competent authorities (US DOE and NRC) agreed to handle the cleanup and decommissioning operations as some sort of experimental project for technological progress.

# Some Prior Experiences: Chernobyl

The Chernobyl accident (1986) was characterized by the destruction of the reactor 4 building and core and by a widespread contamination. One observes:

- A lack of accident preparation and of monitoring systems.
- RW cleanup operations were carried out in extreme conditions.
- A lack of inventory of the RW on the site and burial records.
- The damaged reactor 4 is classified as a "Shelter Object" (1986).
- A *"National strategy to transform the Shelter into an ecologically safe system"* has finally led to creation of a new shelter in 2016.
- A state-appointed Commission was tasked to seek a *"comprehensive solution to the Chernobyl NPP problems",* with the participation of national and local authorities but not the general public.
- A Law *"about the status and social protection of citizens affected by the Chernobyl accident"* focuses on compensation aspects.

# Post-accident Management of Radioactive Waste (I)

- The RW resulting from a nuclear accident may be of such a quantity or type that they cannot be accepted in existing RW repositories.

- Estimates of RW volumes on the site of the Fukushima Daiichi NPP:
  - Various solid debris: 175,ooo $m^3$
  - Felled trees: 85,000 $m^3$
  - Used protective clothes: 66,000 $m^3$
  - Contaminated water: 800,000 $m^3$

# Post-accident Management of Radioactive Waste (II)

- As a result, the installation concerned may find itself converted into an interim facility for the storage of its own waste for an indefinite period of time until a final disposal site can be established and licensed.
- Post-accident management policies must not only serve radiation protection purposes but also avoid generating more waste than strictly necessary, as this would make the ultimate disposal of waste more difficult.

# Post-accident Management of Radioactive Waste (III)

Beyond the technical aspects, the OPTIMISATION principle in the management of RW must take into consideration economic and social aspects, not only radiological factors. There may be difficult questions for the Regulatory Body:

- How to distinguish scientific data from social values judgments?
- How to integrate economic and social factors in decision-making processes without being involved in political issues?
- How to translate radiation doses into actual public risk levels?

# The Importance of Stakeholder Participation (I)

The importance of…

- developing consistent protection objectives;
- applying transparent methods when formulating regulatory approaches; and
- ensuring good communication about risks – and uncertainties;

… is that they can help affected people make "informed decisions" for themselves.

It calls for active stakeholder involvement and therefore it is necessary to identify them at an early stage.

# The Importance of Stakeholder Participation (II)

Stakeholders can be defined as: "*Any actor – whether institution, group or individuals – with an interest or a role to play in the societal decision-making process.*" (from a 2015 NEA Report on stakeholder involvement). For example:

- National/local government representatives.
- Municipalities and other local administrations.
- National expert bodies.
- Independent experts.
- NGOs.
- Nuclear operators.
- Citizens and groups of citizens.

In ordinary circumstances, it may prove sometimes difficult to mobilize stakeholders. However, expect a much larger participation in the event of an accident.

# The Importance of Stakeholder Participation (III)

Objectives of stakeholder engagement are:

- To take into account stakeholder concerns and expectations more effectively.
- To include them in a common evaluation of the post-accident situation and inform them better about radiation risks.
- To cultivate their autonomy and resilience.

- Stakeholders attitudes may reflect different (often contradictory) reactions, understanding or viewpoints on the consequences of an accident and on recovery measures. But engagement is nonetheless necessary.
- Underlines the importance of TRUST in relation to stakeholders.

# Concluding Remarks (I)

- Regarding the formulation of regulations and policies, there is no ready made model nor general formula for handling the management of RW after an accident.
- Every accident is unique, and the conditions of any post-accident scenario are unpredictable, calling for arrangements different from ordinary operating conditions.

# Concluding Remarks (II)

Considering this, it is suggested:

- To give a centralized authority the overall responsibility of the situation (for example: a high-level government commission).
- That the strategy initiated by such an authority seeks the involvement of stakeholders.
- That priority be given to a strategic plan for decommissioning and RW management, which in turn may allow compliance verification by the "implementers" of the plan.

# Concluding Remarks (III)

- That the realization of the plan follows a step-by-step approach and is subject to close and repeated regulatory approval (iterative strategy).
- That a proper distinction be made between urgent tasks (such as the remediation of land for the benefit of local communities) and those for which more time can be allocated (such as the decommissioning of the damaged facilities).

# Recommended Reading

*Management of Radioactive Waste after a Nuclear Power Plant Accident*

A report by the OECD/Nuclear Energy Agency, NEA No 7305, 2016.

# THANK YOU FOR YOUR ATTENTION!

**Patrick Reyners**

patrickreyners@yahoo.fr

ESI-CIL Nuclear Governance Project

www.nucleargovernance.sg