JUSTIFICATION, OPTIMISATION AND DOSE LIMITATION FOLLOWING NUCLEAR ACCIDENTS – AN ICRP PERSPECTIVE

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The ICRP system of radiological protection is a fundamental framework for dealing with any exposure situation in a systematic and coherent manner. At the centre, the system relies on the three principles of justification, optimisation and dose limitation. These principles are applied in the three exposure situations: planned, existing and emergency. ICRP Publications 109 and 111 (ICRP 2009a,b) focussed on emergency and existing exposure situations resulting from nuclear accidents, and were built on the experience of managing the Chernobyl accident in Europe in 1986, but were published before the events at Fukushima Daiichi nuclear power plant in 2011. An ICRP Task Group (TG93) was established in 2013 to update Publications 109 and 111 in light of the lessons learned from the management of Fukushima and from the series of dialogue meetings organised by ICRP in co-operation with national and local stakeholders starting in 2011. This presentation aims to provide the current ICRP perspective[1] on justification, optimization and dose limitation in emergency and existing exposure situations following a large scale nuclear accident.

The principle of justification ensures that any decision that alters the radiation exposure should do more good than harm. It is important to recognise that justification should be applied at different levels/scales and over different timeframes: situations evolve and prevailing circumstances change. For example, when planning for, or responding to an emergency exposure situation, justification should consider whether or not the overall protection strategy, will do more good than harm, taking into account the balance of harms and benefits associated with, for example, evacuation, sheltering and stable iodine prophylaxis. In the case of an existing exposure situation, justification applies initially to the fundamental decision to be taken by the authorities to allow people to live permanently in the long-term contaminated areas. Justification should then be applied on a smaller scale, where decisions on protection need to be taken at the local level. Here the implementation of strategies to improve the radiological situation must also do more good than harm in the broadest sense taking into account overall dose reduction and impact of the strategy on people and the environment in the affected area; specific needs of the individual should also be considered.

The principle of optimisation is intended for application to those situations for which the implementation of protection strategies has been justified i.e. at all levels and for all timeframes. Optimisation of the protection strategy ensures that the likelihood of incurring

[1] The report produced by TG93 will be subject to stakeholder and public consultation before final publication.

exposures, the numbers of people exposed and the magnitude of their individual doses should be kept as low as reasonably achievable, taking into account societal and economic factors. This means that the level of protection should be the best under the prevailing circumstances, maximising the benefit over harm. Optimisation is an iterative process. In order to avoid severely inequitable outcomes of the optimisation process, there should be restrictions on the doses to individuals from a particular source, through the application of reference levels.

The reference level can be taken as an indicator of the level of exposure considered tolerable, given the prevailing circumstances. Reference levels are values to inform decisions on protection strategies in existing and emergency exposure situations. Reference levels are tools to support the practical implementation of the optimisation principle firstly by identifying exposures that require more specific attention and then by reviewing the exposure scenario to further improve protection. Reference levels can be specified in measurable quantities (such as ambient dose rates, maximum permissible levels in foodstuffs) to facilitate their application in specific circumstances. These derived reference levels, must be realistic i.e. not too conservative.

In planning for and responding to wide scale nuclear accidents, ICRP TG93 is considering an update to its recommendations on reference levels to simplify their application (Table 1).

Table 1: Reference levels for optimising protection for members of the public in case of nuclear accidents[2]

Emergency exposure situation	Existing exposure situation
100 mSv or lower[a]	10 mSv/y or lower[b]
[a] Either in a short period or over a year [b] The long-term goal is to reduce exposures to the range of 1 mSv/y or less	

Publication 109 recommended selection of reference levels in the band 20 – 100 mSv for emergency exposure situations. TG93 recognises that under some circumstances it may be appropriate to select a reference level lower than 20 mSv, hence its new recommendation of selecting a reference level of 100 mSv or lower. Publication 111 recommended selection of reference levels from the lower part of the 1 – 20 mSv/y band. For clarity, TG93 now recommends selecting an initial reference level of 10 mSv/y or below, with a long-term goal of reducing exposures to the range of 1 mSv/y or less. Following an accident, annual doses will decrease progressively over time due to natural processes as well as remediation and other actions that are taken. Depending on the circumstances (i.e. presence of long-lived radionuclides) this could take years or decades, during which authorities may use intermediate reference levels to help identify exposures that require attention and stimulate continued improvements in the situation.

References

ICRP (2009a) Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations. ICRP Publication 109. Ann. ICRP 39 (1)

[2] The proposed change in reference levels for workers is presented by Jean-François Lecomte

ICRP (2009b) Application of the Commission's Recommendations for the Protection of People living in Long-term Contaminated Areas after a Nuclear Accident or a radiation Emergency. ICRP Publication 111. Ann. ICRP 39 (3)