ICRP Recommendations on Radiological Protection in Geological Disposal of Long-lived Solid Radioactive Waste

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ICRP C4, TG 80

The ICRP system of Protection
(Publication 103)

The fundamental principles

Justification

Optimisation

Dose Limitation

Dose Constraints and Reference Levels (ICRP)

Projected Dose (mSv)	Characteristics and Requirements	Type of Exposure Situation
20 - 100	Exceptional situations. Benefit on a case-by-case basis. Information, training and individual monitoring of workers, assessment of public doses.	Emergency Existing
1 - 20	Individual or societal benefit. Information, education and training. Individual monitoring or assessment.	Emergency Existing Planned
0.01 - 1	Societal benefit (not individual). No information, training or individual monitoring. Assessment of doses for compliance.	Planned

Terms of reference of TG 80 (1)

Develop a report which covers both the protection of humans (workers and the public) and the environment and discusses key issues like the transition from a planned to an existing exposure situation in case of a loss of control of the waste system as well as the applicability of dose calculated for the far future for decision aiding.

The report should update ICRP Publication 46, 77, and 81.

Terms of reference of TG 80 (2)

Provide guidance in plain language on:

1. **the basic concepts and terms, eg. the radiation protection principles, the different types of situations (planned, emergency, and existing), dose and risk constraints;**
2. **the nature and role of optimization ;**
3. **the use and application of dosimetric units and concepts at different time frames;**
4. **the role of stakeholder involvement in different stages of planning and development.**

Table of Contents of the Recommendations

1. Scope
2. Basic values and goals underlying protection for a geological disposal of radioactive waste
3. Application of the ICRP system of protection during different timeframes in the life of a geological disposal facility
4. „Endpoint considerations“ (The Representative Person and Protection of the environment)

Annex Glossary

Scope of the Recommendations

The report deals with the radiological protection of workers, members of the public and the environment, following the disposal of long-lived solid radioactive waste in geological disposal facilities.

The recommendations given apply to disposal facilities where there is still an opportunity for their implementation during the site selection, design, construction, and operational phases.

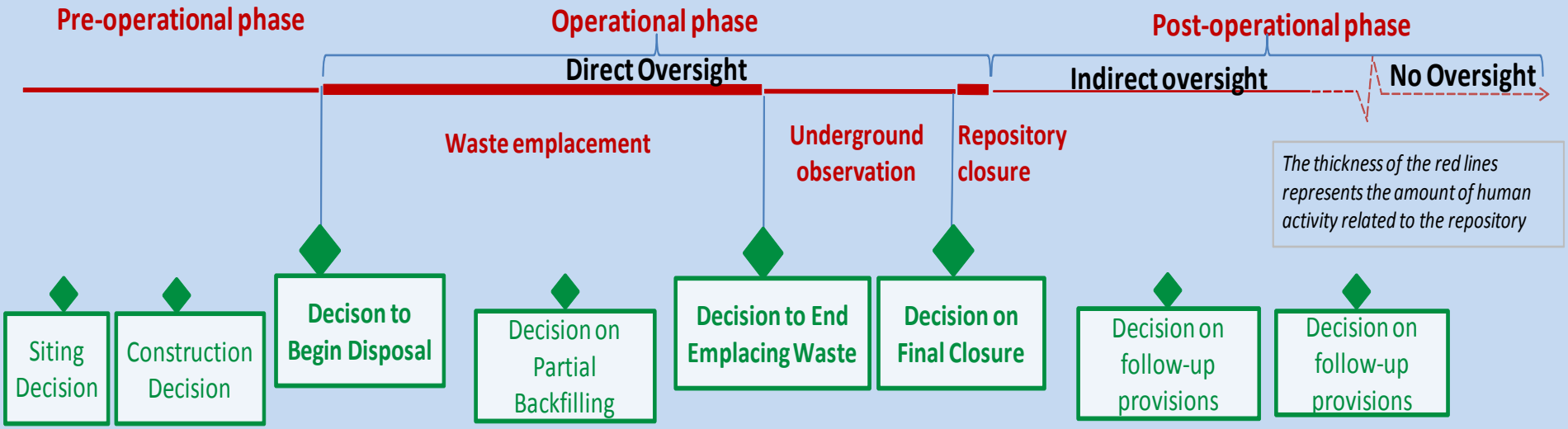
The report does not address near surface facilities.

The main protection issue dealt with are exposures in the far future. Any estimates of doses to individuals and populations will have growing associated uncertainties as a function of time.

Due to the long timescales, verification that protection is being achieved cannot be expected in the same manner as for current discharges.

The Commission recommendations rely on the basic principle that individuals and populations in the future should be afforded at least the same level of protection as the current generation.

Different phases of a geological disposal facility



The application of the radiation protection system of ICRP on long timeframe concerns oversight.

The level of oversight affects the capability to reduce or avoid exposures.

The application of the ICRP system of protection

Justification

The Principle of Justification: "***Any decision that alters the exposure situation should do more good than harm***."

Any practice that will give rise to exposure situations needs to be justified as stated in ICRP Publication 103. **Waste management and disposal operations are an integral part of the practice generating the waste.** It is wrong to regard them as a free standing practice that needs its own justification. Therefore, **justification of the practice should include the management options of the waste generated, e.g. geological disposal**.

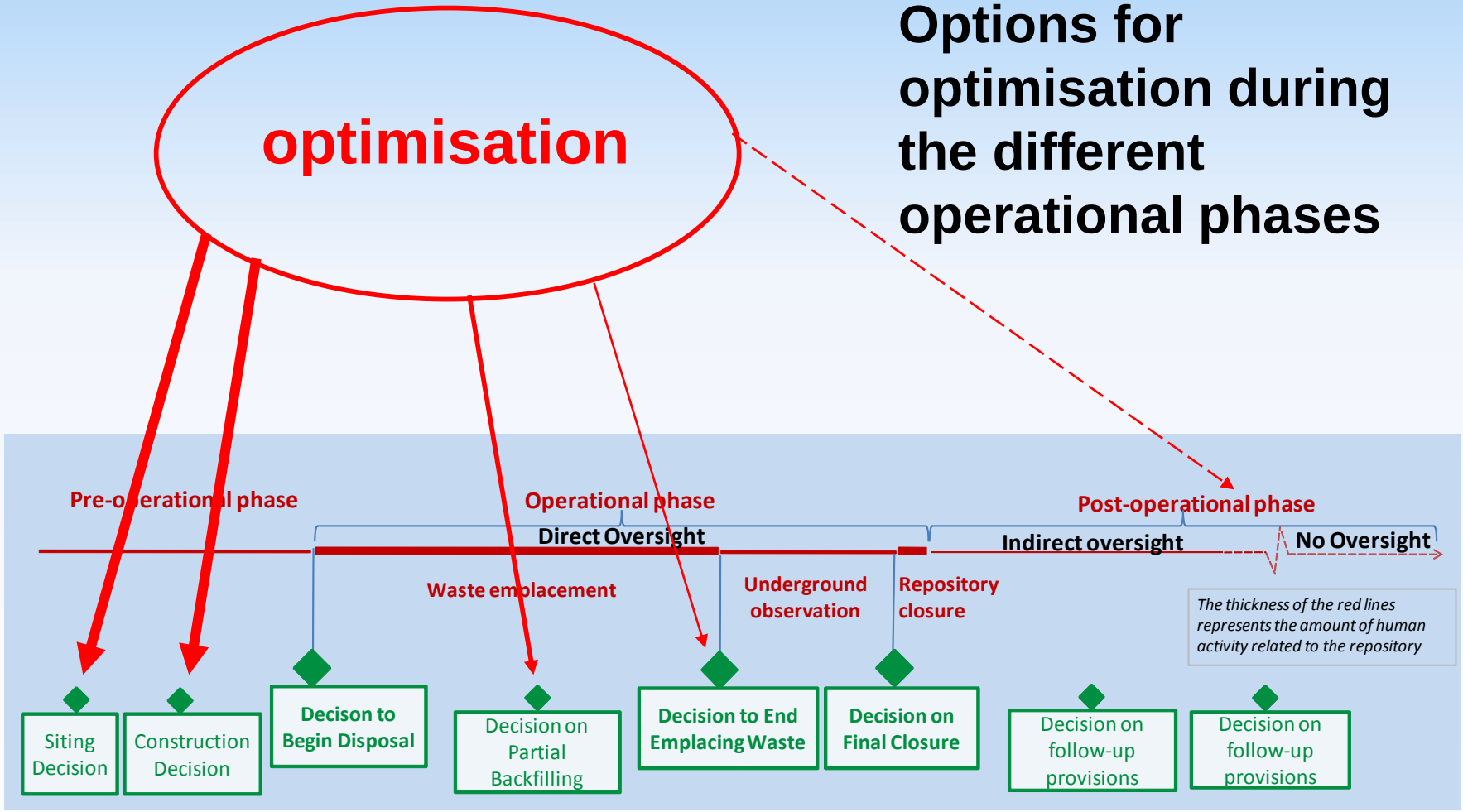
The justification of a practice should be reviewed over the lifetime of that practice whenever new and important information becomes available: such information may arise for societal, technical and scientific reasons. If waste management was not considered in the justification of a practice that has now ceased then the principle of optimisation of protection applies to the management of the wastes.

Optimisation of Protection

Protection can be considered optimized from an ICRP viewpoint provided that:

1. **due attention has been paid to the long-term safety implications of various design options at each step in the development and operation of the disposal facility;**
2. **there is a reasonable assurance that the assessed doses and/or risks resulting from the generally expected range of the natural evolution of the disposal system satisfy the appropriate constraint, over timeframes for which the uncertainties are not so large as to prevent meaningful interpretation of the results;**
3. **the likelihood of events that might disturb the performance of the disposal facility, so as to give rise to higher doses or risks, has been reduced as far as reasonably possible by the siting or design.**

The application of the ICRP system of protection



Basic ICRP principles dealing with future generations

The assessment of the robustness of the protection system provided by solid waste disposal facility in the long-term does not need a precise knowledge of the evolution of the general health of the population in the far future.

At the design stage, what is at stake is not to evaluate what would be the level of health effects in a group of population in the far future. The challenge is rather to estimate, in an optimisation process through a comparison (using dose and risk indicators) of options, the levels of protection achieved by a given disposal facility system and to judge if the estimated protection level of the chosen strategy is acceptable in the light of the level of protection accepted today.

RADIOLOGICAL EXPOSURE SITUATIONS AS FUNCTION OF DISPOSAL FACILITY EVOLUTION AND PRESENCE AND TYPE OF OVERSIGHT			
Disposal facility Status	**Type of Oversight**		
	Direct Oversight	**Indirect Oversight**	**No Oversight**
Design-basis[1] evolution	Planned (Normal and Potential) Exposure Situation[2]	Planned (Potential) Exposure Situation[2,3]	Planned (Potential) Exposure Situation[2,3]
Non-design basis evolution[4]	Emergency Exposure Situation at the time of exposure, followed by an Existing Exposure Situation	Emergency Exposure Situation at the time of exposure, followed by an Existing Exposure Situation[5, 6]	Emergency and/or Existing Exposure Situation, once exposure is recognized[5, 6]
Inadvertent Human Intrusion	not relevant	not relevant	Emergency and/or Existing Exposure Situation, once exposure is recognised[5, 6]

[1] The design basis is the envelope of both normal and potential exposures that are used in planning the facility.
[2] In the planning phase: both 20 mSv in a year dose limit to workers and dose constraints as specified by the operator; 1 mSv in a year dose limit for public exposures from all sources and **0.3 mSv in a year** dose constraint for waste disposal. For potential exposure of the public a risk constraint of 1×10^{-5} per year is recommended.
[3] No worker dose is foreseen during the period of indirect or no oversight. Releases in the far future give rise to potential exposure (ICRP 103, par. 265). Comparisons with the dose or risk constraint become increasingly less useful for compliance purposes at times further in the future.
[4] Non-design basis evolutions include very unlikely or extreme events that could result in significant exposure to people and the environment.
[5] If such an event were to occur in the future, the competent authorities of the time would assess whether it had resulted in an emergency exposure situation or in an existing exposure situation or the equivalent categories of exposure at that time. Assuming that ICRP 103 is still extant, it would be recommended to use its reference levels for emergency and/or existing exposure situations, as appropriate. In the period of no oversight the exposure may not be recognised immediately.
[6] At the planning stage, the potential radiological impact is typically evaluated using stylised or simplified scenarios. The results of those analyses can be used as indicators of system robustness by comparing them with numerical values. In that case, the application of the reference levels defined for emergency and/or existing exposure situations is recommended. It should be noted that a fully optimised system may result in a distribution of doses where some are above the reference level (ICRP 109, p. 37).

4 **Non-design basis analyses include very unlikely or extreme events that could be postulated to lead to significant exposure to people and the environment. If comparisons to numerical criteria are considered appropriate, the reference levels defined for emergency and/or existing exposure situations are recommended. For an emergency exposure situation a reference level between 20 and 100 mSv per year is recommended; for an existing exposure situation a reference level should be selected in the lower part of the band between 1 and 20 mSv per year, e.g., in the range of a few mSv per year.**

5 **If comparisons to numerical criteria are considered appropriate, the reference levels defined for emergency and/or existing exposure situations are recommended.**

Consultation process

29 web comments (95 pages) with specific questions for clarification and/or recommendations for improvement.

Consultation with IAEA-WASSC.

Consultation with OECD/NEA/EGIR-RWMC.

Status of the draft recommendation

In April 2012 the draft has been approved by ICRPMC for publication which is forseen for 2012

Possible future work

During their January 2012 meeting the members of the TG 80 report discussed the need for another ICRP document on surface or near surface disposal that revisits the ICRP Publication 81 on the basis of publications 101 and 103, and complements the recent recommendations on Geological Disposal of Long-Lived Solid Radioactive Waste.

This will be discussed by ICRP C4 during the September 2012 meeting.

Thank you for your attention

For further questions please ask me (wweiss@bfs.de)