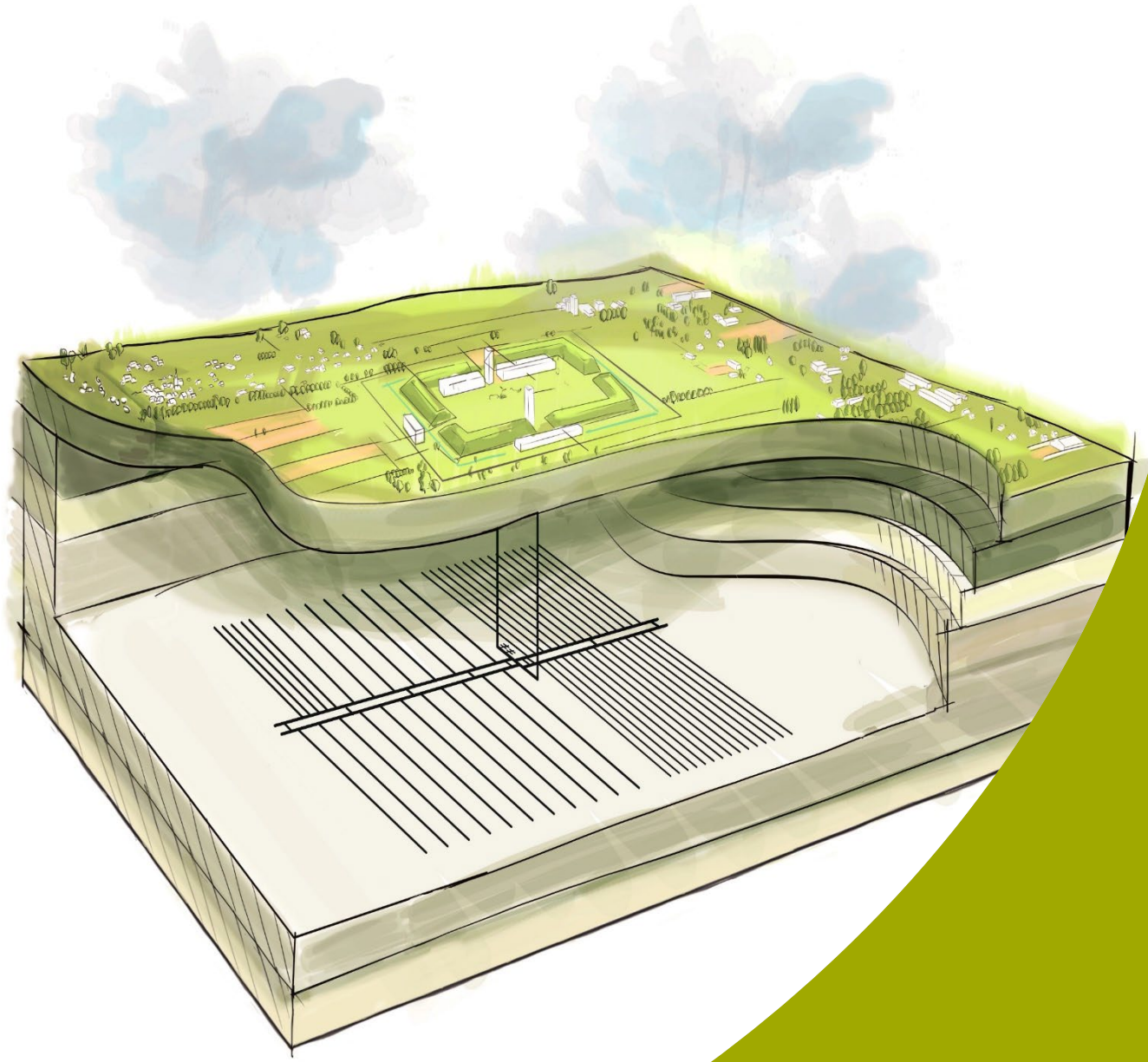

ONDRAF/NIRAS

The hybrid and complex nature of the optimisation principle.

From radiological protection to safety, from ALARA to SAHARA

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Outline

- A few questions to start with…
- History and the broadening of the optimisation
- Where do we stand ?
- Example of a conceptual issue
- Summary and conclusions

1- Are ALARA and optimisation principle synonymous in radiological protection ?

- "The **principle of optimisation** is defined by the Commission as the source related process to keep the magnitude of individual doses, the number of people exposed, and the likelihood of potential exposure **as low as reasonably achievable** *below the appropriate doses* constraints, with economic and social factors being taken into account." (ICRP-101, 2006)

→ The *dose limits principle* comes into play…

1- Are ALARA and optimisation principle synonymous in radiological protection ?

- In the management and control of exposures, an « order » to apply principles has to be respected **but**
  - Only for planned exposure situations;
  - Is this (general) management of exposures the optimisation ?

2- Is optimisation a RP principle or a safety principle ?

Optimisation of protection (and safety): The process of determining what level of protection and safety makes exposures, and the probability and magnitude of potential exposures, as low as reasonably achievable, economic and societal factors being taken into account. » (ICRP-103, 2007, p. 28)

→ It seems that RP and safety should be considered together in optimization…

2a – Are RP and safety synonyms ?

- *Protection: "The protection of people against exposure to ionizing radiation or radioactive materials (…)"*
- *Safety: "safety means the protection of people and the environment against radiation risks (…)"*

- *Nuclear safety: "**The achievement of proper operating conditions**, prevention of accidents or mitigation of accident consequences, **resulting in protection** of workers, the public and the environment from undue radiation hazards" (IAEA, glossary, 2007)*

2b – Relation between RP and safety ?

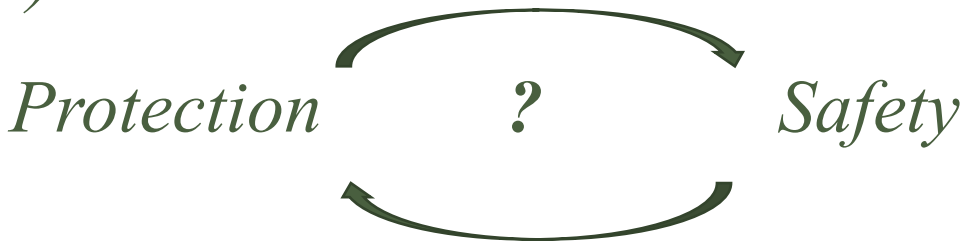
- *"Safety* is primarily concerned with maintaining *control* over *sources*, whereas *(radiation) protection* is primarily concerned with controlling *exposure* to *radiation* and its effects. Clearly the two are closely connected: *radiation protection* (or *radiological protection*) is very much simpler if the *source* in question is under *control*, **so *safety* necessarily contributes towards *protection*.** *(IAEA, glossary, 2007, p150)*

→ Protection *results* from safety…

→ Safety *contributes* to protection…

3- Link between *optimisation of protection* and *safety*?

- *"**Protection** must be **optimized** to provide the **highest level** of **safety** that can reasonably be achieved" (IAEA, SF-1, 2006)*



→How can **optimization** of protection lead to **maximization** of safety ?

→How to shift from **ALARA** to **SAHARA** ?

Where did this confusion come from ?

History of ALARA

- Evolution of its formulation :
  - ✓ ICRP (1955): to **reduce** exposures **to the lowest possible level**
  - ✓ ICRP-1 (1959): to **keep** exposures **as low as practicable**
  - ✓ ICRP-9 (1966): to **keep** exposures **as low as readily achievable**
  - ✓ ICRP-26 (1977): to **keep** exposures **as low as reasonably achievable**

  […] economic and social **considerations** being taken into account (**1966**-…)

  […] economic and social **factors** being taken into account (**1977** -…)

→ **ALARA principle** (formalization in 1977)

Broadening the optimisation: from a rule (ALARA) to a process

- **Optimisation continuously broadened** since 1977, without changing the 'ALARA formulation' :

  - "The optimisation is a forward-looking iterative **process** aimed at preventing exposures before they occur (...) Optimisation is a **frame of mind**, always questioning whether **the best has been done** in the **prevailing circumstances**" (ICRP-101, 2006)

  - "This means that the level of protection **should be the *best*** under the **prevailing circumstances**, ***maximising*** **the margin of benefit** over harm (…)" (ICRP-103, 2007)

Broadening the optimisation: from RP to safety…

- "The **optimization of protection** for a disposal facility is a judgmental process (…) Good engineering and technical solutions should be adopted (…) ***to ensure the quality of all safety related work throughout the development***, construction, operation and closure of the disposal facility" *(IAEA, SSG-23, 2012)*

… from nuclear safety to overall safety

- Safety as used here and in the IAEA safety standards (…) does not include non-radiation-related aspects of safety. (IAEA, 2007)

- « Nevertheless, the approaches to assessment described in this Safety Guide may also be of use in the assessment of hazards posed by non-radioactive waste and in ***optimization of protection and safety against all potential hazards***. » *(IAEA, SSG-23, 2012)*

And ICRP confirms IAEA…

- *"**Optimisation** has to be understood in the broadest sense as an iterative, systematic, and transparent evaluation of protective option, including Best Available Techniques, for enhancing the protective capabilities of the system and reducing its potential impacts (**radiological and others**).* » (ICRP-122, 2013)

- *As a central component, optimisation and the application of Best Available Techniques have **to cover all elements of the disposal system in an integrative approach** [i.e. site (including host rock formation), facility design, waste package design, waste characteristics] as well as all relevant time periods*. (ICRP-122, 2013)

Where do we stand?

A few major leaps

Domains

RP → Nuclear safety → Overall safety

Status

Rule → Process → Frame of mind

Nature

ALARA → … → SAHARA

Is this evolution justified ?

→ Open issues ?

Example of a conceptual issue…

- *"**Optimisation** has to be understood in the broadest sense (…), including Best Available Techniques (BAT), for enhancing the protective capabilities (…)* (ICRP-122, 2013)
- **Regarding geological disposal,** optimisation of safety applies (…) and encompasses **good engineering, good practices** (ICRP-81, 1998) **and good management** (IAEA, SSG-23, 2012).

- But BAT has its own history and theoretical framework.

Example of a conceptual issue…

BAT: Best *Available* Techniques

- *das Vorsorgeprincip* in 70's (precursor of precautionary principle), required to use the *best available technologies*.;
- BAT was further introduced by 84/360/EEC directive as BAT(NEEC)
- And finally, promoted as BAT~~(NEEC)~~ by IPPC 96/61/EC

→ Legally introduced by environmental law

→ Technically referring to the « availability » of a component (i.e., reliability in the « safety of industrial systems »)

Example of a conceptual issue…

- **“Stepwise optimisation decisions** mainly have to be taken in **chronological order** (e.g. the decisions on the choice of a host rock and on one or a limited number of sites are often prior to decisions on a detailed design)” (ICRP-122)

- Sequential optimisation of components ~~→~~ optimisation of the system ?

- Where does “stepwise” come from ?

  The strength of a chain is that of its weakest link

  (from *reliability of the systems,* the domain of *BAT*)

→ But is it still optimisation ?

Summary and conclusions

- From 1977, optimisation becomes a global process – not only restricted to operational radiological protection but – extended to safety. Optimisation becomes a " state of mind" and a management principle.

- Far from its original meaning, optimisation needs the support of BAT principle to conduct the development of all aspects of safety, including the non-radiological ones.

- In parallel, ALARA remains in radiological protection. A kind of duality is expressed in optimisation.

Summary and conclusions

- Is the rationale behind the extension of optimisation (broadening the process) well known and properly justified/substantiated ?

- Is the broadening of the scope of optimisation at the expense of consistency between concepts ? Do we still control the proper use of such a principle ?

- When we “optimise”, do we really follow the international guidelines or do we tailor optimisation to our needs and/or capabilities ?

Thank you for your attention !