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Optimisation of radiological protection applied to the development and implementation of a geological disposal

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OUTLINE

- Introduction - SITEX-II project,
- Methodology used (position paper on optimisation, objectives and scope, principles)
- The role of regulatory body and disposal facility operator
- Key messages
- Conclusions

Sitex-II project

SUSTAINABLE NETWORK FOR INDEPENDENT TECHNICAL EXPERTISE OF RADIOACTIVE WASTE DISPOSAL

INTERACTIONS AND IMPLEMENTATION

- The coordination and support action; duration: 30months
- 18 entities (TSOs, REs, NRAs, CSOs, educational institute) + Asociated Group
- 12 countries
- initiated in 2015 within the EC programme Horizon 2020 with a view to further developing the independent Expertise Function network in the field of deep geological disposal safety.
- aimed at practical implementation of Expertise Functions defined by the former EURATOM FP7 SITEX project (2012–2013), using the interaction modes identified by that project.

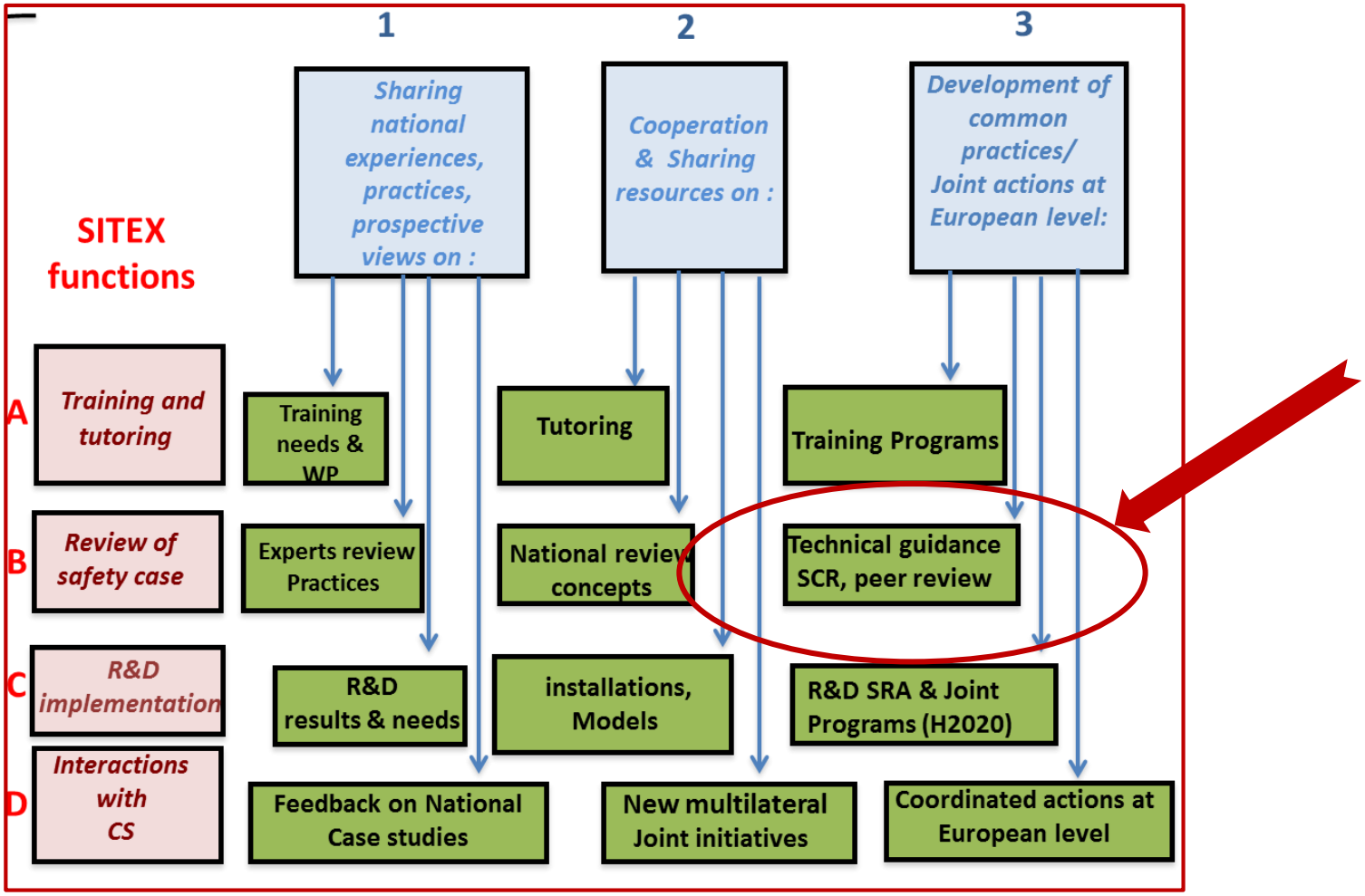
SITEX-II objectives

- **The definition of the Strategic Research Agenda (SRA)** based on the common R&D orientations defined by SITEX (2012-2013), the definition of the Terms of Reference (ToR) for the implementation of specific topics from the SRA, and the interaction with IGD-TP and other external entities mandated to implement research on radioactive waste disposal regarding the potential setting up of a Joint Programming (JP) on radioactive waste disposal; (WP1, BelV)
- **The production of a guidance on the technical review of the safety case** at its different phases of development, fostering a common understanding on the interpretation and proper implementation of safety requirements for developing, operating and closing a geological repository and on the verification of compliance with these requirements; (WP2, FANC)

SITEX-II objectives

- **The development of a training module for generalist experts** involved in the safety case review process, including the implementation a pilot training session; (WP3, LEI)
- **The commitment of Civil Society (CS) in the definition of the SRA**, considering the expectations and technical questions to be considered when developing R&D for the purpose of Expertise function. In addition, close interactions between CS and experts conducting the review work will allow enhancing the safety culture of CS and more globally, proposing governance patterns with CS in the framework of geological disposal; (WP4, Mutadis)
- **The preparation of the "administrative" framework for a sustainable Expertise Function network**, by addressing the legal, organisational and management aspects. (WP5, CV REZ)

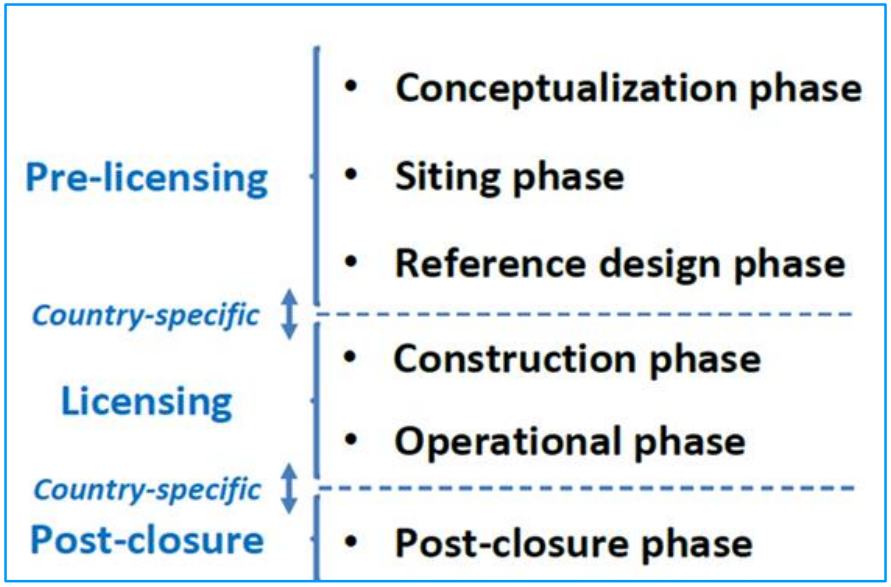
SITEX functions



SITEX-II: Approach to the optimisation of protection

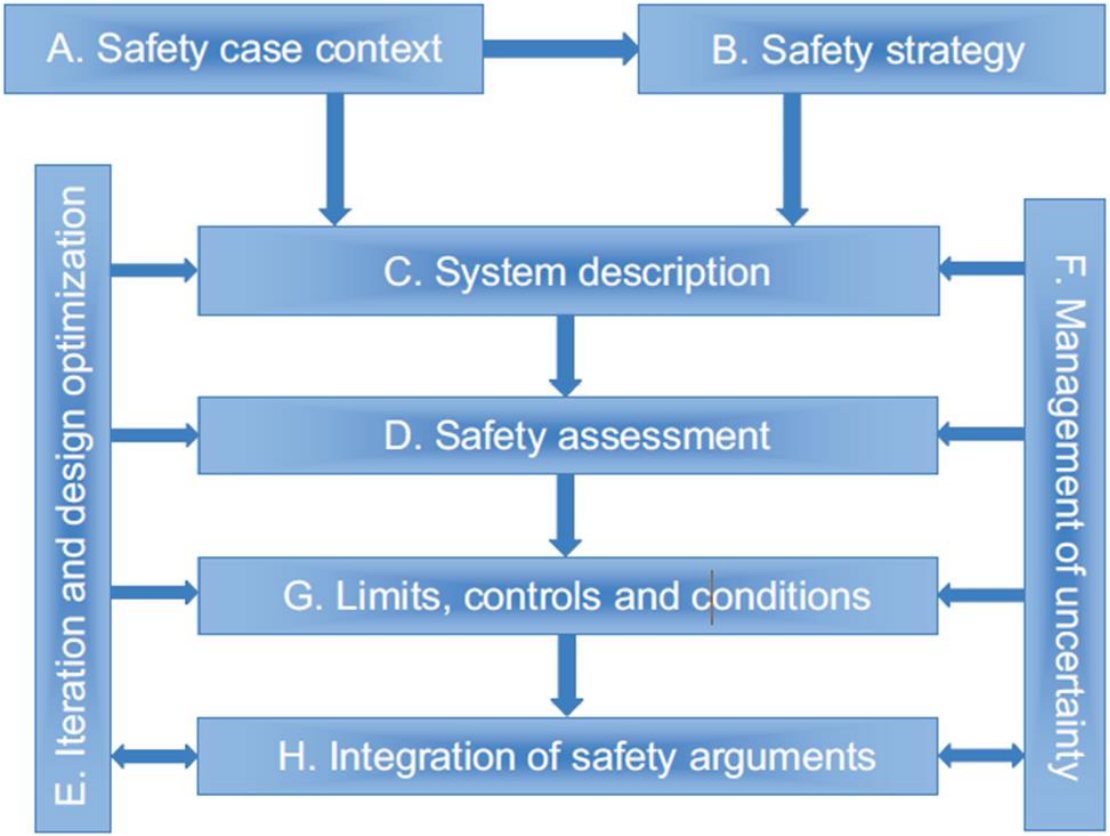
One of the KEY objective of SITEX iniciative (SITEX-II, WP2)

- To further develop a common understanding of the interpretation and proper implementation of safety requirements in the safety case for all phases of disposal facility development:



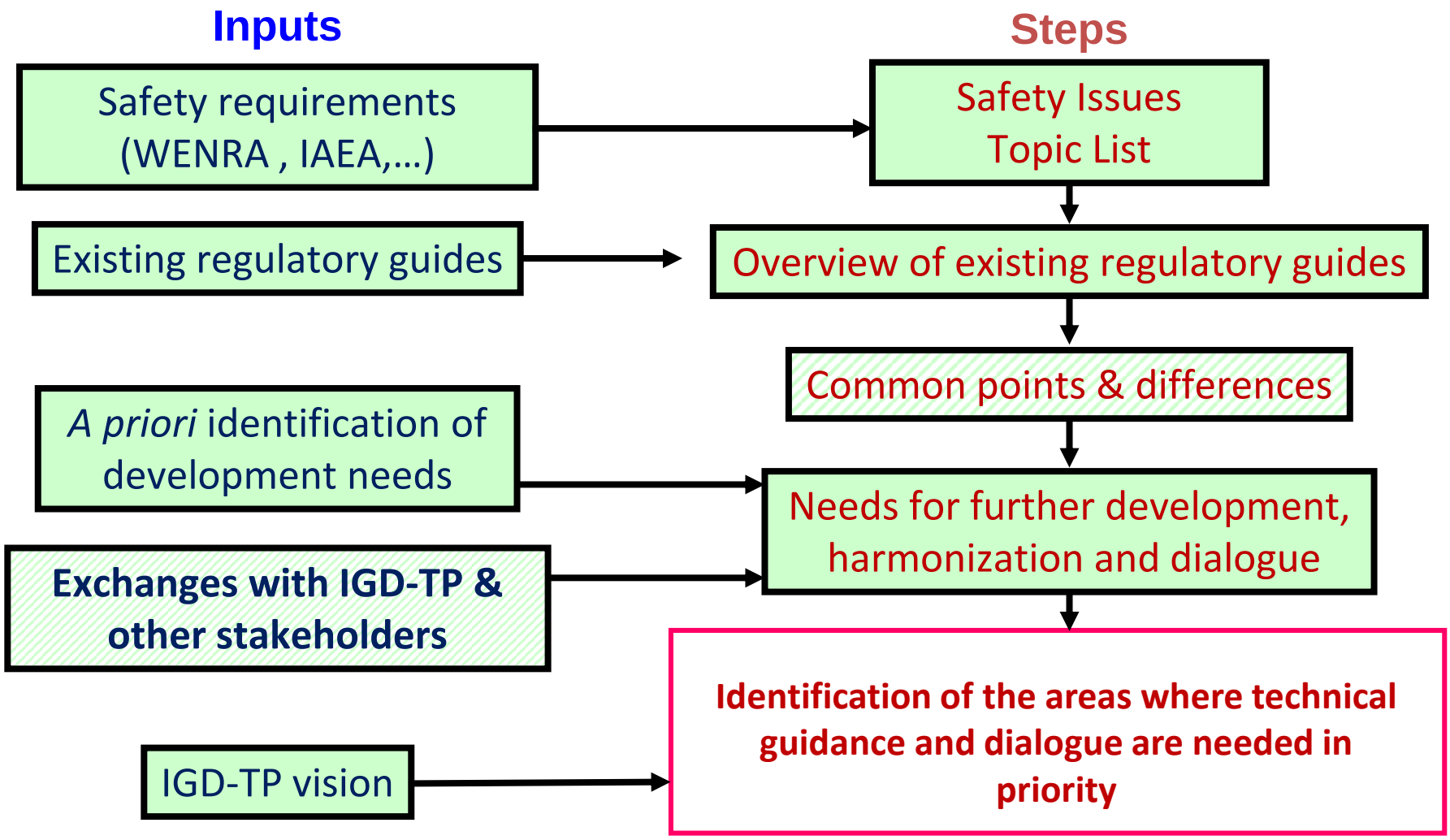
- position papers
- technical guidance with a review tools

Key aspects of the safety case (review & content)



Components of safety case. Specific Safety Guide No. SSG-23. IAEA.2012

Identification areas where guidance and dialog is needed



Position papers

4 topics of priority: Optimisation of protection

Waste acceptance criteria

Programme for site characterisation

Operational issues in regards with post-closure safety

objectives

- **share national experiences and prospective views on the interpretation and implementation of safety requirements**
- **exchange on how to implement in practice related high-level international requirements position papers provides:**
- **provide a reference to national regulatory bodies when they are developing their own technical guides**
- **provide a guidance to WMOs when developing the safety case during the various phases**

Position paper on protection optimisation – scope

- Only radiological protection in the sense of ICRP
  - acknowledgment of the importance of protection against non-radiological pollutants
  - depending of the countries, the ICRP optimisation principle can be enlarged or not to non-radiological issue
- Focus on geological disposal
  - however the outlined principles should be applicable to disposal of radioactive waste in general
  - the decision of geological disposal has been taken in national programme

ICRP principle on optimisation of radiological protection

- Optimisation of radiological protection in the sense of International Commission on Radiological Protection (ICRP) definition has been adopted in this work:

The likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable, taking into account economic and societal factors.

This means that the level of protection should be the best under the prevailing circumstances, maximising the margin of benefit over harm

ICRP (2007): The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37.

The role of regulatory body and disposal facility operator (1)

- The role and responsibilities of both the regulator and the disposal facility operator within the step wise process of a disposal radiological optimisation has to be clearly dedicated/defined;
- Reaching an optimised level of safety throughout the process of disposal facility development (e.g. conceptualisation, siting, reference design, construction phase, operational phase and post-closure phase, is a high level international requirement;
- An open dialogue between the implementer and the regulator at an early stage of the disposal development is necessary about the expectations and methodology for optimisation;

The role of regulatory body and disposal facility operator (2)

- It is important that the safety case shows that the principle of optimisation has been addressed in relevant choices and decisions on the disposal system;
- Level of resources is specific for each country as it depends on the national context:
  - legislative background,
  - extent and stage of the waste management programme,
  - availability of technologies,
  - expert capacities and capabilities,
  - public engagement, etc.

The role of regulatory body and disposal facility operator (3)

- A robust and effective management system for the optimisation process shall be established by the implementer and verified by the regulator;
- Key elements of this system comprise:
  - the responsibility allocation,
  - the provision of resources,
  - the specification of procedures and processes,
  - the transparent decision making process, as well as
  - the systematic examination of options.

Key messages (1): Principle of optimisation applicable for DGR?

- Yes, same objective as classical nuclear installations but the way to achieve it can be different
- **Acknowledgment that for long term safety**
  - increasing uncertainties with time on the calculated doses or risks (lose of their intrinsic meaning)
  - no control of actual doses can be exercised

➔ INDIRECT optimisation of dose reduction:
by optimisation of the performance of the DGR (i.e. the capacity of the components to fulfil the safety functions of containment & isolation in a robust manner)

➔ doses and risks can be used for relative comparison of potential radiological impact

Key messages (2/1): Optimisation proces during the disposal lifecycle

- **The system has to be optimised as a whole considering**
  - all the components of the system
  - all phases of development

➔ **short term and long term safety**

  - both have to be optimised across the full life of the geological disposal, and balanced as a whole,
  - impacts on each other has to be considered & assessed

➔ It is the global benefit for safety, which has to be considered

Key messages (2/2): Optimisation proces during the disposal lifecycle

- **Optimisation of protection applies to each phase of development and implementation**

Siting, including host rock selection

  - can be considered as a part or not of the optimisation process depending of the countries
  - anyway comparison of host-rocks should be based on defined criteria/attributes related to the performance to contain and isolate.

- **Chronological order of decision**
  - to avoid to go to far in the detailed design before to have a decision on the choice of the host rock and of a site

Key messages (3): How and when to make a decision to move forward?

- Although optimisation is a continuous effort, **milestones have to be defined in the stepwise process**
- The efforts set in optimisation should follow **a graded approach** taking into account the complexity of the facility and the type of waste considered
- Any **decision to go-back** should be the result of optimisation in the sense that the benefits to go back should be balanced with harm (efforts to go-back, dosis detriment, etc.), e.g. looking forward is not to conflict with reversibility
- **Delaying decision** should be considered in the balance between benefits and harm. Doing nothing (wait and see option) is not recommended by international bodies

Key messages (4/1): How to balance benefits over harm?

- **Implementer should do its best t**o consider all reasonable options
- It is important to have a **mutual dialog** between the regulator and the implementor on the **optimisation methodology from the beginning**
- **Comparison of options**
  - on the basis of safety/technical criteria/attributes
  - non safety/technical factors (e.g.: policy decisions and socio-economical issues), that may have to be considered in some countries, can bound the decisions to various extents, such as by limiting the available options and/or by defining additional conditions

Key messages (4/2): How to balance benefits over harm?

- **Both qualitative and quantitative judgements**
- **The "optimum"** (taking into account prevailing circumstances)
  - considered to be reached once the benefit in protection becomes small in regards to the resources (financial, human, …) needed.
- The implementer shall ensure that the safety case shows that the **principle of optimisation has been addressed in relevant choices and decisions** on the disposal system
- Any choices in the safety case need to be justified based on the safety objective and the safety requirements

Key messages (4/3): How to balance benefits over harm?

- Frame of mind - **always questioning if the best has been done** to reduce doses in the prevailing circumstances

Should be **systematic and carefully structured** to ensure that all relevant aspects are taken into account

➔ important **to document the process**

➔ should be covered by the **management system**

- Requires **commitment at all levels in all concerned organisations** as well as adequate procedures and resources

- Best available technologies (BAT) can be considered as part (or to support it) of the optimisation process but broader than only BAT

Conclusion (1)

- ***Optimisation* of radiological protection does not mean *minimisation*** of radiological impacts as the best option is not necessarily the one with the lowest dose.
- The optimisation of radiological protection in the sense of ICRP definition is a **process which consists of the identification and use of safety criteria/attributes necessary** to select the best protective options under prevailing circumstances.
- Optimisation of long term radiological protection of geological disposal requires taking into **account uncertainties regarding doses and risks for the very long term** in comparison with other nucleaar facilities.
- Both operational and long term radiological protection **have to be optimised from early phases and across the full lifecycle** of the geological disposal, and balanced as a whole.

Conclusion (2)

- Waste disposal is the final stage of the waste management lifecycle. However, the **optimisation process shall cover also corresponding predisposal technologies**, such as conditioning and packaging, as the waste management system shall be optimised as a whole, i.e. considering all its components.
- The optimisation of radiological protection **process is stepwise and iterative**, it shall be duly planned and adequate milestones identified upon inception.
- **The regulatory body shall verify that the optimisation principle and associated requirements have been adequately implemented throughout the disposal development**.

Acknowledgement

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