RD&D for the future: needs of the TSOs

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JOPRAD

SITEX-II Technical Expertise network Radioactive Waste Disposal

HORIZON 2020

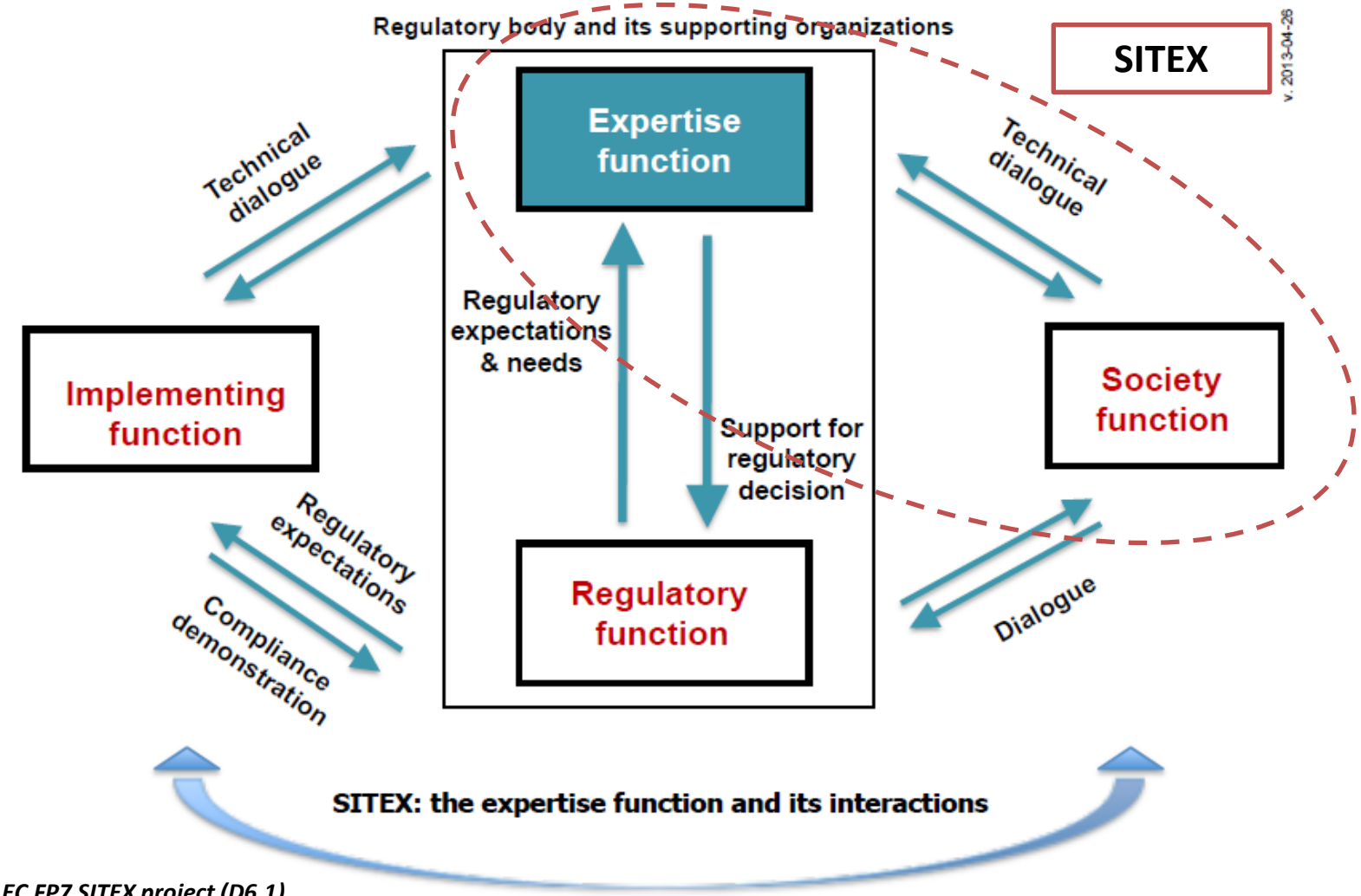
RD&D Needs for the TSOs

- SITEX : the Expertise Function
- SITEXII : the SRA
- Why partnering with WMOs, REs and Citizens?
- The way forward with JOPRAD
- Conclusions

SITEX : the Expertise Function

- the SITEX initiative (EC Project SITEX 2012-2103 and SITEXII 2015-2017) brings together organizations fulfilling an “expertise function”
- The “expertise function” entails activities carried out in the context of the regulatory review of the Safety Case and provide the technical and scientific basis for notably supporting the decisions made within the regulatory function

the « Expertise Function » at national level



EC FP7 SITEX project (D6.1)

SITEX : the Expertise Function

- These activities may include:
  - Conducting safety reviews
  - Developing the capacities to understand and assess the Safety Case
  - Contributing to inspections
  - Interacting with Civil Society along the review process and developing appropriate governance patterns to conduct this interaction
  - Implementing R&D in safety

SITEXII : the SRA

- Topics for which a sufficient level of common interest has been expressed
- The needs identified in the SRA include **R&D and horizontal activities** (i.e. exchanging on practices, establishing states of the art & transferring knowledge)
- Scope of the SRA:
  - Topics relevant to assess whether geological disposal facilities are **developed** and will be **constructed**, **operated** and **closed** in a safe manner
  - Topics related to **pre- and post-closure safety** and to the **technical feasibility** of geological disposal
  - Topics related to **pre-disposal management** of radioactive waste and spent fuel having an impact on the safety of geological disposal

Categorization of scientific topics relevant for TSO

Waste inventory and source term

- **R&D** on waste form degradation mechanisms, leaching rates of various radionuclides, radionuclide speciations, etc.,
- **HA** : radionuclide inventories , the waste acceptance criteria (WAC), the verification of the conformity to them.
- **HA**: new treatments and conditioning, such as thermal processes and new mineral matrix other than usual concrete (e.g. geopolymer), are also foreseen.
- existing knowledge related to release processes and WAC : candidate for **transfer of knowledge** (less advanced programmes)
- IAEA project “Status and trends” or the NEA expert group on inventorying and reporting methodologies (EGIRM)

Categorization of scientific topics relevant for TSO

Transient THMBC conditions in the near field

- **R&D** oxidative transient during the construction and operational phase, notably with regard to corrosion of metallic components, and chemical transient induced by metallic and/or cement components on clays
- Generation processes and rates of safety-relevant gases other than H_2 (CAST)
- Influence of gas on geochemistry and microbial activity in host rock (HR) and EBS, and associated impact on radionuclide transport (MIND)
- Uncertainties still exist on processes driving gas migration through Excavation Disturbed Zone (EDZ) and EBS, with possible saturation levels and scenarios of bentonite evolution or with alkaline plume
- **HA**: interpretation of the outcomes of the former FORGE project, Transients associated with co-disposal of radioactive waste

Evolution of EBS material properties (1/2)

- Heterogeneous behaviour of bentonite components.
  - Improvement of existing models to account for the time-dependence of Hydro-Mechanical (HM) processes
  - Coupling of these HM processes with Thermal (T) and Chemical (C) processes should also be improved; bentonite transformation due to interactions with canister material is of interest at long term → mechanical stability, swelling pressure and related radionuclide migration
  - Influence of these processes on the effective closure of a disposal facility (e.g. performance of seals and plugs on the long term and large scale)

Evolution of EBS material properties (2/2)

- **R&D** Evolution of metallic and cementitious components
- impact of radiations on cement material properties important for safety
- **HA**: exchanging on container design and manufacturing issues (e.g. modelling codes and standards and QA/QC programs and procedures for container design and manufacturing)

Categorization of scientific topics relevant for TSO

Radionuclide behaviour in disturbed EBS and HR

- **R&D** Effects of :
  - degradation product fronts (e.g. corrosion products), metal fronts (Mn, Cu, Ni, Fe, …) on RN sorption and sorption competition and bentonite properties in general,
  - organic matter fronts on RN sorption in cementitious environment and competition of RN with Fe,
  - temperature fronts on mineral precipitation/dissolution rates
- microbial activity related to these fronts

Safety-relevant operational aspects

- **R&D** monitoring system (follow up Modern2020)
- Fire and explosion: modelling tools to simulate the behaviour of a fire and the generated smokes in galleries and disposal vaults, using theoretical laws and parameters values, potential for run-away (uncontrolled) chemical reactions (e.g. WIPP)
- HA: risk of flooding, influence of disturbed events on long term safety (IAEA GEOSAF)

Categorization of scientific topics relevant for TSO

Managing uncertainties and safety assessment

- **HA**: exchanging and developing states of the art on the management of uncertainties associated with site characteristics, and more particularly: the present state of the site (e.g. uncertainties associated with the upscaling of lab measurements to site characteristics, the transposition of characteristics from one site/host rock to another, transfer of (sorption) data from diluted systems to compacted systems, ….) ; possible geodynamics and tectonic perturbations of the site at the long term
- transferring knowledge and exchanging about review approaches

Lifecycle of a disposal programme and its safety case

- **HA**: develop guidance for reviewing the safety case
- how to assess the feasibility of a geological disposal concept (e.g. expectations of the expertise function on the methodology that should be followed to assess the feasibility) ?
- evolution of the safety case content with the lifecycle of the disposal facility
- organization of the pre-licensing phase
- reversibility and retrievability

Categorization of scientific topics relevant for TSO

Socio-technical topics

- **R&D** on interdisciplinary topics embedding societal and technical issues → how to address with citizens the complexity of :
  - Application of the optimization principle
  - License of disposal operation
  - Conditions for closure
  - Site selection process
  - Safety culture in the context of geological disposal
  - Intergenerational governance of the operational phase

Why partnering with WMOs, REs and citizens/NGOs?

- Fostering between Waste Management Organizations, Technical Support Organizations and Research Entities a shared understanding of the overall system behaviour and of RD&D needs for managing the radioactive waste in a responsible manner, through to disposal,
- Recognizing the strong social dimension in the management of radwaste, that implies innovation in the management of RD&D and transverse activities for 1/ dealing with interdisciplinary topics embedding societal and technical issues and 2/ interacting with citizens during the implementation of the activities → e.g. BEACON
- Continuously analysing the need for, developing and sharing the required knowledge, and transforming mature knowledge into commonly agreed upon guidance, and
- Sharing, developing and making effective use of human, technical and administrative competencies and resources.

The way forward with JOPRAD

- The SITEXII SRA was used by the TSO WG of JOPRAD as a basis for the identification of the activities that TSOs could share in a JP with WMOs and REs
- The TSO WG represents the views of **(potentially) mandated TSO actors** responsible for R&D on radioactive waste management including geological disposal at the national level
- 16 (potentially) mandated TSOs were identified in EU Member States and Switzerland
- **7 TSOs responded positively** to the invitation to participate in the WG
- The WG includes:
  - 3 members of the JOPRAD Consortium
  - 7 technical "3^{d} parties"

JOPRAD TSO Working Group

Organisation	*Country*
Bel V	Belgium
CV-REZ	Czech Republic
IRSN	France
GRS	Germany
TS Enercon Kft (TSE)	Hungary
Centre for Physical Sciences and Technology (CPST)	Lithuania
Nuclear Research and consultancy Group (NRG)	Netherlands
Instituto Superior Técnico (IST)	Portugal
DECOM, a.s.	Slovakia
Jozef Stefan Institute (JSI)	Slovenia

The way forward with JOPRAD

- Remaining challenging issues:
- The inclusion of such topics into a scheduled programme of activities → Prioritisation with WMOs and REs
- The definition of governance rules for JP

Conclusion

- SITEXII and JOPRAD collaboration useful for moving towards joint RD&D and IKMS – confidence between actors and willingness
- SITEXII SRA proposes numerous horizontal activities, reflecting the needs for fostering exchanges and establishing joint positions (not only RD&D)
- Major innovation in framing and governing RD&D projects or CSA: the association of citizens with scientific background and the implementation of socio-technico topics embedding social and technical aspects that reflects the complexity of radwaste management in the society

Thank you for your attention