SMALL AND ADVANCED MODULAR REACTOR WASTE GENERATION AND MANAGEMENT IN EURAD-2 WP4 FORSAFF

Timothy Schatz, VTT

WHAT IS EURAD-2?

EURAD-2 is a European partnership focused on radioactive waste management under the EURATOM Research & Training Programme

- Participants include WMOs, TSOs and REs
- 5 years (October 2024 – September 2029)

Research & Development
scientific research and
technological innovation

Strategic Studies
short-term, cross-cutting collaborative
studies on complex or emerging issues

Knowledge Management
knowledge preservation and transfer between
organizations, Member States and generations

WHAT IS FORSAFF?

FORSAFF (Waste Management <u>for</u> <u>S</u>MRs <u>a</u>nd <u>F</u>uture <u>F</u>uels) is a Strategic Study Work Package (WP4) in EURAD-2

The primary aim of FORSAFF is to identify knowledge gaps and provide recommendations for future research in SMR/AMR waste management
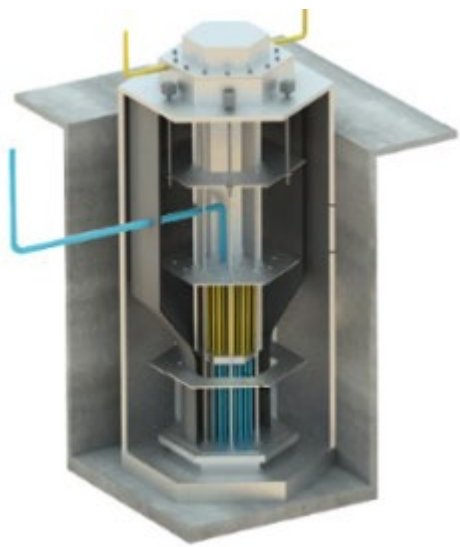
➢ Evaluate SMR/AMR waste inventories.

➢ Review management routes for SMR/AMR wastes.

➢ Examine national policies and regulatory frameworks in the context of SMR/AMR fuel cycle and waste management as well as stakeholder perceptions and concerns.

Continue as a second wave R&D proposal over the last three years of EURAD-2
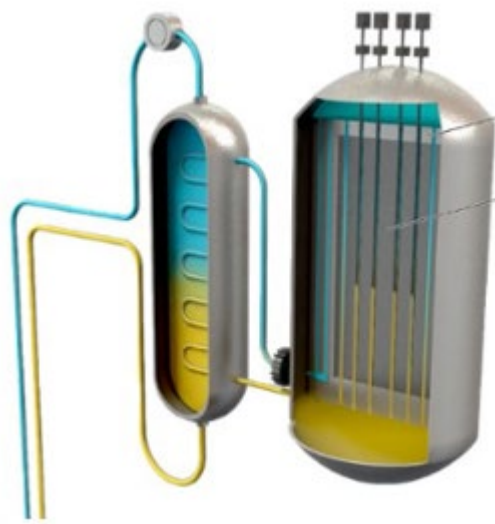
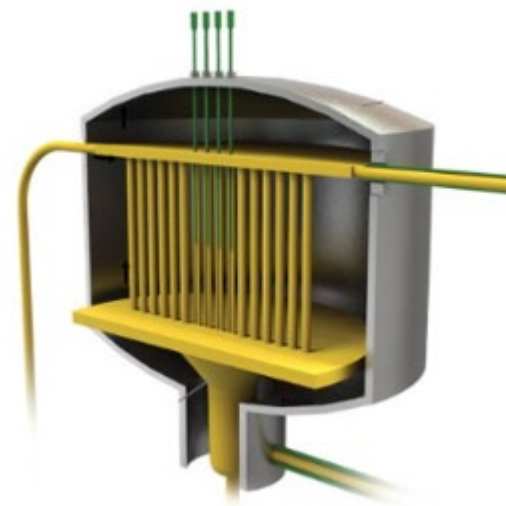*!EURAD-2 Wave 2 Proposal Meeting tomorrow afternoon!*
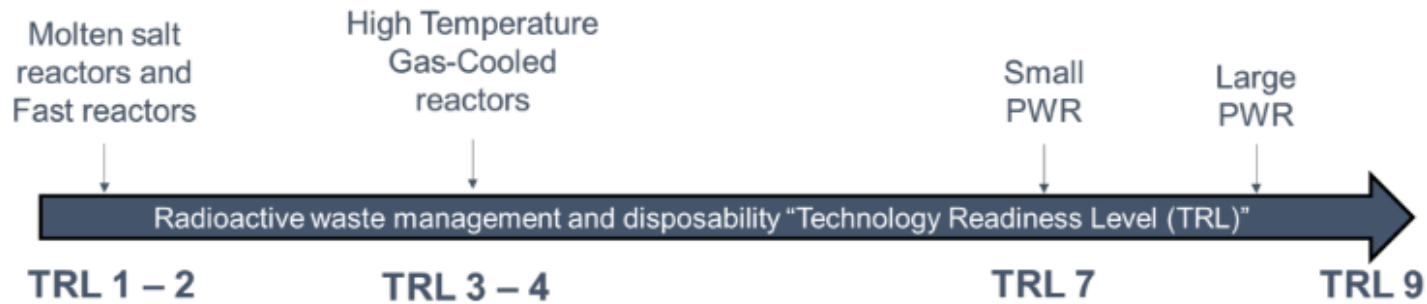
FORSAFF SCOPE

LWRs   **HTGRs**   **LMFRs**   **MSRs**

https://x.com/GovNuclear/status/1990587533613310012/photo/1

eurad2

SMR/AMR WASTE MANAGEMENT

❏ Nuclear waste will vary substantially depending on the technology, design and operating conditions.

Molten salt reactors and Fast reactors

High Temperature Gas-Cooled reactors

Small PWR

Large PWR

Radioactive waste management and disposability "Technology Readiness Level (TRL)"

TRL 1 – 2   TRL 3 – 4   TRL 7   TRL 9

https://assets.publishing.service.gov.uk/media/65c26c9ca6838e000d49d589/corwm-smr-and-amr-position-paper.pdf

❏ Preparation for the back-end fuel cycle of non-LWR SNFs (AMRs) will require considerable effort, given their distinct natures.

➤ **new approaches to nuclear waste management will be required to realize large-scale deployment of these reactors**

SMR/AMR WASTE MANAGEMENT R&D NEEDS

❑ R&D activities are readily identifiable, particularly with respect to the less mature AMR waste management.

❑ Recognise that the largest uncertainty in several topics is the lack of input data; i.e., conservative assumptions and sensitivity analyses should be used until proprietary data become available.

   - wide vendor and design developer buy-in

❑ EURAD-2 Wave 2 does not offer unlimited time or budget (plus there might be EURAD-3, etc)

➢ **How to prioritize R&D focus?**

NUCLEAR ENERGY AND SMRs/AMRs IN THE EU LANDSCAPE

❑ Of the four commercial projects in Europe with firm agreements and stated delivery ambition in the 2030s, all are light-water reactor types.

❑ Of the nine projects the European Industrial Alliance on SMRs put forward for 2030s deployment, six are light-water reactor types.

❑ It is projected that 75% of small reactors deployed in Europe by 2050 will be light-water reactor types (Nuclear Europe, European SMR pre-Partnership)

➢ **Waste-management R&D for light-water SMRs is the most urgent, most valuable in the near term, most feasible, and may unlock capability needed for all other reactor types.**

R&D TOPICS

❖ Determine RN inventories in SMR/AMR spent fuel under various burnups, enrichments and power densities to include impurity and structural material effects

  – expand existing numerical tools to SMR/AMR designs

❖ Assess disposability of SMR/AMR spent fuels

  – existing or proposed facility concepts, co-disposal, DBD
  – fuel characteristics (e.g., dissolution rates), packaging (e.g., criticality safety)

❖ Predisposal

  – treatment and conditioning of AMR waste streams (liquid metal coolants, molten salts), decontamination of structural AMR components, recycling of AMR waste streams

R&D TOPICS CONT.

❖ Reprocessing of AMR fuels

   – advanced actinide/lanthanide separation techniques, optimization of uranium extraction, scalability, adaptation of existing facilities

❖ Governance and accountability

   – licensing approaches (new operators, responsibility arrangements, oversight mechanisms) for (decentralized) SMR/AMR systems

❖ Societal

   – public conditions for trust, transparency and dialogue frameworks, engagement models

THANK YOU!