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SNETP Forum

Day 2, 13.05.2025

Parallel Session I.2: The European Alliance to develop, demonstrate and deploy SMRs by early 2030s (16:00 – 18:00)

Panelists:

- Peter Baeten, Director-General, SCK-CEN, BE
- Olli Kymäläinen, Technical Director, Fortum, Fl
- Virginie Wasselin, Chef du service stratégie filières, ANDRA, FR
- Ghislain Pascal, Policy Officer, DG ENER, EC
- Hidde Baars, Director Government Affairs NL and EU, URENCO, NL
- Jan Prasil, Director, Ministry of Industry and Trade, CZ

Moderators:

- Angelgiorgio lorizzo, EC DG RTD
- Fabio Nouchy, Italian YGN, Tractebel BE, INYG

Rapporteur:

Ivan Horvatovic, SCK-CEN, BE



European Industrial Alliance on SMALL MODULAR REACTORS

13 May 2025

Ghislain PASCAL European Commission Directorate General for Energy (DG ENER)



nucleareurope

Sustainable Nuclear Energy Technology Platform



European IA on SMRs – Objectives

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grow-EU-SMRS-ALLIANCE@ec.europa.eu

deployment of SMRs projects in Europe in the early 2030s.

development, demonstration, &

Main Objective

Facilitate & accelerate the

Specific Objective I

Provide **customised support** to all SMR projects deemed eligible for support under the Alliance

Specific Objective II

Enabling conditions to ensure the further deployment, operation, and maintenance of SMRs in the medium and long term.



European IA on SMRs General Assembly

Brussels, May 29 – 30, 2024





Kadri Simson 🧔

Honoured to open the 1st General Assembly of the #SMRAlliance & happy to see such a great mix of participants.

There is a lot of momentum behind SMR's & Europe will need all lowcarbon sources to play their role in achieving decarbonisation.



Thierry Breton 🧔 @ThierryBreton • May 29 Nuclear energy is back! 💷 🏹



The Commission's call for the new Small Modular Reactors #Alliance has met a great enthusiasm.

With 300+ members already, the Alliance is ready for business to manufacture and deploy by early 2030s "#MadeInEurope" SMRs

#SMR

Iliana Ivanova @Ili Ivanova · May 29

Honoured to address the first General Assembly of the European #SMR Industrial Alliance, together with @KadriSimson & @ThierryBreton 4

Small Modular Reactors hold great potential for clean electricity, and R&I is key to the success of the Alliance.





European IA on SMRs – Governing Board + secretariat



Alliance Governing Board members:

J. Panek (chair, EC), J. Nunes de Almeida (vice-chair, EC) Y. Desbazeille until March 2025, E. Brutin (nucleareurope), B. Salha (SNETP) N. Rega (TWG1, CEFIC), P. Baeten (TWG2, SCK-CEN), V. Ramany (TWG3, EDF), M. Ricotti (TWG4, Polimi), M. Martell (TWG5, GMF), O. Kymäläinen (TGW6, FORTUM), H.Baars (TWG7, URENCO), M. Jedlicka (TWG8, CEZ), M. Brugmans (observer, ENSREG)



Alliance Secretariat members: PASCAL Ghislain (ENER) VIHANTA Jussi (ENER) IVANOVA Ivelina (ENER) PANTALOS Nikos (GROW) IORIZZO Angelgiorgio (RTD) ALDAVE DE LAS HERAS Laura (JRC) AL MAZOUZI Abderrahin (SNETP) GOICEA Andrei (nucleareurope)

European IA on SMRs – TWGs







European Industrial Alliance on SMALL MODULAR REACTORS

Find out more



Contact us: grow-EU-SMRS-ALLIANCE@ec.europa.eu

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European Industrial Alliance on SMALL MODULAR REACTORS

TWG 2 Action Plan Update Chair: Peter BAETEN Vice-chair: Michel PASQUET





Overhaul

Public administration

ETP

125 Organisations

TWG 2 Governance & Events

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CEA

CIEMAT

ENEA

UJV

NCBJ

TWG-sub groups

- 1. Core performance R&D:
 - TH, neutronics, Chemistry, ...
- 2. Materials R&D:
 - properties, compatibility, ageing, ...
- 3. Safety demonstration R&D:
 - Passive safety, severe accidents, Human factors
- 4. Modularization and components:
 - manufacturing, qualification,
- 5. Digitalization (incl Cybersecurity): Tractebel
 - Digital Twins, AI, ...
- 6. Test facilities and Demonstrators, Innovation clusters:
 - mock-ups, infrastructures, integral VTT experiments
- 7. Non-electrical applications:
 - conception, demonstration, ...

Activities

- Kick off meeting July 2024: more than 120 participants
- Preparation and launch of questionnaire to all TWG2 members (september 2024)
- Analysis of the outcome by the subgroup leaders
- Comparison with the PWGs expressed needs
- Draft of the action plan by each subgroup leader
- 4 coordination meeting between the chair/vice chair and subgoup leaders (October/November 2024)
- Plenary meeting including all TWG members and the PWGs
- Finalisation of the action plan: February 2025







Materials and Fuels R&D

1 Materials and Fuels

1.1 Build a database with material test data libraries

- 1.2 Identify gaps in materials and fuel performance characteristics
- 1.3 Accelerate materials discovery, selection and testing
- 1.4 Improve standardization of material codes at EU level
- 1.5 Secure fuel supply for EU
- 1.6 Improve in service inspection tools
- 1.7 Ensure the availability of future competences



Modular Construction Optimization Process









3 Digital (r)evolution and cybersecurity

- 3.1 Be able to allow sharing/centralizing digital data between partners and subcontractors
- 3.2 Develop a Model-based System Engineering (MBSE) and Model-based Information Management
- 3.3 Identify the areas where use of AI technologies can have the biggest impact
- 3.4 Develop AI and digital twins based technologies
- 3.5 Enable better predictive core performance, multiscale-multiphysics simulation software
- 3.6 Identify potential weaknesses for remote monitoring and control



4 Safety demonstration

- 4.1 Support the development of shared reference methodologies and common European guidelines
- 4.2 Develop specific safety and permitting requirements for co-located nuclear/chemical plants and for remote operation
- 4.3 Improve the validation of passive systems functionality and assessment of severe accidents
- 4.4 Assess the impact of SMR specificities in terms of human and organizational factors
- 4.5 Develop specific capabilities to allow modelling of radionuclide dispersion and dose assessments



ESMR Safety and Integration





Development Path for Advanced Nuclear Technologies



Creating frameworks for research infrastructure sharing Capabilities Securing and expanding

Secure

experimental

capabilities

Build Test Infrastructure Constructing and

Increase TRL operating EU-funded readiness levels of test facilities

Raising technology

components

Industrialization **Pathways**

Developing pathways for industrial-scale fuel production

6 Test facilities and demonstrators

6.1 Develop a framework dedicated to an optimal access, improvement, funding of EU test facilities

6.2 Investigate the possible configuration of an Integral Test Facility of common interest for SMR

6.3 Build non-electrical application demonstrators of adjacent technologies 6.4 Develop industrialization pathways for advanced fuels for SMRs



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Integrating Nuclear and Renewable Energy for Industrial Decarbonization







TWG 2 Key Topics – Actions per technology

Prioritization of LWR-SMR Challenges

Safety and Operational

Support for in-vessel retention approaches

Critical for immediate containment strategies in reactors.

Short-Term

Fuel assembly qualification for shorter design

Essential for quick adaptation to new fuel designs.



Design and Materials

Passive safety systems qualification

Ensures safety systems are reliable in various conditions.

Medium-Term

Development of new simulation software

Advances critical analysis of complex nuclear processes.

7 Specific Light Water Reactors challenges

7.1 Develop or adapt the existing design rules for innovative SSCs and associated materials data

7.2 Seek support for in-vessel retention approaches

7.3 Develop qualification for innovative fuels or fuels specific to SMR

7.4 Gain experience and develop robust protocols for operation without boric acid

7.5 Develop new simulation software and experimental testing

7.6 Address specific materials selection and creep/fatigue issues

7.7 Develop LW-SMR designs specific to heat and co-generation



TWG 2 Key Topics – Actions per technology

Development and Qualification of Liquid Metal Fast Reactors





Re-qualify MOX Supply Chain

Develop Corrosion Protection Solutions



Accelerate Qualification of New Materials



02

03



Develop Instrumentation for **High Temperatures**

Specific Liquid Heavy Metal fast reactors challenges
8.1 Re-qualify the supply chain of fast reactor MOX
8.2 Develop solutions for corrosion and demonstrate material compatibility with lead coolant
8.3 Address corrosion aspects of supercritical Brayton cycle systems
8.4 Improve existing reactor physics/thermal-hydraulics codes
8.5 Accelerate the qualification path of new materials and solutions
8.6 Develop instrumentation, sensors and measurement techniques suitable and compatible for use with liquid metals
8.7 Develop a European lead fast reactor demonstrator



TWG 2 Key Topics – Actions per technology

Advancing Molten Salt Reactor Research





TWG 2 Key Topics – Main Actions

- 1. To identify **gaps in applying the current European codes and standards** for light water SMRs and to accelerate the development new ones for AMRs: **designate and reinforce their ownership by an EU organisation**.
- 2. To evaluate **the availability and the cost** of building a "**European data source centre**" (accessible for the European alliance members) that pools the existing datasets currently under proprietary restrictions.
- 3. To leverage trans-national access to **experimental facilities** by implementing financing mechanisms across the EU
- 4. To simplify the **export control** within the EU to facilitate transnational cooperation.
- 5. To identify together with the PWGs **the needs for (integral, partial-integral, etc.) tests** necessary for licensing of each design under development and to select the partners and facilities where these tests can be performed.
- 6. To define an EU action plan and timeline for implementation of **securing fuel supply for EU for the PWG's within the EU**.
- 7. To execute the necessary experimental investigations to qualify **innovative techniques for construction** (e.g., Steel-concrete(-steel)), for the modular design of SMRs.
- 8. To draft a recommendation document for the **assessment of passive systems** to come to a shared EU reference methodology and safety approach for all PWG's.
- 9. To identify short-term, value-driven innovation in **digitalization**, prioritizing high-impact initiatives that deliver practical benefits.
- 10. To investigate the critical issues concerning **coupling of SMRs to other systems (heat to X)**, covering technical, economical security and licensing challenges and to define the need for non-electrical application demonstrators together with end-users.





Considerations on safety, security and safeguards for SMRs (TWG6 of the Industrial Alliance)

FISA EURADWASTE 2025, Warsaw, 13 May 2025 Olli Kymäläinen

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Key challenges and topical areas identified



Facilitate pre-licensing and safety assessment cooperation in different countries

Support safety and licensing readiness for AMRs

Ensuring safeguards and security issues in the new types of reactors and new types of environments

Non-nuclear requirements: ensure high level of EHS; minimize risks to standard design due to national differences

Assessing and mitigating risks from external industrial hazards

Consideration of emergency planning, EPZ, radiological impact in siting

TWG6 Subgroups

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1. Pre-licensing and safety assessment cooperation for SMRs

2. Pre-licensing and licensing readiness of AMRs

3. Safeguards (and Security)

4. Non-nuclear requirements

5. External hazards (due to industrial facilities)

6. Emergency preparedness and Response (EP&R) and links with site selection

Selected key actions of TWG6 (safety, safeguards, security)

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Develop "industry position papers" on nuclear safety issues for SMRs

- Propose ways to demonstrate compliance with converged main safety requirements
- Examples of possible topics: Defence-in-depth matrix, Safety classification, Analysis codes and validation requirements, etc ...
- Both for LW SMRs and for AMRs

Organise workshops on LFRs and MSRs to raise awareness and engage with EU regulatory authorities

Improve the availability of information to SMR developers regarding security and safeguards issues

· Generic and possibly technology type workshops in cooperation with e.g. Euratom Safeguards

Develop "industry position papers" on non-nuclear safety issues for SMRs

 Mapping the country-dependent differences and key challenges regarding non-nuclear topics such as fire safety, health and safety at work, equipment safety, civil works

Assess risks caused to SMRs by nearby industrial facilities and vice versa

- Gather and analyze European requirements regarding external hazards due to industrial facilities and relevant to nuclear installations
- Benchmarking the approaches for defining emergency planning zones (EPZ) and siting requirements and practices

Other support needed for Project Working Groups

Ways of working

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Close interaction with ENSREG SMR TF	 Regular meetings and dialogue Feedback to position papers
Cooperation with Project Working Groups (PWGs)	 The main purpose of the Alliance is to support the Projects Focus on the actual needs of the Projects Workshops, Feedback, questionnaires
Cooperation with other TWGs	 For example: TWG1 (Industrial Applications), TWG2 (technology and R&D&I), TWG7 (Fuel cycle and waste management)
Alignment with other international activities	• For example, IAEA, OECD NEA, Euratom Safeguards, ENISS, EUR, ESARDA



Technical Working Group 7

Nuclear Fuel Cycle and Radioactive Waste Management

Chair: Urenco Vice-chair: Orano



Context: nuclear innovation & sector ramp up

- Many large reactors are eligible for lifetime extensions. Many countries and utilities have plans for additional large reactors. At the same time there is a lot of innovation taking place in the development of small and advanced modular reactors and microreactors.
- The challenge is for the nuclear sector as a whole to deliver on all these developments after a time stagnation in the sector. And from a fuel perspective, a lot has to be done in parallel: fuel for large NPP's, GENIII SMR's and anticipate advanced reactor fuel needs.
- The global nuclear fuel supply chain will need to meet demand for a **range of different fuel types**. Fuel needs might include U-Pu mixed oxide (MOX) fuels, LEU oxide, RepU oxide, HALEU-based fuel, Plutonium-based salts, Thorium-based fuels.
- SMR's and AMR's are coming to market as soon as they can. From a fuel cycle perspective there is a need for innovation and investment for various reactor and fuel types. But with 80+ SMR and AMR designs underway it is difficult to predict what fuel type needs priority in development.



Nuclear innovation



Technology Platform

Context – growth of nuclear

Required nuclear capacity



Tripling of installed nuclear capacity – COP28

-

IEA states that 1160GW _ installed nuclear capacity is need for 1,5°C scenario





European Industrial Alliance on SMALL MODULAR REACTORS

[Country distribution, TWG7 members, Jan 2025]



TWG7 Fuel & Waste Management

69 Organisations



organisations





TWG 7 Sub-Group Structure

Sub-Group 1

Strengthen existing and develop new nuclear front-end industrial capabilities

Sub-Group 2

Fuel manufacturing capabilities and manufacturing of Advanced Fuels

Sub-Group 3

Used fuel and waste management



High level conclusions

- No significant concerns around existing nuclear fuel cycle, although bottlenecks have been identified (conversion for example). It is crucial to **limit Russian nuclear fuels in the EU**. Allow no market distortion.
- A stable and **agile regulatory framework** is needed and **political long-term policy** is critical for enabling investment in new fuel cycle capabilities. Harmonisation of regulations would greatly help.
- To minimise lead times for licensing of 'new' fuels a Common Framework for Technological Readiness Levels (TRL) could be envisaged.
- With more nuclear deployment we need to focus on back-end **solutions for spent fuel** (minimisation, recycling, reprocessing and final storage).
- The **EU is home to several key elements** of the nuclear fuel supply chain. Crucial fuel cycle facilities are operated in the EU, mainly in Germany, the Netherlands, and France.
- There are clear challenges which need to be addressed but with coherent policies and support, the European Nuclear fuel supply chain will support the EU's decarbonisation and energy independence ambitions whilst driving the bloc's industrial competitiveness.





SMR/AMR

Management of radioactive waste challenges

COCKALISCHERGERERGE CEECOLOGICU

Virginie WASSELIN FISA - EURADWASTE 2025 13th May 2025

Virginie.wasselin@andra.fr

and and highlight



Innovative Nuclear Reactor Support Program

Decision in 2022

11 SMR/AMR Projects funded





Fission and fusion projects

- Water, HTR, MSR concepts
- Pb, Na coolant
- Graphite moderator
- Oxide, triso, tritium fuel

Some concepts not in the territory



Disposal in operation

E SMR/AMR waste Challenges

Compliance with waste acceptance criteria of the future waste

- New type/nature of waste : salt , Natrium (pyrophoricity risk)...
- Limit on long lived radionuclides content in the waste like activation products

¹⁴C : Graphite in HTR, ³⁶CI : NaCI in MSR...

Identification of toxic element

Lead : use in HTR as moderator





Disposal project -High-level waste (HLW) and long-lived intermediate-level waste (LL-ILW)



Back end fuel?

Reprocessing :

- → Compatibility with La Hague reprocessing plant of new fuel: salt fuel ? Triso fuel ?
- \rightarrow Which HLW/LL-ILW ?
 - structural nuclear assembly waste
 - Characteristics of the vitrified waste

Without reprocessing :

- → Direct disposal
- → No spent fuel is considered in the reference inventory for the licence application of DGR project, only vitrified waste
- → New type of fuel not studied in the adaptability study, dedicated sudy in the future ?

→ Compliance with the safety case of HLW/LL-ILW DGR project ?





The integrated Waste Management Approach by design must be taken into account in order to obtain an overall vision of the impacts of SMR/AMR on the entire fuel cycle (front-end and back-end, transport)

 \rightarrow Dialog with new actor is essential at each step of the development of the reactor to avoid creating a new burden for future generations

Implementation of the Czech SMR Roadmap

Jan Prášil

Director of New Technologies Section Nuclear Energy and New Technologies FISA-EURADWASTE 2025 & SNETP Forum, May 13, 2025





2023 scenarios for SMR capacities

- The sensitivity analysis (CEPS, MAF 2023) shows the need for repowering as early as 2030, where for the Progressive Scenario it indicates a need for 3 GW or up to 4.1 GW.
- Probable baseline scenario 2+2 NPP at Dukovany and Temelín, SMR Temelín and other SMRs as a completion.
- The 2023 SMR Roadmap analyses needed steps.







2023 Government resolution No. 808

- i. Use the SMR Roadmap as an **input for the State Energy Policy.**
- ii. Analyse ownership, operation and financing models for SMRs including state aid.
- iii. Negotiate and support the involvement of Czech companies in the SMR supply chains.
- iv. Inform the Government on the possibilities of using intergovernmental agreements for cooperation in the field of SMRs.
- v. Propose the **streamlining of licensing and permitting processes** for SMR technologies.
- vi. Assess the need to define the sites listed in the SMR Roadmap in the **spatial planning documentation** of regions and municipalities.
- vii. Negotiate with investors the preparation of preferred sites and associated infrastructure.
- viii. Recommend to the Governors and the Mayor of Prague to cooperate in the implementation of the SMR Roadmap.

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2024 activities

- MIT and the Canadian Embassy organized a trade mission in the field of SMRs for Czech and Canadian companies.
- MIT involved in the General Assembly of the European Industrial Alliance on SMRs and has applied for membership in WGs on Skills, Financing, Supply Chain and Public Engagement.
- Project MASAM (Mapping of seismic amplification in the Czech Republic), Masaryk University, Institute of Geophysic of the Czech Academy of Sciences, Institute of Rock Structure and Mechanics of the Czech Academy of Sciences, IP Consult. Project Period 5/2024 10/2027.
- Project Phoenix (U.S. funded) provides technical assistance to support feasibility studies for SUAS Group.
- Program NEXT (U.S. funded) provides a SMR regulatory and licensing consultancy support (Jensen Hughes and NUMARK) to eligible Czech counterparts.
- A knowledge-sharing visit in the USA for the Czech delegation within the NEXT program (Texas, Washington, D.C.).
- SUJB has observed the process of ONR's Generic Design Assessment of Rolls-Royce SMR.
- French, Czech and Finnish regulators cooperated in the **1st phase of Nuward design review**.



2025 activities

- MIT involved in the Financing WG of the European Industrial Alliance on SMRs.
- MIT and the Czech Embassy in Helsinki organized a trade mission in the field of SMRs for Czech and Finnish companies.
- Embassy of the Republic of Poland in Prague organized a conference "Poland and the Czech Republic: leading the way in the implementation of SMR technologies in Europe" for Czech and Polish companies.
- Following the discussion on the financing analysis, implementation of the steps mandated by the Government and eventually initiation of negotiations on State Aid for SMRs and its notification to the European Commission.
- Signature of the **Memorandum of the Czech and British Prime Ministers** on nuclear energy and SMRs.
- Assessment of the need for an intergovernmental agreement for the selection of SMR technology as a follow-up to the CZ-UK Memorandum and execution of necessary steps.
- MIT involved in the Accelerating SMRs for Net Zero Initiative a NEA/OECD solutions-oriented platform with a defined plan of work for collaboration and knowledge exchange to support decision makers in maximizing the full potential of SMRs.

Potential investors

- Negotiations with **ČEZ** pursuant to Act No. 367/2021 Coll. (Low Carbon Act) and conclusion of the Security Agreement.
 - Information to the government on the intention of ČEZ, a. s. to acquire a shareholding in **Rolls-Royce SMR Limited**.
 - The working group consisting of the Ministry of the Interior, the Security Information Service, the Office for Foreign Relations and Information, the Military Intelligence, the Ministry of Foreign Affairs and the National Cyber and Information Security Agency provided the evaluation of Rolls-Royce SMR Limited from the point of view of the security interests of the state.
- Negotiations with Orlen Synthos Green Energy (OSGE)/BWRX CZ pursuant to Act No. 367/2021 Coll. (Low Carbon Act).
 - Intention to conclude the Security Agreement.
- Support of the **SUAS Group** in the project Phoenix and program NEXT.
 - Joint work on the feasibility study.

Important Projects of Common European Interest

IPCEI on Innovative nuclear technologies - Innovative Nuclear Power Generation (SMR/AMR) and Enabling Activities

- Key activities include SMRs/AMRs but also enabling activities such as innovative fuels, uranium processing, waste management and decommissioning, and supply chain development.
- ➡ 13 Member States supported the IPCEI in the JEF-IPCEI High-Level meeting on 9 April 2025.
 - Signing the Endorsement letter does not constitute an obligation to allocate budgetary resources and does not guarantee participation to the IPCEI candidate.
- Design Phase Stage I, from April 2025 to February 2026 (indicative)
 - Exploration of the allocation of budgetary resources.
 - Each Member State may decide to contribute to one, several or all of the technologies.







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SNETP Forum

Day 2, 13.05.2025

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