# Technical Meeting on the Management of Spent Fuels from High Temperature Gas Cooled Reactors.
# Objectives

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# IAEA's Organization

## Department of Nuclear Energy

NE | NS | NA | TC | SG | MT

Division of Planning, Information and Knowledge Management

NEPIK

Division of Nuclear Fuel Cycle and Waste Technology

- NEFW
- RRS
- WTS
- NFCMS
- DERS

Division of Nuclear Power

- NENP

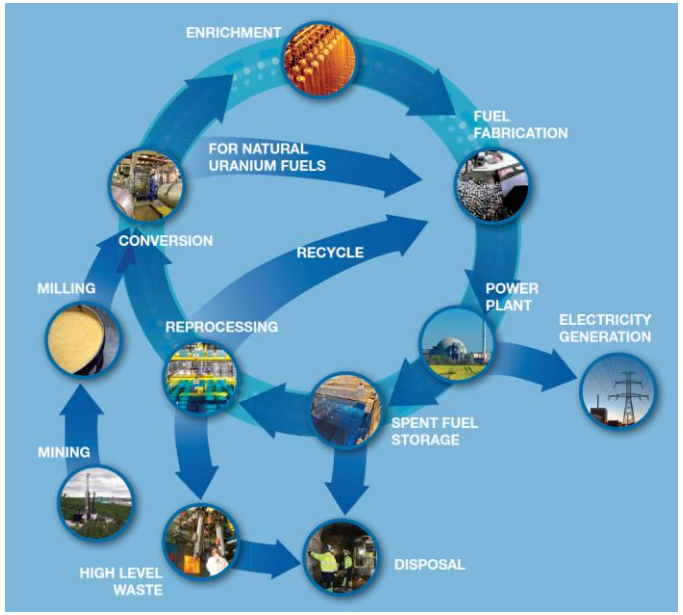
NFCMS

- UPC Team
- NFE Team
- SFM Team

SFM Team

- Spent Fuel Management
- Advanced Fuel Cycles
- Transport Radioactive Materials

### Nuclear Fuel Cycle and Materials Section (NFCMS)



# Technical Working Group on Nuclear Fuel Cycle Options and Spent Fuel Management (TWG-NFCO)

**20 Member States** (Belgium, Canada, China, Finland, France, Hungary, India, Japan, RoK, Mexico, Netherlands, Romania, Russia, Spain, Sweden, Slovakia, UK, UAE, Ukraine, USA). **Three International Organizations** (EC, OECD/NEA and WNA)

**TWG-NFCO focuses on nuclear fuel cycle options** with an emphasis on:

- **Spent fuel management** (storage, recycling and transportation)
- **Innovative fuel cycles** (multirecycling, minor actinides management and P&T of long-lived fission products)
- **Nuclear materials management**

***In its Annual Meeting in April 2019, TWG-NFCO recommended the IAEA that***:

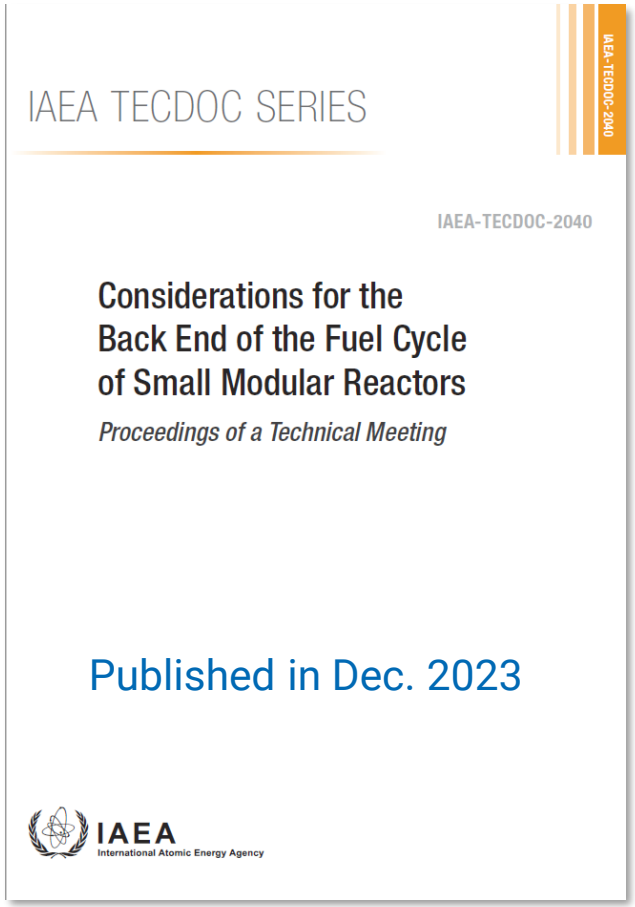
- *"… the IAEA has several Sections looking into several different aspects of SMR deployment…, however, fuel cycle and in particular spent fuel management from SMRs does not appear to be a topic of investigation.*
- *The next update of the Advances in Small Modular Reactor Technology Developments Report should consider technologies for managing SNF from SMRs including the back-end infrastructure that would be needed to support SMRs (e.g. transportation, storage, recycling, and disposal).*
- *Nuclear fuel cycle aspects, in particular the backend, should be integrated into all IAEA working groups that are looking at SMRs…"*

**TWG-NFCO Meeting, 1-3 April 2025**

# Technical Meeting on **Backend of the Fuel Cycle Considerations for SMRs**, 20-23 September 2022

**107** Participating Experts from **32** Member States & **3** International Organizations

**~ 40** Presentations and Extended Abstracts

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https://conferences.iaea.org/event/321/

# Technical Meeting on **Backend of the Fuel Cycle Considerations for SMRs**, 20-23 September 2022

## Presentations and Discussions on

- IAEA Activities
  - SMR Developments and Associated Nuclear Fuel Cycle Options, Fuel Designs, Safety, Security, Safeguards, Economics, Transportation
- International Organization's Activities and Perspectives
  - EC/JRC, OECD/NEA and ERDO
- Member States' Activities and Perspectives
- Three Breakout Sessions (Storage, Reprocessing&Recycling, Transportation, Disposal)
  - LWR type
  - **HTGR type**
  - AMRs (LMFRs and MSRs) type
- General Discussion
- Conclusions and Future Areas of Work

# Identified Challenges for the Management of SMRs' Spent Fuels

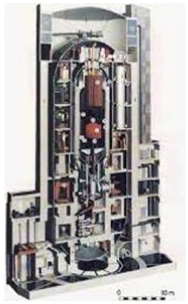
- HTGR-type SMRs: TRISO particles in Pebble beds/Prismatic blocks

**CHALLENGES**

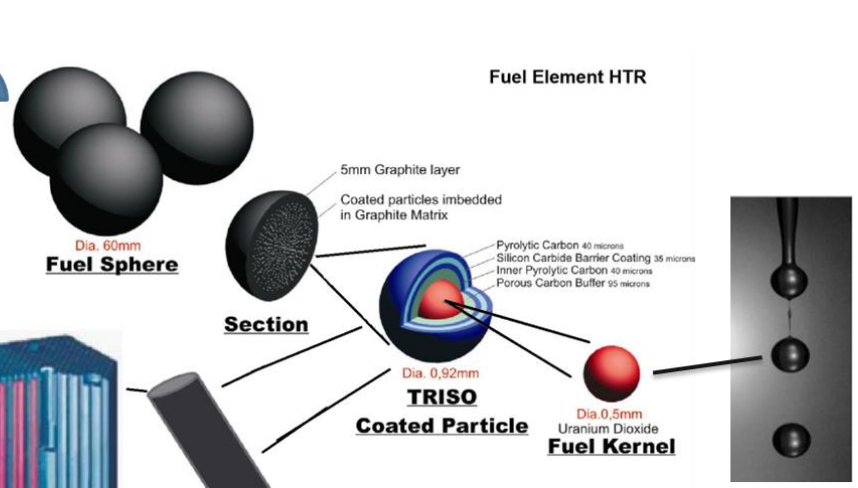
– Very limited worldwide experience in managing the back end of the fuel cycle

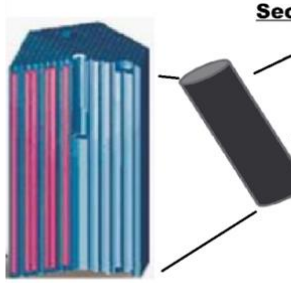
- *about 92% of the SNF is graphite*
- *about 2% is PyC and SiC from the kernel particle*

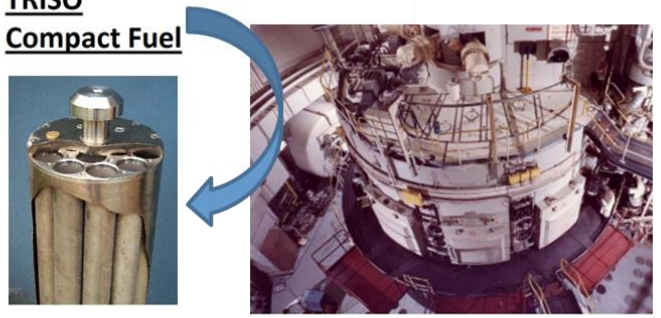
- AVR Jülich, Germany (1967-1988)
- Storage experience



- HTTR (Japan first criticality 1998)
- Prismatic graphite fuel blocks
- Reprocessing and recycling is planned, R&D needed




- Dragon fuel from Winfrith, UK (1965-1975)
- Storage experience

# Consultancy Meeting, Vienna 10 – 12 December 2024

**The main objective of** framing the scientific content of a Technical Meeting on the Management of Spent Fuels from High Temperature Gas Cooled Reactors on **7 - 11 July 2025**

## Scope of TM on 7 – 11 July 2025

Target types of spent fuel:

- TRISO particles embedded in graphite matrix used in conventional gas cooled reactors (HTGRs) as well as in reactors using other coolants (e.g. molten salt, liquid metal)
- TRISO particles embedded in SiC matrix

**Irradiated graphite** that comprises moderator, reflector, and any other structural component without fuel embedded *is out of scope for this Technical Meeting*

# Agenda of the Technical Meeting, Monday

IAEA
International Atomic Energy Agency
*Atoms for Peace and Development*

**EVT2404558**

**Technical Meeting on the Management of Spent Fuel (Pebbles and Compacts) from High Temperature Reactors, 7 – 11 July 2025**
**Vienna International Centre, Room C-CR-5 (C Building, 7th floor)**

| **Monday, 7 July 2025** | | | |
|---|---|---|---|
| 14:00 – 14:15 | 1. | Welcome Address<br>- DIR-NEFW<br>- SH-NFCMS | Ms Olena Mykolaichuk (IAEA)<br>Mr Clément Hill (IAEA) |
| 14:15 – 14:45 | 2. | - Opening Remarks - Scientific Secretaries<br>- Overall Objectives of the Technical Meeting<br>- Introduction of Participants<br>- Adoption of the Agenda | Ms Amparo Gonzalez-Espartero (IAEA) |
| 14:45 – 15:30 | 3. | Status of the Preparation of the IAEA Booklet on Roadmap for Developing HTGR Spent Fuel Management Programme.<br>Work to be completed during the Technical Meeting. | Mr David Hambley (UK) |
| **15:30 – 16:00 Coffee Break** | | | |
| 16:00 – 16:25 | 4. | IAEA Activities on High-Temperature Gas-Cooled Reactors (HTGRs) | Mr Hadid Subki (NPTDS, IAEA) |
| 16:25 – 16:50 | 5. | IAEA Activities on HTR Fuel.<br>Recent Publication and Coordinated Research Project. | Ms Anzhelika Khaperskaia (NFCMS, IAEA) |
| 16:50 – 17:15 | 6. | IAEA Coordinated Research Project on Challenges, Gaps and Opportunities for Managing Spent Fuel from SMR Technologies | Ms Amparo Gonzalez-Espartero (NFCMS, IAEA) |
| 17:15 – 17:30 | 7. | Safety issues and Challenges and IAEA activities on safety of fuel cycle facilities | Mr Lakshman Valiveti (NSNI, IAEA) |
| **Adjourn 17:30** | | | |

1. Introductory session with information from the IAEA about:
   - HTG reactors,
   - HTGR fuels
   - IAEA CRP SMR-COGS

2. Introduce the draft of the **“IAEA Booklet on Roadmap for Developing HTGR Spent Fuel Management Programme”** we would like to finish during the TM with your inputs

# Agenda of the Technical Meeting, Tuesday

| Tuesday, 8 July 2025 | | | |
|---|---|---|---|
| 9:00 – 9:30 | 8. | IAEA Activities on Managing i-Graphite | Ms Karina Lange (WTS, IAEA) |
| 9:30 – 10:30 | 9. | Presentation on Graphite and Irradiated Graphite (TBC) | Ms Abbie Jones (UK) |
| **10:30-11:00 Coffee Break** | | | |
| 11:00 – 12:00 | 10. | Discussion on Graphite Information to be Included in the Draft Roadmap Booklet | All |
| **12:00-13:15 Lunch Break** | | | |
| 13:15 – 13:40 | 11. | Facilitating SMR Fuel Fabrication from HALEU $UF_6$ | Ms Marina Sokcic-Kostic (Germany) |
| 13:40 – 14:05 | 12. | On Accounting the Materials in the Pb-HTR Spent Fuels Based on the Random Fuel Shuffling Algorithm | Mr Bing Xia (China) |
| 14:05 – 14:30 | 13. | Demonstration Plan for Head-End Process of HTGR Spent Fuel Reprocessing in Japan | Mr Yuji Fukaya (Japan) |
| 14:30 – 14:55 | 14. | Recent Progress of Treatment Research for HTGR's Spent Spherical Fuels in China | Ms Xiaotong Chen (China) |
| **14:55-15:25 Coffee Break** | | | |
| 15:25 – 15:50 | 15. | HTGR SNF Reprocessing Technology Development in Russia | Ms Elizaveta Filimonova (Russia) |
| 15:50 – 16:15 | 16. | HTGR Spent Fuel and Waste Generation and Management in the Framework of EURAD-2 WP4 FORSAFF | Mr Jesus Martinez (Spain) |
| 16:15 – 17:30 | 17. | Discussion on Information About HTGR Spent Fuel Recycling to be Included in the Draft Roadmap Booklet | Mr David Hambley (UK) All |
| **Adjourn 17:30** | | | |
| **19:00 - Partially-Hosted Hospitality Event** | | | |

GASTHAUS Strandcafé AN DER ALTEN DONAU SEIT 1921

https://www.strandcafe-wien.at/
Florian-Berndl-Gasse 20, 1220 Wien

1. Session on management of irradiated graphite from HTGR spent fuels
2. Session on HALEU fuels for SMRs
3. Session on recycling HTGR spent fuels
4. **Non-hosted dinner**

Please, if you do not plan to join us let us know

# Agenda of the Technical Meeting, Wednesday

| Wednesday, 9 July 2025 | | | |
|---|---|---|---|
| 9:00 – 9:25 | 18. | Spent Fuel Management in HTR-PM | Mr Fu Li (China) |
| 9:25 – 10:05 | 19. | Management of Spent Fuel from High-Temperature Gas-Cooled Reactors in US | Ms Laura Price (USA) |
| 10:05 – 10:40 | 20. | UK (Title TBC) | Mr Greg Black (UK) |
| **10:40-11:05 Coffee Break** | | | |
| 11:05 – 11:30 | 21. | Experience on the Management of HTGR Spent Fuel at the WWR-K Reactor | Mr Asset Shaimerdenov (Kazakhstan) |
| 11:30 – 12:00 | 22. | Spent Fuel Management in the decommissioning process for the AVR and THTR-300 HTRs | Mr Karl Verfondern (Germany) |
| 12:00 – 12:30 | 23. | Operational Experience in Germany for Managing Spent Pebble Fuels | Mr Roland Hüggenberg (Germany) |
| **12:30-13:40 Lunch Break** | | | |
| 13:40 – 14:20 | 24. | Research and Development on HTR Spent Pebble Fuel | Mr Karl Verfondern (Germany) |
| 14:20 – 14:45 | 25. | Managing Spent TRISO Fuel for High Temperature Reactors Using Deep Isolation's Universal Canister System | Mr Jesse Sloane (USA) |
| 14:45 – 15:00 | 26. | Canister Internal Conditioning & Stabilization System (CIC&S) Technologies for CANDU SNF in SC108 Cask, for PWR SNF in TC21 Cask and Opportunities of Adoption of CIC&S Technologies for TRISO - Compact SNF of HTR Reactors | Mr Muhammad Saadullah (Pakistan) |
| 15:00 – 15:15 | 27. | Technical Challenges in the Management of Spent TRISO Fuel from Next Generation SMR-HTGRs | Ms Rowayda Fayez M. AbouAlo (Egypt) |
| **15:15-15:40 Coffee Break** | | | |
| 15:40 – 16:10 | 28. | Spent Nuclear Fuel Aspects in Evaluating Jordan's Options for the First NPP in the Kingdom: The Unique Nature of HTGRs | Mr Tariq Mheidat (Jordan) |
| 16:10 – 16:35 | 29. | HTGR-POLA: A Project Overview and Approach to Spent Fuel Management | Mr Dominik Muszynski (Poland) |
| 16:35 – 17:30 | 30. | - Objectives of the Roadmap Booklet and the gaps of information to be filled in during Break-out Sessions on Thursday.<br>- Comments from participants on the Booklet-Draft. | Mr David Hambley (UK)<br>All |
| **Adjourn 17:30** | | | |

1. Session on country experiences on managing spent fuel from HTGR (e.g, China, Germany, Kazahastan, UK, USA, EC on-going Projects, etc)
2. Session on newcomer's perspectives on HTGR spent fuel management (e.g., Pakistan, Egypt, Jordan, Poland, etc)

# Agenda of the Technical Meeting, Thursday

| Thursday, 10 July 2025 | | | |
|---|---|---|---|
| 9:00 – 9:30 | 31. | Discussion on Failed HTGR Fuels Definition | Mr David Hambley (UK) to lead |
| 9:30 – 10:45 | 32. | 3 Break-out Sessions of about 7 people each to work on information to be included in the corresponding tables of the document | – Management of Pebbles - Open Cycle (Session 1) Room C07-29<br>– Management of Prismatic/Compact – Open Cycle (Session 2) Room C07-33<br>– Management Pebbles and Prismatic/Compact - Closed Cycle (Session 3) Room C07-31 |
| **10:45-11:15 Coffee Break** | | | |
| 11:15 – 12:30 | 33. | 3 Break-out Sessions of about 7 people each to work on information to be included in the corresponding tables of the document | – Management of Pebbles - Open Cycle (Session 1) Room C07-29<br>– Management of Prismatic/Compact – Open Cycle (Session 2) Room C07-33<br>– Management Pebbles and Prismatic/Compact - Closed Cycle (Session 3) Room C07-31 |
| **12:30-14:00 Lunch Break** | | | |
| 14:00 – 15:30 | 34. | Presentation of findings from the 3 Groups (10 minutes each) on:<br>– Management of Pebbles - Open Cycle<br>– Management of Prismatic/Compact – Open Cycle<br>– Management Pebbles and Prismatic/ Compact – Closed Cycle<br>Consolidation of content of the tables.<br>Discussion of comments on the draft Roadmap Booklet. | All |
| **15:30 – 16:00 Coffee Break** | | | |
| 16:00 – 17:30 | 35. | - Consolidation of content of the tables<br>- Discussion of comments on the draft Roadmap Booklet<br>- Identification of gaps of information and future actions to be taken to have the Draft Roadmap Booklet published after summer<br>- Discussion on visualization of the stages of the Roadmap | Mr David Hambley (UK) to lead<br>Ms Amparo Gonzalez-Espartero (IAEA)<br>All |
| **Adjourn 17:30** | | | |

- 3 Break-out Sessions to work on information on HTGR spent fuel management to be included in the draft on “IAEA Booklet on Roadmap for Developing HTGR Spent Fuel Management Programme”

# Agenda of the Technical Meeting, Friday

| Friday, 11 July 2025 | | | |
|---|---|---|---|
| 9:15 – 10:15 | 36. | Case Study for the Management of Spent Pebble Fuel | Mr Roland Hüggenberg (Germany) |
| 10:15 – 10:45 | 37. | Case Study for the Management of Spent Prismatic/Compact Fuel | Mr David Hambley (UK) |
| **10:45-11:15 Coffee Break** | | | |
| 11:15 – 11:45 | 38. | Explanation of Qualitative Comparison Exercise of Managing Prismatic, Pebbles and LWR | Mr Roland Hüggenberg (Germany) and Mr David Hambley (UK) |
| 11:45 – 12:15 | 39. | Discussion on assignation of responsibilities for actions and plan of work for the coming months | Mr David Hambley (UK) Ms Amparo Gonzalez-Espartero (IAEA) All |
| 12:15 – 12:45 | 40. | Closing Session<br>- DIR-NEFW<br>- SH-NFCMS | Ms Olena Mykolaichuk (IAEA) Mr Clément Hill (IAEA) |
| **Adjourn 12:45** | | | |

1. Presentation of the exercise on case studies on managing spent pebble and prismatic fuels conducted by Mr Roland Huggenberg (Germany) and Mr David Hambley (UK)
2. Wrapping up and distributing tasks and future activities to finalise the IAEA Booklet

# Thank You

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