



Technical Meeting on the Management of Spent Fuel (Pebbles and Compacts) from High Temperature Reactors

7 – 11 July 2025

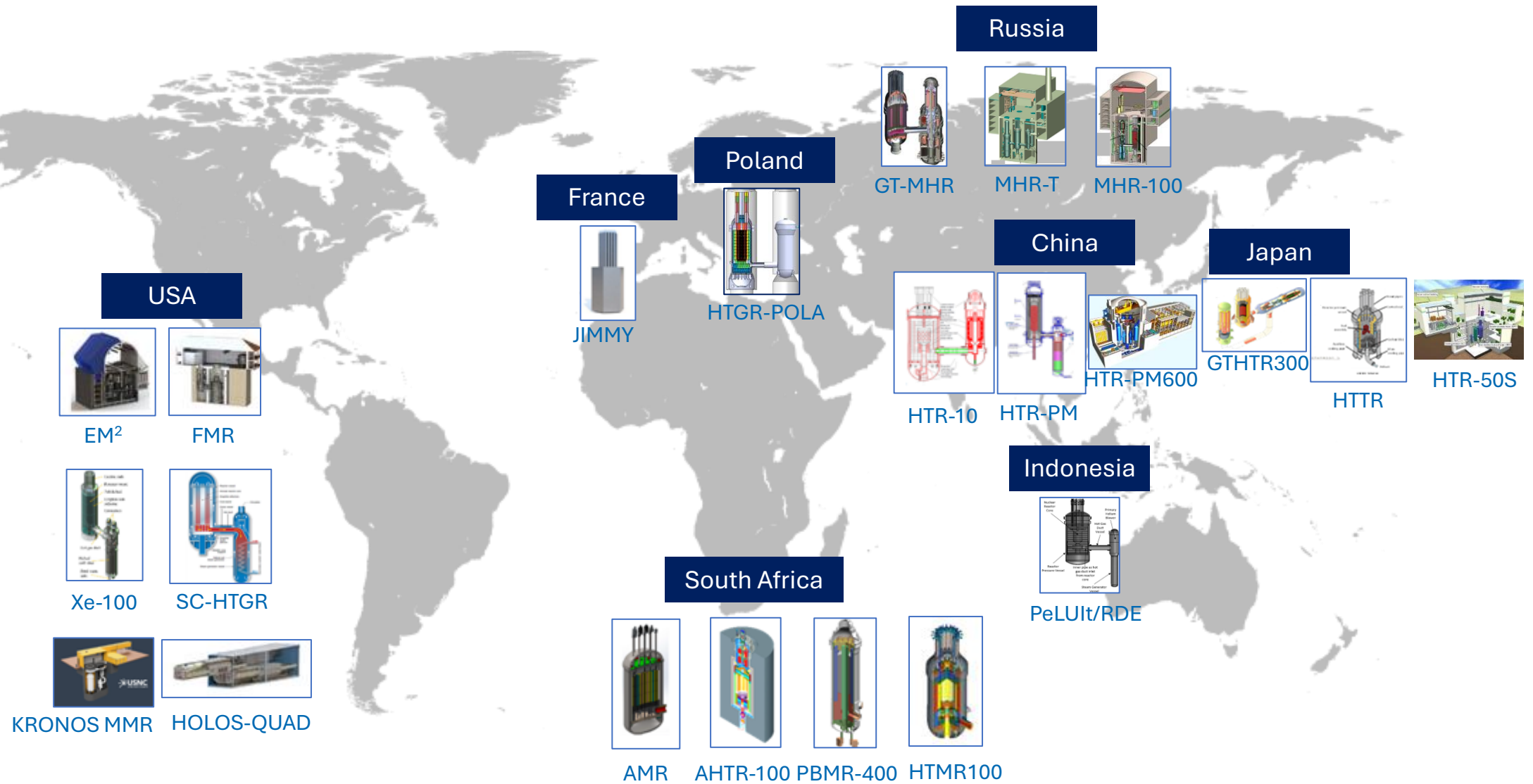
Advances in HTGR development and IAEA activities to Support Member States on HTGR Technology Development

Dr. Alina Constantin

Nuclear Engineer, Project Officer for HTGR
Technology Development

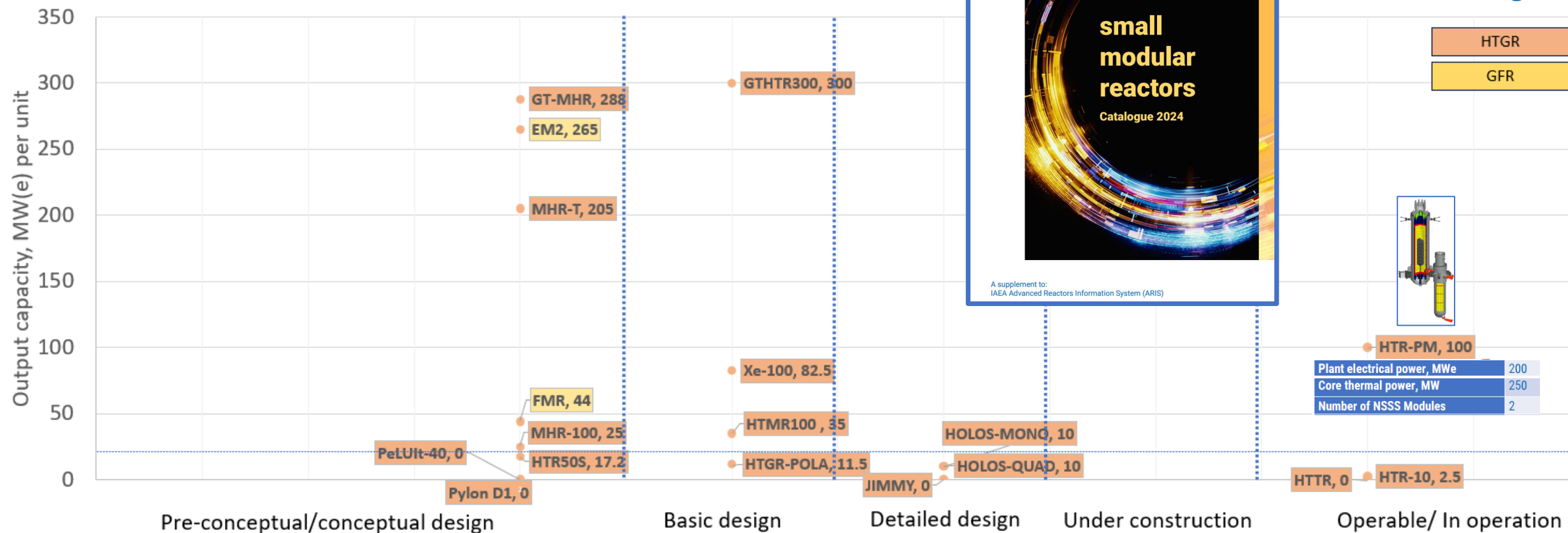
Nuclear Power Technology Development Section,
IAEA Division of Nuclear Power

Global Activities on HTGR-SMR development



SMR2024 Catalogue

https://aris.iaea.org/publications/SMR_catalogue_2024.pdf

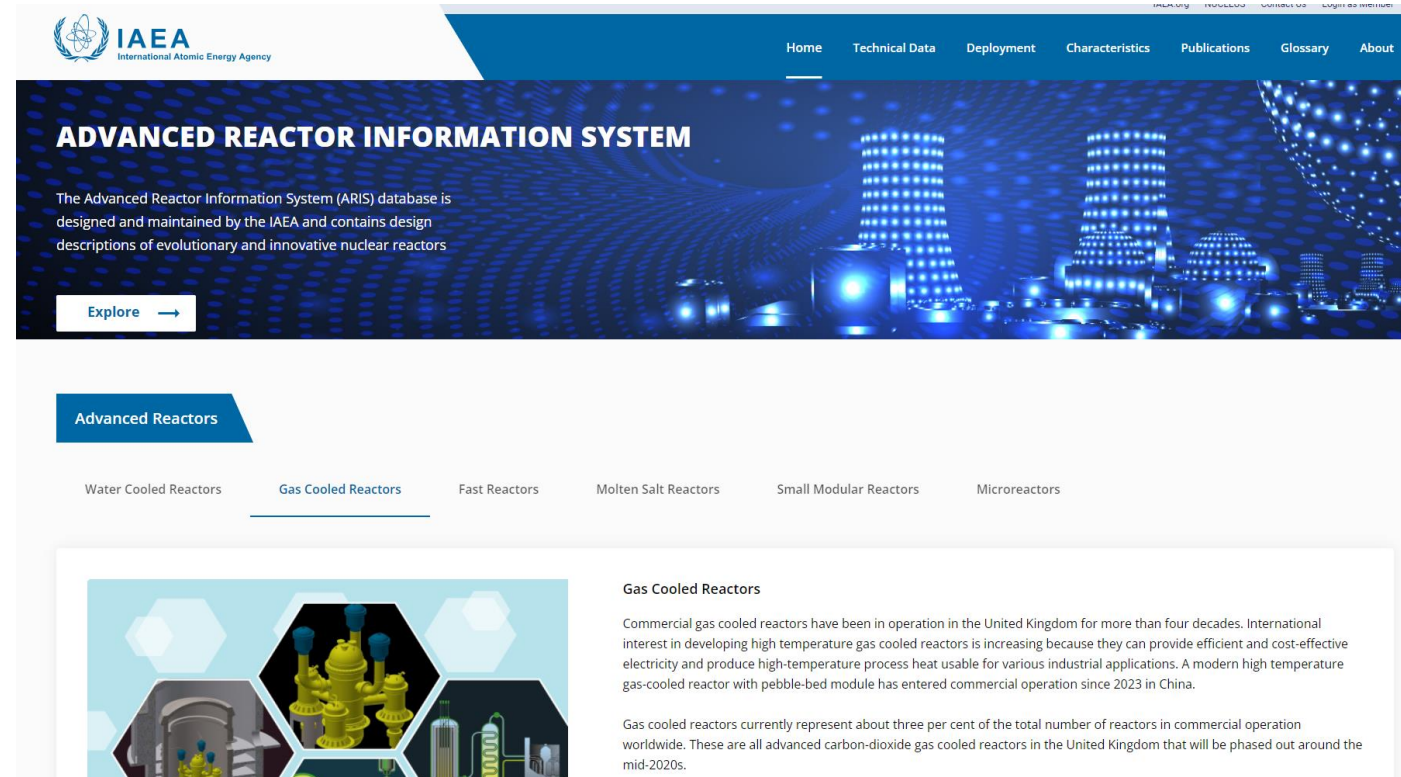


Note: The value displayed with the design refers to the output capacity in MW(e) per unit.

IAEA Advanced Reactor Information System (ARIS)

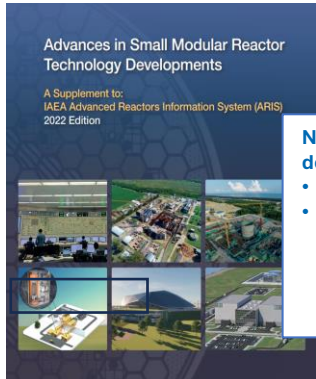
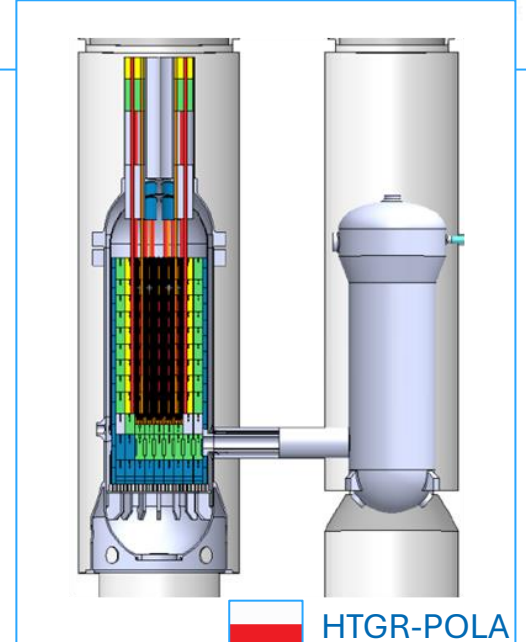
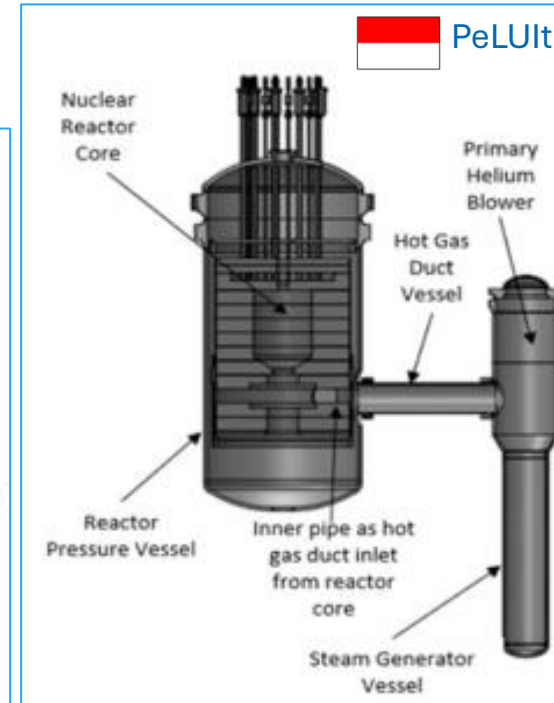
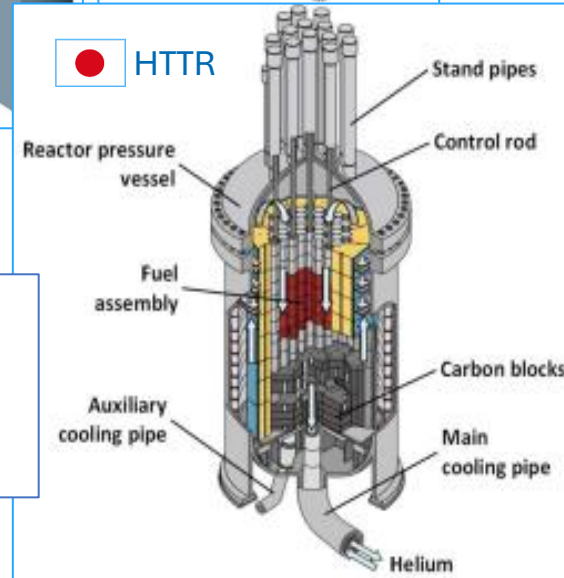
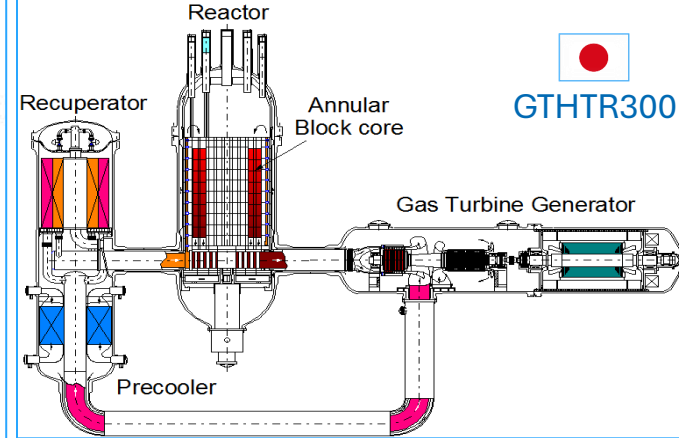
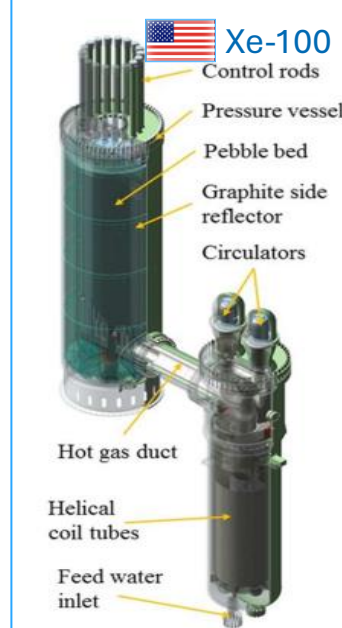
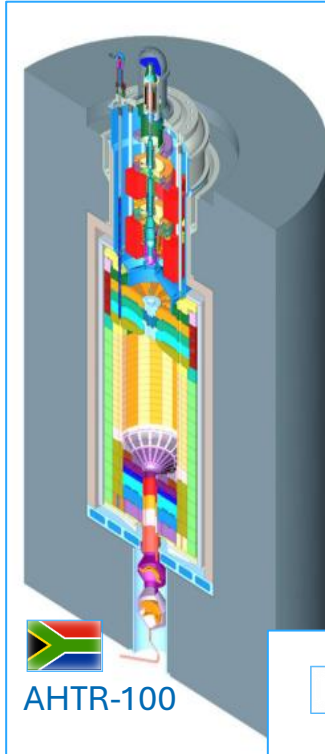
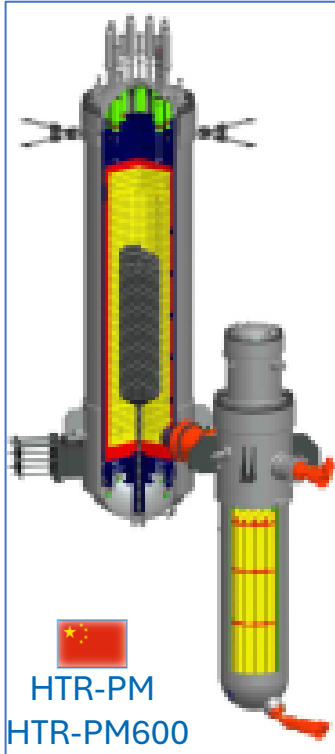
[Advanced Reactor Information System | Aris \(iaea.org\)](https://aris.iaea.org)

- Web-accessible database that provides Member States with balanced, comprehensive and up-to-date information about advanced nuclear plant designs and concepts
 - WCRs, GCRs, FRs, MSRs, SMRs, Microreactors
- A tool for Member States at various stages of nuclear power development, offering standardized, impartial data on reactor designs, including evolutionary and innovative concepts, to support informed reactor technology assessments



21 GCR designs
4 GFR designs

Multiple designs from Member States



Number of SMR designs under development (2022)

- 38 Water-cooled
- 45 Non-water cooled
- HTGR 21
- MSR 13
- LFR 8
- SFR 3

Gas Cooled Reactors – Technical Working Group (TWG-GCR)

- Advises the IAEA DDG-NE on specific topics of relevance to the IAEA programmatic activities in the field, since 1978
- Shares information and knowledge on national and international programme
- Contributes to the development and/ or review of selected IAEA publications, in particular from the IAEA Nuclear Energy Series, assesses existing gaps and advises on the preparation on new publications or e-learning materials
- Upon request, presents to the Standing Advisory Group on Nuclear Energy (SAGNE) the key findings of the TWG meeting
- Shares experience and advice on increasing the participating of young professionals and improving the gender balance in the nuclear sector
- Focus today on HTGRs
- **15 Member States** with designated member (2021-2024)
- **2 Observers:** European Commission, OECD/NEA
- *Renewal of membership for the term 2025-2029 ongoing*



No	Country	Name and Affiliation
1	OECD/NEA	Mr Brent WILHELM
2	EC-JRC	Mr Michael FUETTERER

No	Country	Name and Affiliation
1	Canada	Mr Ali SIDDIQUI Canada Nuclear Laboratories (CNL)
2	China <i>The Chair of TWG-GCR (2021-2024)</i>	Mr Yujie DONG Tsinghua University, Institute of Nuclear and New Energy Technology (INET)
3	Finland	Mr Ville TULKKI VTT Technical Research Centre of Finland
4	France	Mr Christoph DÖDERLEIN Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
5	Germany	Mr Hans-Josef ALLELEIN RWTH Aachen
6	Indonesia	Mr Topan SETIADIPURA National Research and Innovation Agency (BRIN)
7	Japan	Mr Tetsuo NISHIHARA Japan Atomic Energy Agency (JAEA)
8	Republic of Korea	Mr Chan Soo KIM Korea Atomic Energy Research Institute (KAERI)

No	Country	Affiliation
9	Poland	Ms Agnieszka BOETTCHER National Centre for Nuclear Research (NCBJ)
10	Russian Federation	Mr Peter FOMICHENKO National Research Centre Kurchatov Institute
11	South Africa	Ms Vishana NAICKER North-West University
12	Switzerland	Mr Manuel POUCHON Paul Scherrer Institute (PSI)
13	Ukraine	Mr Mykola ODEYCHUK Kharkov Institute for Physics and Technology
14	United Kingdom	Mr Timothy ABRAM University of Manchester
15	United States of America	Mr Gerhard STRYDOM Idaho National Laboratory (INL)

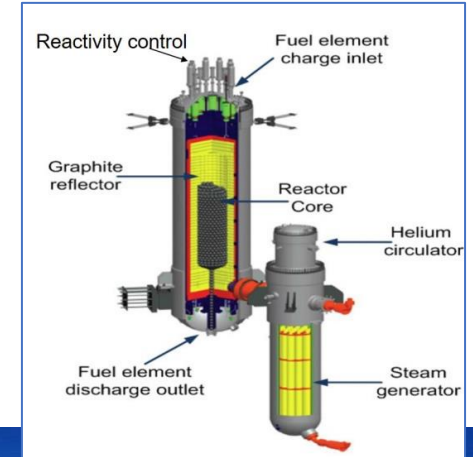


Suggested strategic topics

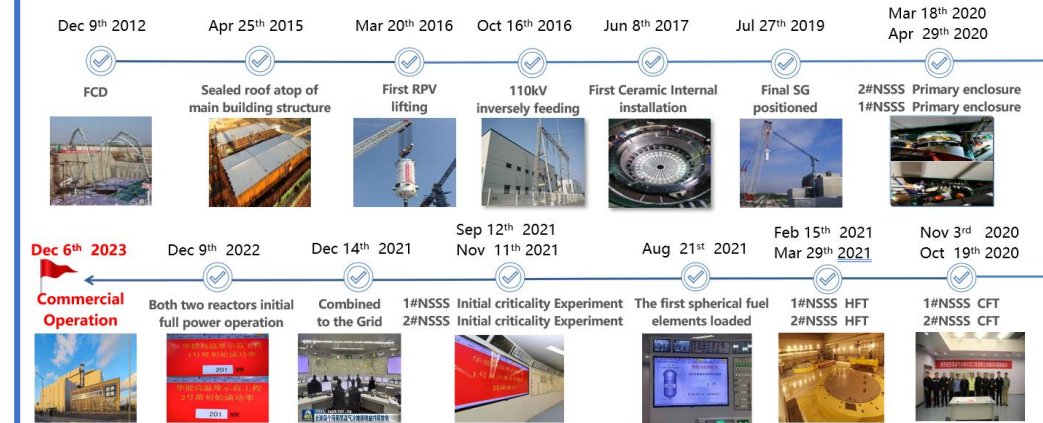
- **Develop safety standards applicable to modular HTGRs**
- **Facilitate and support R&D on HTGR for non-electric applications**
 - Economic competitiveness of HTGRs for cogeneration
 - Continue and intensify effort to implement a HTGR based cogeneration, through facilitation of information exchange, especially with technology providers in order to better assess technology maturity and requirements needed for connection with HTGR
 - Develop hydrogen roadmaps to accelerate the hydrogen economy for carbon neutralization, using HTGR
 - Develop safety standards for non-electric applications, especially for the coupling infrastructure and coupling with other industries
 - Encourage harmonization of regulatory approach for collocating HTR with various industrial processes, for cogeneration of heat and electricity
- **Disseminate modelling tools and facilitate E&T for HTGRs**
 - Continue and intensify the HTGR safety analysis code knowledge/capability training and sharing
- **Foster information sharing and collaboration (reactor technology, fuel cycle, waste management, ..)**
 - Treatment of irradiated graphite at industrial scale and management for its disposal
 - Establish the standard fuel design and manufacturing for HTGR
 - Develop approaches for quality control at industrial level
 - Initiate international collaboration on separation of TRISO particle fuels from fuel matrix and R&D on irradiated graphite disposal
- **Facilitate experiments, code development and data sharing for validation of thermo-hydraulic, neutronics, materials and safety codes, and uncertainties assessment**
 - Identify experimental facility requirements for establishing an HTGR design (incl. licensing) and possible experimental facilities available
 - Facilitate sharing of experimental facility required for establishing and checking an HTGR design, including the main components and systems, as well as the auxiliary systems (for e.g. the He purification system, RCCS)
 - Facilitate material testing and sharing of data
 - Development of codes for fuel design and benchmark models that apply for pebble bed and prismatic core
 - Establish a database not only for graphite but also for some other materials of interest for HTGRs where test results can be included
 - Develop user manuals to ensure effective use of results of various completed studies
 - Continuation of the ONCORE project and development of HCP code
 - Develop practice of multiphysics calculation for HTGR design purpose as regulators are used with this approach for LWR
- **Establishing a systematic approach for developing the safety analysis report for HTGR**
- **Support young generation through dedicated events and programmes**
- **Identify and improve material and component classification and reduce as much as possible the nuclear grade materials for economic reasons**
- **Address challenges of transportable HTGRs, transport after operation, safeguards and security**

China

- HTGR basic research started in China in 1980s and in 1992 the government approved to construct HTR-10; its first criticality was achieved in 2000 and the full operation started in 2003.
- In 2006, HTR-PM project was listed as a major project in the national R&D programme for science and technology.
- In 2012, first concrete for HTR-PM was poured, 2016 first RPV was installed. Fuel loading started in August 2021 and the connection to the grid was done in December 2021. The commercial operation started in December 2023.
- An industrial scale fuel plant, capacity 300,000 fuel elements/ yr was built in Baotou. Construction was started in 2013 and production in 2016.
- 2023: 2 LOFC safety tests were conducted
- April 2024: China's HTR-PM started heating project operation
- HTR-PM600 will feature 6 modules connected to one single turbine to produce 650 MWe, building on the experience from the demonstration plant. Based on requirements from particular utilities, larger units with more modules can also be built that would enhance the economic competitiveness.
- Another version is HTR-PM600S for cogeneration having HTR-PM modules with some minor changes.
- August 2024: the Jiangsu Xuwei nuclear heat project was approved to build 2 Hualong 1 units and 1 HTR-PM600S unit.
- Further development of HTR-PM for elevated temperatures is on-going (900-950C) looking at extending qualification of fuel performance and key component development.
- For H₂ production, for I-S and hybrid sulphur processes, basic research and testing in laboratory were completed

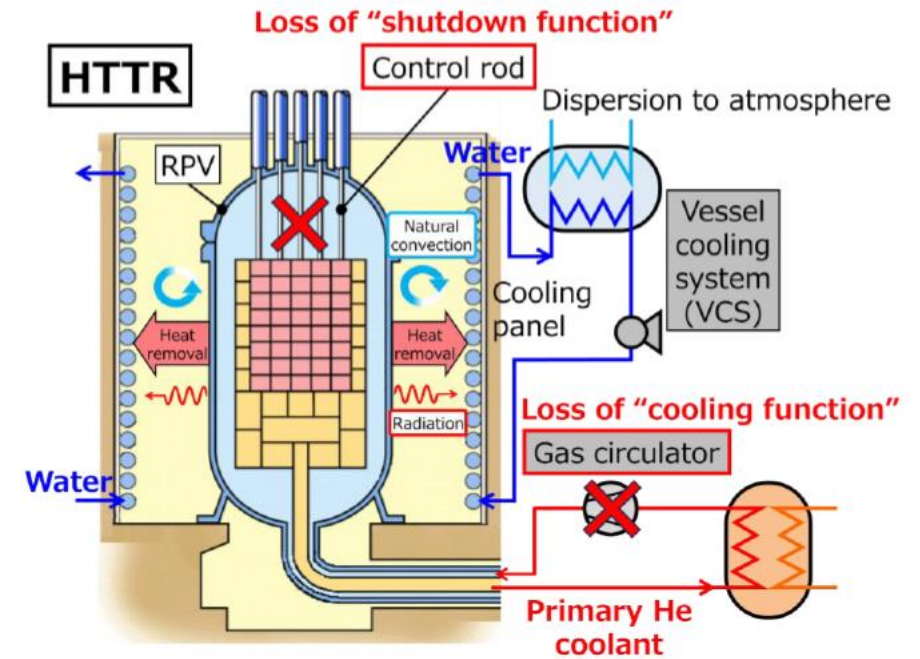


Milestones of Construction (HTR-PM, Shidao Bay, Shandong)

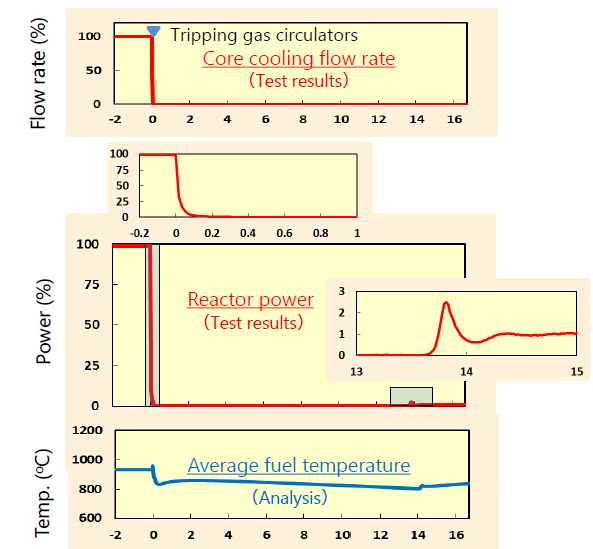


Japan

- Japan's Green Growth Strategy for achieving carbon neutrality in 2050 was issued in December 2020. As part of the supporting policy, the *Government is looking at international safety demonstration for HTGR technology utilizing HTTR and facilitates the technology development for hydrogen production using HTTR.*
- The LOFC tests as the safety demonstration of HTGR were completed.
- Design and safety analysis of the HTTR hydrogen production system is ongoing.
- Control technology development test of IS process is ongoing.
- Demonstration of coupling of hydrogen plant and HTGR is expected by 2040.
- The draft application documents for licensing the HTTR hydrogen production project was completed in 2024. JAEA will submit the application documents in the early 2025 to Nuclear Regulatory Authority. The hydrogen production test using HTTR is expected by 2030.
- JAEA collaborates with Mitsubishi Heavy Industries (MHI) for basic design, detailed design, manufacturing, and construction for the **domestic demonstration HTGR**. Reactor power will be range from 150MW-250MW, supplying above 800C to a hydrogen plant.
- JAEA participates in overseas demonstration reactor projects through **Japan-UK HTGR collaboration**.
- In March 2024, the loss of forced cooling test (with all helium gas circulators stopped at 100%) was conducted.
- JAEA holds the HTGR fuel design technology and the Japanese private company, NFI, holds the HTGR fuel manufacturing technology
- JAEA plans to **establish HTGR fuel manufacturing technology in the UK** with a view to commercial HTGRs, and to use the UK's fuel as an option for procuring fuel for the Japan demonstration HTGR.
- In April 2024, NNL and JAEA signed a collaboration memorandum and license arrangement for UK Coated Particle Fuel Programme



❑ Loss of forced cooling test (All HGC stopped at 100% (30MWt)) March 2024



United States of America

- Over the past 21 yrs DOE allocated 625M USD to HTGR R&D
- No “national” HTGR is being developed since NGNP (2005-2012)
- DOE 50/50 cost-share demonstration awards to commercial HTR designers – for XE Xe-100: \$1,230M over 7 years to build a 2-unit Xe-100 demonstration plant
- XE will site first 4 units at Dow’s Chemical facility in Seadrift, Texas by 2029
- Utility Energy Northwest and XE plan to deploy up to 12 units in central Washington State, with first unit online by 2030
- The US TRISO fuel qualification program aims for completion of fuel qualification test by 2027.
- Selection, irradiation, characterization and qualification of existing nuclear grade graphite is on-going; the graphite data are included in the NDMAS database [NDMAS - DOE-ART Graphite](#)
- The activities on metals are focused to achieve ASME codification of alloys and design methods for high-temperature use in pressure vessels, heat exchangers, and other primary circuit components
- US supports experiments (HTTF, NSTF) and international collaboration for V&V of HTGR modeling and simulation tools
- Amazon announced investments in X-energy, with a goal of deploying up to 5 GW of its Xe-100 in US by 2039 (~62 units) for datacenter supply
- XE and Canadian power producer TransAlta Corporation will study feasibility of deploying Xe-100 at a repurposed fossil fuel power plant in Alberta
- Radiant, USNC and Westinghouse microreactors were awarded \$3.9M of DOE funding for front-end engineering and experimental design (FEED) in the DOME facility



DOE-ART

NEUP Website

NEUP Prj Files

NDMAS

DOE-ART Graphite

The DOE-ART Graphite R&D program is the primary nuclear graphite research program for the USA. This program focuses on research and development activities necessary to qualify and license graphite components for use within nuclear applications, specifically within advanced reactor designs such as High Temperature Reactor designs. The data generated within the ART Graphite program is intended to be used in conjunction with other publicly available nuclear graphite data such as is contained within the [IAEA Nuclear Graphite Knowledge Base](#). The ART Graphite program is divided into 5 primary research areas providing a combination of data, analysis reports, and pertinent references to describe and explain the trends within the data.

- ▶ **Unirradiated (Baseline):** Establish as-manufactured (Baseline) values for unirradiated material properties that can be used to determine the quantitative changes during irradiation and degradation during nuclear applications.
- ▶ **Irradiation (AGC Experiment):** Establish evolution of material property changes due to irradiation dose and temperature. The AGC Experiment is an irradiation creep experiment which provides creep data for selected graphite grades.
- ▶ **Degradation:** Establish effects of irradiation, oxidation, and molten salt interaction on graphite behavior.
- ▶ **Behavior models:** Predictive and degradation models for graphite behavior.
- ▶ **Licensing and code:** Papers and data supporting ASME code development and NRC license assessment.

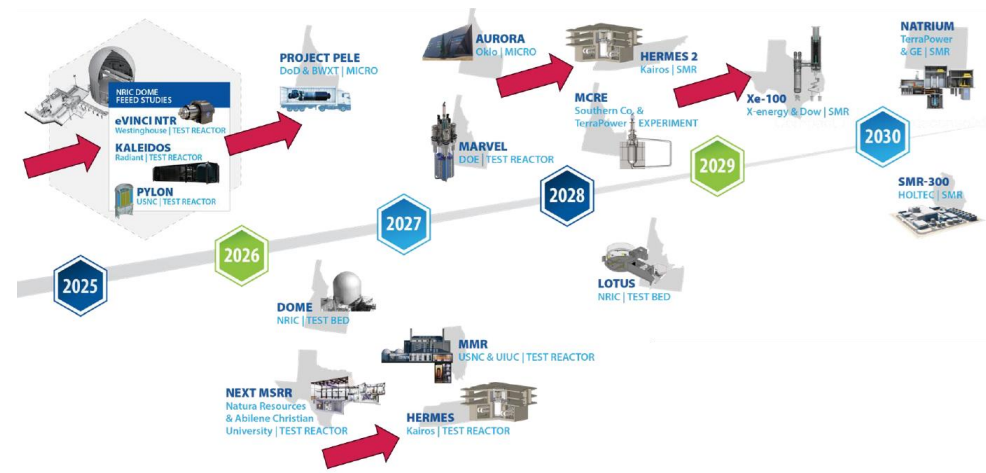


Baseline
(Unirradiated)

AGC
(Irradiated)



Advanced Reactor Demonstration & Deployment Timeline



Other highlights from TWG-GCR members

Canada

- OPG and X-Energy have signed a framework agreement to pursue opportunities to deploy Xe-100 SMRs for electricity and high-temperature steam for industrial applications in Ontario and Canada (e.g., oil sands, petrochemical).
- CNL is conducting a series of R&D activities on HTGR on materials, hydrogen production, modelling, nuclear fuel.

Indonesia

- target is to acquire 250 MWe from nuclear power in 2033;
- Since 2015 BATAN has been planning to build a 10 MWt pebble bed HTGR; in 2016 the transfer of RDE conceptual design from NUKEM and OKBM Rosatom was completed;
- PeLUIt-40 (an upscale from the 10 MWt reactor to 40MWt) development for de-dieselization, low-carbon hydrogen production, desalination.

Poland

- **HTGR-POLA** completed its basic design phase, entering into the detailed design and licensing phase expected to end by 2028. The commissioning of the reactor is aimed to be in 2033. The reactor will be a prismatic type HTGR (30-40 MWt), with an outlet temperature of 750C.

Republic of Korea

- KAERI has developed the key technologies of VHTR for hydrogen production since 2017: VHTR code V&V and code improvements, materials characterization and lab scale TRISO fabrication, helium experimental loop, long term life prediction for IHX, lab scale sulphur-iodine cycle, coupling of VHTR and HTSE for hydrogen production (HTSE module fabrication – 6 kW, HTSE performance test, coupled analysis VHTR-HTSE)

Russian Federation

- HTGR technology development in Russia started in the 70s for electricity and heat generation for ammonia production. Several HTGR designs were developed: VG-400 (1060 MWt), VGM (200 MWt), VGM-P (215 MWt), GT-MHR (600 MWt), MHR-T (600 MWt), RDE (10 MWt) and since 2021, **VTGR-200** (200 MWt).
- The investment stage of the project for a VTGR-200 reactor plant construction (prismatic core); awaiting the approval of the justification of investments in 2025; hydrogen production process intended is steam methane reforming; the FOAK NPP expected to enter commercial operation in 2035

South Africa

- North West University is conducting a study on the feasibility to restart the PBMR project (Oct 2024-Nov 2025).
- STLN designs: 100 MWt and 30 MWt pebble bed HTGR, and HTR fuel design and manufacturing using U and U/Th

United Kingdom

- UK government funding is mainly directed towards advanced reactor systems, especially HTGRs
- JAEA>NNL collaboration on a pilot-scale TRISO fuel manufacturing capability; Urenco to build a HALEU enrichment facility by 2031

HTGR Technology Development Knowledge Base

[HTGR Public - Home](#)

Welcome to the HTGR Technology Development Knowledge Base

The HTGR Technology Development Knowledge Base, is intended to increase collaboration and experience sharing in the field of innovation and technology for high temperature gas cooled reactors (HTGRs), as well as to retain the critical knowledge transferred from Forschungszentrum Jülich, Germany to the IAEA.

The scope of the 'HTGR Technology Development Knowledge Base' is to provide and maintain a:

- Community of practice and learning for technology related aspects for high temperature gas cooled reactors (HTGRs), sharing experience and critical knowledge of IAEA Member States;
- Platform to gather the IAEA resources on HTGR technology;
- Platform to propose new topics, events, and collaborative works such as IAEA topical publications.

For further information or questions please contact: HTGR.Contact-Point@iaea.org.

Featured Publications on SMR

Members Areas (with access based on IAEA nucleus account and approval from the coordinators of the 'HTGR Knowledge Base')



Already a member?

Enter your username and password to access member area

[Members Area →](#)



Not a member yet?

Submit your required details to join and access member area

[Join Here →](#)

Latest News on SMRs and HTGRs



IAEA Milestones Guidance Update to Include Considerations for SM

FZJ Documentation (FZJ, Thesis, Lectures)

Name	Modified
01-FZJ	July 17
09 - Habil PhD Dipl Master Bach L...	August 12
index.xlsx	August 12

FZJ Documentation - International Projects

Name	Modified
CEC	August 12
EU Projects	August 13
HTMP - High Temperature Materi...	August 13
OECD DRAGON Project	August 13
index - International projects.xlsx	August 14

FZJ Documentation - THTR

Name	Modified
01-THTR_CEC	September 6

FZJ Documentation - AVR

Name	Modified	Modified By
03 - AVR	March 25	CONSTANTIN, Alina

FZJ Archive – indexing in INIS

(~40 yr of experience documented in reports, articles, technical notes, etc. in ~20,000 files, 300 GB)

- Access INIS – International Nuclear Information System
- 4500 files from FZJ archive already indexed (as of Dec 2024)
- **Search for “Juelich Preservation Project”**

The screenshot shows the IAEA INIS database search results for the query "Juelich preservation project". The interface includes a header with the IAEA logo, a search bar containing the query, and navigation links for "Communities" and "My dashboard". A "Log in" button is also present. Below the header, the search results are displayed, showing 5,122 results found. The results are sorted by "Best match". The left sidebar contains filters for "File type" (PDF), "Resource types" (Publication, Miscellaneous), and "Access status" (Restricted, Open, Metadata-only). The main content area lists three search results, each with a title, author, summary, and upload/publication information.

IAEA International Atomic Energy Agency Agency for Peace and Development

"Juelich preservation project"

Communities My dashboard

Log in

5,122 result(s) found

Sort by Best match

File type

☐ PDF

Resource types

☐ Publication

☐ Miscellaneous

Access status

☐ Restricted

☐ Open

☐ Metadata-only

Help

[Search guide](#)

2017 (v1) Miscellaneous Open

Irradiation Test Facility in NRG Petten for HTR-PM Spherical Fuel Elements

Zhao, Hongsheng

Summary: -- Superb irradiation facilities HFR Petten -- Limited PIE facilities -- X-ray tomography of TRISO spheres have provided insights into the manufacture of high-quality spherical fuel elements

Uploaded on January 19, 2025 | Published in: 48 p., 2017.

Proceedings of: IAEA Fellowship Training Course on HTGR Fuel

2012 (v1) Miscellaneous Restricted

Pilot-scale production of UO₂ kernels by sol-gel process at INET

Hao, Shaochang

Outline: 1. Introduction 2. Processes, Facilities and Results 3. Concluding Remarks 4. Acknowledgement

Uploaded on January 19, 2025 | Published in: 19 p., 2012.

Proceedings of: 6. International Topical Meeting on High Temperature Reactor Technology

2012 (v1) Miscellaneous Restricted

Experiments to Improve the Modeling of Air Ingress Accidents in Gas-Cooled VHTR

Allelein, H.-J.; Schlögl, B.; Jühe, S.; and 3 others

Overview: - Introduction - Experiments -- INDEX (small scale) -- NACOK (Integral) - HTR Code Package (HCP) / STAR - Outlook

Uploaded on January 19, 2025 | Published in: 20 p., 2012.

Proceedings of: 6. International Topical Meeting on High Temperature Reactor Technology

2012 (v1) Miscellaneous Restricted

Post-irradiation Examination and Fission Product Inventory Analysis of AGR-1 Irradiation Capsules

Harp, Jason M.; Demkowicz, Paul A.; Ploger, Scott A.

Summary: • Fission product inventory has been extensively surveyed in the AGR-1 capsule components and compacts - Spatial distribution of Ag and Cs studied - Locating Cs activity in graphite fuel holder has lead to identification of particles with defective SiC for further study • Fractional releases from compacts: - Very low Cs release from int...

Uploaded on January 19, 2025 | Published in: 26 p., 2012.

The 11th International Topical Meeting on High Temperature Reactor Technology

Published 2024 | Version 1.0.0

Book

Open

The 11th International Topical Meeting on High Temperature Reactor Technology

Tsinghua University High Temperature Reactor Branch of China Nuclear Society, Institute of Nuclear and New energy Technology, Beijing, China

Shanghai Electric Group Co., Ltd., Shanghai, China

China North Nuclear Fuel Co., Ltd., Baotou City, China

China Nuclear Power Operation Technology Corporation, Ltd., Wuhan, China

China Techenergy Co., Ltd., Beijing, China

Chengdu Taihua Zhongcheng Technology Group Co., Ltd., Baoji, China

The HTR conference series focuses on High Temperature Gas-cooled Reactors (HTGR) technology including heat applications.

Inaugurated in 2002 by the European High Temperature Reactor Technology Network (HTR-TN) at Petten, the Netherlands, successive meetings were held in China (Beijing, 2004), South Africa (Johannesburg, 2006), the USA (Washington DC, 2008), Czech Republic (Prague, 2010), Japan (Tokyo, 2012), China (Weihai, 2014), the USA (Las Vegas, 2016), Poland (Warsaw, 2018) and Indonesia (Yogyakarta, 2021).

HTR 2024 is to be held in Beijing, China during 14-18 October, 2024. HTR 2024 aims to accelerate research and development on HTGR and heat application technologies, and make practical use of HTGR systems, through discussing and exchanging on the latest results and information on the above technologies and user requests as well as future perspectives and plans.

Files

HTR 2024 - International Conference on High Temperature Reactor Technology (August 2024) - China.pdf

Page: 4 of 4

Automatic Zoom:

Contact

Inquire about this record

Details

Resource type

Book

Conference

The 11th International Topical Meeting on High Temperature Reactor Technology (HTR 2024) , Beijing, China, 14-18 October, 2024

Languages

English

Associated items

A concept of fast steady-state therma...

GEMINI 4.0, a project for developing ...

Criticality Safety for HTGR Fuel Plan...

Advancing Nuclear Energy in Indonesia...

Analysis and Evaluation of Mining Are...

Simplifying Reactor Protection System...

Three-dimensional Radiation View Fact...

Advanced Process Design for HTR TRISO...

Effects of Urea and Cerium Addition i...

...

Find all associated items

Versions

Version 1.0.0

2024

Citation

HTGR Technology Development Knowledge Base

Resources

HTR codes documentation

HTR2024

Publications

Experimental Facilities

HTGR Code Documentation

IAEA HCP Workshop in Jakarta 2017

Name ▾	Modified ▾
Presentations	March 20
Tutorials	March 20

HTR2024



*The 11th International Topical Meeting on
High Temperature Reactor Technology*

高温气冷堆技术会议 (HTR 2024)

Oct. 14-18, 2024, Beijing, China

主办方：清华大学核能与新能源技术研究院
中国核学会高温堆分会

协办单位：上海电气集团股份有限公司
中核北方核燃料元件有限公司
中核武汉核电运行技术股份有限公司
北京广利核系统工程有限公司
成都泰华中成科技集团有限公司

Organizers： Institute of Nuclear and New Energy Technology, Tsinghua University
High Temperature Reactor Branch of China Nuclear Society

Co-organizers： Shanghai Electric Group Co., Ltd.
China North Nuclear Fuel Co., Ltd.
China Nuclear Power Operation Technology Corporation, Ltd.
China Techenergy Co., Ltd.
Chengdu Taihua Zhongcheng Technology Group Co., Ltd.

The Proceedings of the Conference are also available through IAEA INIS at [The 11th International Topical Meeting on High Temperature Reactor Technology](#).

HTR2024 Papers

[See all](#)

Name ▾	Modified ▾	Modified By ▾
 100 - Particle deposition characte...	December 16, 2024	CONSTANTIN, Alina
 102 - Influences of Boundary Con...	December 16, 2024	CONSTANTIN, Alina
 103 - A Comparative Analysis on ...	December 16, 2024	CONSTANTIN, Alina
 104 - CP Thermodynamics and Ca...	December 16, 2024	CONSTANTIN, Alina
 106 - Simulation Modelling of Sec...	December 16, 2024	CONSTANTIN, Alina
 108 - Project plan of HTTR heat a...	December 16, 2024	CONSTANTIN, Alina
 111 - Commissioning of HTR-PM ...	December 16, 2024	CONSTANTIN, Alina

HTGR Technology Development Knowledge Base

Resources

Experimental facilities database – 174 entries
Includes also closed, decommissioned, in care and
maintenance facilities
(will included in NEXSHARE)

HTR codes documentation

HTR2024

Publications

Experimental Facilities

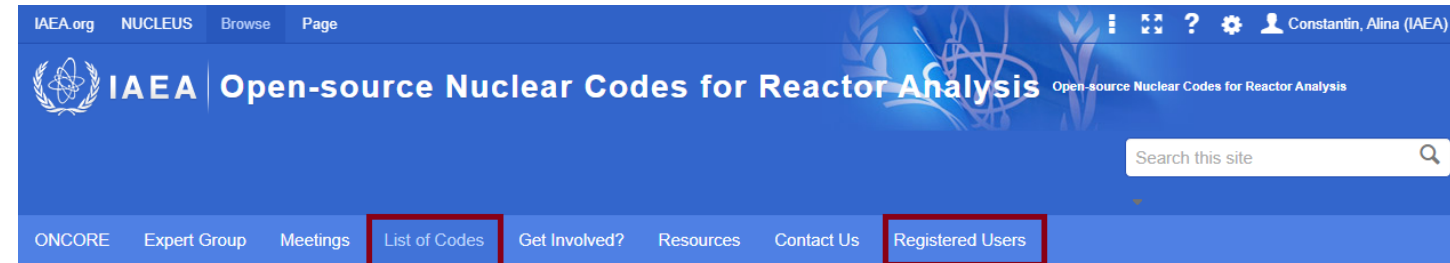
Experimental Facilities

Name ▾	Fac. Name ▾	Country ▾	Fac. Status ▾	Neutronics ▾	Thermal Fluids ▾	Fluid Dynamics ▾	Coolant Chemistry ▾	Materials ▾	Sys. & Comp. ▾
☐ ADI.docx		Germany		No	No	No	No	No	No
AFTF.docx	Air Flow Test Facility	USA		No	No	Yes	No	No	No
AHTI.docx	Apparatus for High Temperature Irradiation (official name not known)	USA		No	No	No	No	No	No
AIADE.docx	Apparatus for Iodine Adsorption/Desorption Experiments (official name not known)	USA		No	No	No	No	No	No
ALEX.docx		Germany		No	No	No	No	No	No
ARGONAUT.docx		Austria		No	No	No	No	No	No
ARGUS.docx	ARGUS Loop	Germany		No	No	No	No	No	No
ASTRA.docx	ASTRA Critical Facility	Russia	Operational	Yes	No	No	No	No	No
ASTRA-PBMR.docx	ASTRA Critical Facility (Experiments for PBMR)	Russia	Operational	Yes	No	No	No	No	No
ASU-8.docx		Russia		No	No	No	No	No	No
ATR.docx	Advanced Test Reactor	USA		No	No	No	No	No	No

HTR Codes (HCP, STACY, VSOP)

- HTR codes are accessible through the Open-Source Nuclear Codes for Reactor Analysis (ONCORE)

- The ONCORE initiative is an IAEA-facilitate international collaboration framework for the development and application of open-source multi-physics simulation tools to support research, education and training for the analysis of advanced nuclear power reactors. Institutions and individuals participating in ONCORE can collaborate in, and benefit from, the development of open-source software in the field of nuclear science and technology.
- <https://www.iaea.org/topics/nuclear-power-reactors/open-source-nuclear-code-for-reactor-analysis-ncore>
- <https://nucleus.iaea.org/sites/ncore>



[Home](#)

List of Codes

Want to get involved? You are invited to submit code to be included in this list, please follow the instruction available at [Get Involved?](#)

This preliminary list has been compiled by the ONCORE expert group. It does not include software that is not made available by its developers, nor software whose development has been discontinued. The authors acknowledge the fact that they might have overlooked on several available open-source codes. Would you be aware of other relevant software that could complement this list, please contact us at (ONCORE@iaea.org).

Codes available through ONCORE

Name	Brief description	How to obtain the software	License
VSOP99/11	HTR pebble-type design and safety analysis	Available at: Registered users of ONCORE	MIT
STACY	V/HTR safety analyses for the quantification of fission product release from the fuel.	Available at: Registered users of ONCORE	MIT
HCP	HTGR safety analysis integrated code	Available at: Registered users of ONCORE	MIT

Source code available in Github

If you need access to source code, please write an email to:
ncore.contact-point@iaea.org with detailed explanation of the expected use.

2025: Workshop on High Temperature Gas Cooled Reactor Technology and Training on the High Temperature Reactor Code Package (2-7 November 2025, hosted by TUM)

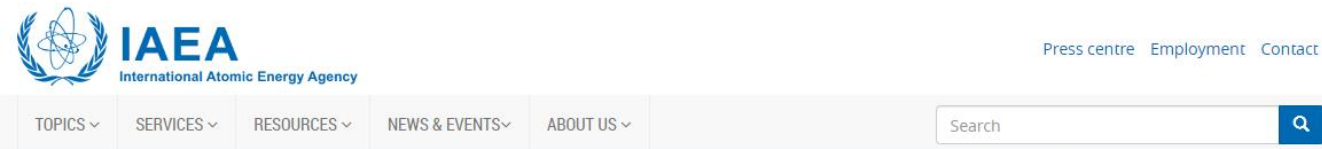
IAEA Expert mission on the High Temperature Gas-cooled Reactor Package (HCP) and STACY code (4-8 November 2024, Bandung, Indonesia)

- Organized locally by the National Research and Innovation Agency (BRIN), at the premises of Bandung Institute of Technology, Bandung (ITB), with IAEA support from TC Programme INS2019
- Agenda included lectures and practical sessions, illustrating the capabilities of the version available in the IAEA ONCORE platform and also the capabilities of the HCP version under development at the Technical University of Munich and of the STACY version developed in Becker Technologies
- Training provided by:
 - ❑ Mr Andre Xhonneux (former developer of HCP code in FZJ, Germany)
 - ❑ Mr Chunyu Liu (Technical University of Munich)
 - ❑ Meryll Colomber (Becker Technologies, Germany)
- 9 Indonesia BRIN staff and 5 online South African participants joined the event
- It is expected that the new version developed by TUM to be transferred to IAEA during 2025 and make available to Member States through the IAEA ONCORE platform
- The need of having a comprehensive documentation of the HCP code and its modules (including training material, developer manual and theoretical manual) was highlighted by the participants; however, currently the developers have limited resources and the focus is to complete the expected enhanced versions of both HCP and STACY
- Participants (both users and developers) agreed on the need to have a dedicated HCP Forum to exchange data, models, work on further developments, report bugs/issues, create test cases
- *Consultancy Meeting on the HTR Code Package (HCP) Update and Establishing of a Dedicated Working Group for Future Utilization in HTR Analysis (7-9 April 2024, Munich, Germany) aiming to define the scope of a HCP WG to be established and lead by IAEA.*



Nuclear Graphite Knowledge Base (NGKB)

<https://www.iaea.org/resources/databases/iaea-nuclear-graphite-knowledge-base>



Home / Resources / NUCLEUS information resources / IAEA Nuclear Graphite Knowledge Base



This knowledge base supports the preservation and sharing of expert knowledge and experience across the international Graphite Community.

The knowledge base contains general information on the subject of nuclear graphite and specialist knowledge that is restricted to members of the international project.

Resource Information

Quality Level	Not quality checked
Completeness	Selective - Effort is made to create a comprehensive database on Irradiation Graphite but it might not cover all elements
Update Frequency	Updated periodically



Open Knowledge Wiki Restricted Resources NGKB Meetings

Home

Welcome to the IAEA Nuclear Graphite Knowledge Base

Mission Statement

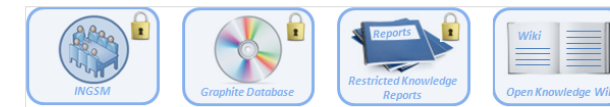
The aim of this knowledge base is to support the preservation and sharing of expert knowledge and experience, across the international Graphite Community.

The knowledge base contains two levels of knowledge:

- General information on the subject of Nuclear Graphite
- Specialist knowledge, secured for members of the international project

Please click on the below images to link to the desired section of the knowledge base

Databases



More about the NGKB

- [How to Register for the NGKB Services](#)

- Open knowledge wiki
- Restricted resources
- NGKB meetings

International Nuclear Graphite Specialists Meeting (INGSM)

Open Knowledge Wiki Restricted Resources ▾ NGKB Meetings

Knowledge Base

Libraries

GraphiteDB

INGSM

Test Area

Meetings

March_2015_I3-TM-50155

Lists

INGSM

[+](#) New [↑](#) Upload [↻](#) Sync [↻](#) Share [More ▾](#)

All Documents ...

Drag files here to upload

✓ ☐	☐	Name	Modified	Modified By	File Size
	☐	INGSM-1 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-10 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-11 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-12 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-13 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-14 Material	... December 24, 2013	☐ GLADYSHEV, Maxim	
	☐	INGSM-15 Material	... February 3, 2015	☐ YASAR, Tufan	
	☐	INGSM-16 Material	... November 17, 2015	☐ SANTOSO, Sigit	
	☐	INGSM-17 Material	... September 16, 2016	☐ KIM, Wooseub	
	☐	INGSM-18 Material	... November 20, 2017	☐ KIM, Yongjin	
	☐	INGSM-19 Material	... September 11, 2018	☐ REITSMA, Frederik	
	☐	INGSM-2 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-20 Material	... November 13, 2019	☐ LUQUE GUTIERREZ, Juan Cristhian	
	☐	INGSM-21 Material	... November 27, 2023	☐ Frederik Reitsma	
	☐	INGSM-22 Material	... November 21, 2023	☐ SUBKI, M. Hadid	
	☐	INGSM-23 Material	... November 26, 2023	☐ SUBKI, M. Hadid	
	☐	INGSM-3 Material	... December 24, 2013	☐ GLADYSHEV, Maxim	
	☐	INGSM-4 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-5 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-6 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-7 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-8 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	INGSM-9 Material	... April 23, 2013	☐ ELGHOBARY, Ahmed	
	☐	Copy of INGSMA_Index	... September 11, 2018	☐ REITSMA, Frederik	511 KB
	☐	INGSM_Index	... August 9	☐ CONSTANTIN, Alina	847 KB

24th International Nuclear Graphite Specialists Meeting (INGSM)



24th International Nuclear Graphite Specialists Meeting

- Irradiation damage, in-pile experiments
- Oxidation
- Graphite waste, and graphite assembly and component disassembly and decommissioning
- Use of graphite in molten salt reactors
- Thermo-physical, thermo-chemical, and mechanical properties of graphite
- Microstructure and characterization
- Standards, licensing and graphite qualification
- Physisorption and chemisorption of tritium and other gases in graphite
- Innovations and experience in manufacturing and purification, component and assembly fabrication and installation, and graphite supply chain
- Functional/performance requirements for graphite components

25th International Nuclear Graphite Specialists Meeting (INGSM)

29 Sept – 3 Oct 2025 (Vienna)

[25th International Nuclear Graphite Specialists' Meeting](#)

Abstracts must be received by 30th JUNE 2025

International Network for Experiment and Code Validation Sharing (NEXSHARE)



NEXSHARE

NEXSHARE Public NEXSHARE Member's Area

<https://nucleus.iaea.org/sites/connect/NEXPublic/SitePages/Home.aspx>

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STANDARDIZATION
INITIATIVE

NEXSHARE - Home

Welcome to the IAEA NEXSHARE

The International **Network for Experiment and Code Validation Sharing (NEXSHARE)** is forum for global cooperation and resource sharing on experiments and code validation for Small Modular Reactors (SMRs). Participating organizations includes experimental facilities, technology holders, International Organizations and Technical Support Organizations (TSOs).

The objectives of **NEXSHARE** are to:

- Reduce costs and increase schedule certainty associated with experiments and code validation needed for design and licensing of SMRs.
- Provide greater reach and enhanced utilization of existing experimental facilities.
- Share information on existing experimental programs and identify potentials for resource sharing and synergies.
- Provide greater confidence on data and codes used in safety cases by establishing globally recognized common approaches and best practices in testing and code validation.

For further information or questions please contact NEXSHARE.Contact-Point@iaea.org



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Partners



GENIV
International Forum
Expertise | Collaboration | Excellence

International Network for Experiment and Code Validation Sharing (NEXSHARE)



NEXSHARE

NEXSHARE Public NEXSHARE Member's Area

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About NEXSHARE



Participating Vendors



Participating Experimental Facilities



Resources



Collaboration Projects



Events



Contact Us



Steering Committee

experiments and code validation for small modular reactors (SMRs). Participating organizations includes experimental facilities, technology holders, International Organizations and Technical Support Organizations (TSOs).

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Submit your required details to join and access member area

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Partners



*****This Network is currently under construction. It is open to members for proposals and recommendations on its format, content and functionalities***

Facility	Full Name	Country Name ↑	Organization	Reactor family	Fluid	Application	Operating conditions	Max Power (kW)
Bell Jar	CNL Vacumm Bell Jar Apparatus	Canada	CNL	High Temperature Gas Cooled, Wa...	N/A	Severe Accident, Components/Feature, Materials	Accident conditions	50
HANC	Helium-Air Natural Convection	Canada	CNL	High Temperature Gas Cooled	helium and air	Containment, Thermalhydraulics - separate effects	Accident conditions	130
BTF	Burst Test Facility	Canada	Kinectrics Inc.	High Temperature Gas Cooled, Wa...	Water/inert gas/Hydrogen/Helium (environment can change as required)	Components/Feature, Materials, Severe Accident	Accident conditions, Normal operation	
HTTR	High Temperature Engineering Test Reactor	Japan	Japan Atomic Energy Agency	High Temperature Gas Cooled	Helium gas	Neutronics	Normal operation	30,000
HITHEF	High-Temperature Helium Experimental Facility for HTGRs	United States of America	University of Michigan	High Temperature Gas Cooled	Helium	Components/Feature, Thermalhydraulics - separate effects	Normal operation	52
GOTeF	Graphite Oxidation Test Facility	United States of America	University of Michigan	High Temperature Gas Cooled	Helium	Materials	Accident conditions, Normal operation	
MAGNET/He-CTF	Microreactor AGile Non-nuclear Experimental Test bed/Helium Component Test Facility	United States of America	Idaho National Laboratory	High Temperature Gas Cooled	Helium, Nitrogen	Components/Feature, Thermalhydraulics - integral effects, Thermalhydraulics - separate effects	Normal operation	250
PBRT	Pebble Bed Reactor Test facility	United States of America	Purdue University	High Temperature Gas Cooled	Helium	Thermalhydraulics - integral effects, Thermalhydraulics - separate effects	Accident conditions, Normal operation	
EXHALE	Experimental Helium Analysis and Laboratory for Extreme Conditions	United States of America	Texas A&M University	High Temperature Gas Cooled	Helium	Severe Accident, Thermalhydraulics - separate effects	Accident conditions, Normal operation	1.2

- Operator
- Applications
- Detailed technical description
- Past and planned experiments

Facility	Full Name	Country Name
Bell Jar	CNL Vacuum Bell Jar Apparatus	Canada
HANC	Helium-Air Natural Convection	Canada
BT		
H1		
HI		
GC		
M/CTF	experimental test bed/Helium Component Test Facility	
PBRT	Pebble Bed Reactor Test facility	United States
EXHALE	Experimental Helium Analysis and Laboratory for Extreme Conditions	United States

CNL Vacuum Bell Jar Apparatus



GENERAL INFORMATION	
Acronym:	Bell Jar
Facility name:	CNL Vacuum Bell Jar Apparatus
Organization:	Canadian Nuclear Laboratories
Country:	Canada
Operational since:	2008
Reactor family:	
☒ Water Cooled ☐ Molten Salt Other:	☒ High Temperature Gas Cooled ☐ Liquid Metal Cooled Fast Spectrum
Website/Contact email:	www.cnl.ca/ chuk.azih@cnl.ca

TECHNICAL DESCRIPTION

Operating conditions modelled:	☐ Normal operation	☒ Accident conditions
	please specify:	
Application:		
☐ Thermalhydraulics - separate effects	☐ Thermalhydraulics - integral effects	☐ Neutronics
☐ Fuel	☒ Components/Feature	☒ Materials
☐ Containment	☒ Severe Accident	☐ Hazards (seismic)
Other:		

Phenomena modelled:

Radiation heat transfer

Key facility parameters:

Fluid: Vacuum, oxidizing gas atmosphere (e.g., helium-oxygen mixture, CO₂, oxygen mixture).
 Dimensions/volume: 1.4×10⁶ mm² surface area.

	Min	Max
Facility power [kW]:	0	4.8 - 50*
Pressure [MPa]:	1.33×10 ⁻⁸	0.1
Temperature [°C]:	0	1100 - 1400*

* Indicates upgrades that have been recently implemented but not tested.

Key characteristics for integral effect test facilities:

- Measures total hemispherical emissivity of metals up to 1100°C
- Measures total hemispherical emissivity of graphite up to 1400°C
- Measure total hemispherical emissivity of silicon carbide up to 1400°C
- Measures emissivity under vacuum conditions
- Measures emissivity of coated and oxidized specimens

Last update: 22 January 2024

	Operating conditions	Max Power (kW)
Components/Feature,	Accident conditions	50
Thermalhydraulics -	Accident conditions	130
Temperature, Materials, Severe	Accident conditions, Normal operation	
	Normal operation	30,000
Temperature, Thermalhydraulics	Normal operation	52
	Accident conditions, Normal operation	
Temperature, Thermalhydraulics	Normal operation	250
Thermalhydraulics -		
Thermalhydraulics -	Accident conditions, Normal operation	
Thermalhydraulics -	Accident conditions, Normal operation	1.2



Chair: Sunming Qin (INL)
SiSec: Alina Constantin (IAEA)

General Scope

1. **Working paper and webinar on the overview of relevant work from the International Organizations and incorporate the information in the Network.**
2. Merge with and update the existing GCR experimental facility database:
 - Evaluate how to harmonize with the existing database, including updating the template
 - Identify contact points
 - Update operating facility data (with new template), get concurrence and upload in NEXSHARE
 - Update non-operational facility data (with new template) and upload in NEXSHARE
3. Establish a list for computer codes for HTGR:
 - Evaluate the approach to include the list of codes and high level information to be include (e.g. contact website, application, etc)
 - Map additional codes
 - Populate the list
4. Webinar on HTR codes with focus on HCP code (an upgraded version is expected to be released by Technical University of Munich, Germany in Q3 2025). The webinar is expected in Q1 2026 (after the release of the upgraded HCP code). It will introduce the HTGR Focus Group under NEXSHARE, the NEXSHARE HTR facilities database and will highlight the HTR codes transferred to the IAEA and available under ONCORE platform (HCP, STACY, VSOP), emphasizing on the capabilities of the upgraded HCP version.
5. A working paper will be done collaboratively with the HTGR Focus Group members to be presented in HTR2026 Conference. It will include an overview of selected activities on experiments and code validation for HTGR technology at organizations represented by the HTGR Focus Group Members.
6. Proposals for next steps for experiments and code validation for HTGRs.



Experimental Facility Database

Team: Alina Constantin / Sunming Qin, TWG-HTGR, Intern (IAEA)

Deliverable	Date/Status
HTGR template agreed on	June 2025
Update operational facilities information and upload in NEXSHARE	Q2 2026
Update non-operational facilities information and upload in NEXSHARE	Q4 2026

List of Computer Codes for HTGR

Team: Alina Constantin / Sunming Qin, TWG-HTGR, Intern (IAEA)

Deliverable	Date/Status
Evaluate the approach to include the DB, including the template	Q4 2025
Map additional codes	Q2 2026
Populate the database	Q4 2026



Publications/Events	Date/Status
Webinar and working paper on <i>Agencies activities on experiments and code validation for HTGRs</i> Authors: Alina Constantin (IAEA), Sunming Qin (INL), GIF , NEA, EC, EPRI and additional contributors under discussion	October 2025
Webinar on HTR codes Authors: Alina Constantin (IAEA), experts from Technical University of Munich and Becker Technologies Germany	Q1 2026
Working paper to be presented in HTR2026 Conference Authors: Alina Constantin (IAEA) and HTGR Focus Group Members	Q3 2026

Meetings	Date
Informal virtual meetings	On needed basis

Events on HTGR Technology in the second half of 2025

- International Nuclear Graphite Specialists Meeting, INGSM-25, organized in cooperation with the IAEA, 29 September – 3 October 2025 in Vienna
- Workshop on High Temperature Gas Cooled Reactor Technology and Training on the High Temperature Reactor Code Package, in the framework of TC-INT2023 interregional project, 2-7 November 2025, in Munich.
- Meeting of the Technical Working Group on Gas Cooled Reactors, 1 – 4 December 2025, in Vienna.

Thank you for your attention.

For inquiries, please contact:

Small Modular Reactor Technology Development Team

IAEA Division of Nuclear Power, Nuclear Power Technology Development Section

E-mail: SMR@iaea.org