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

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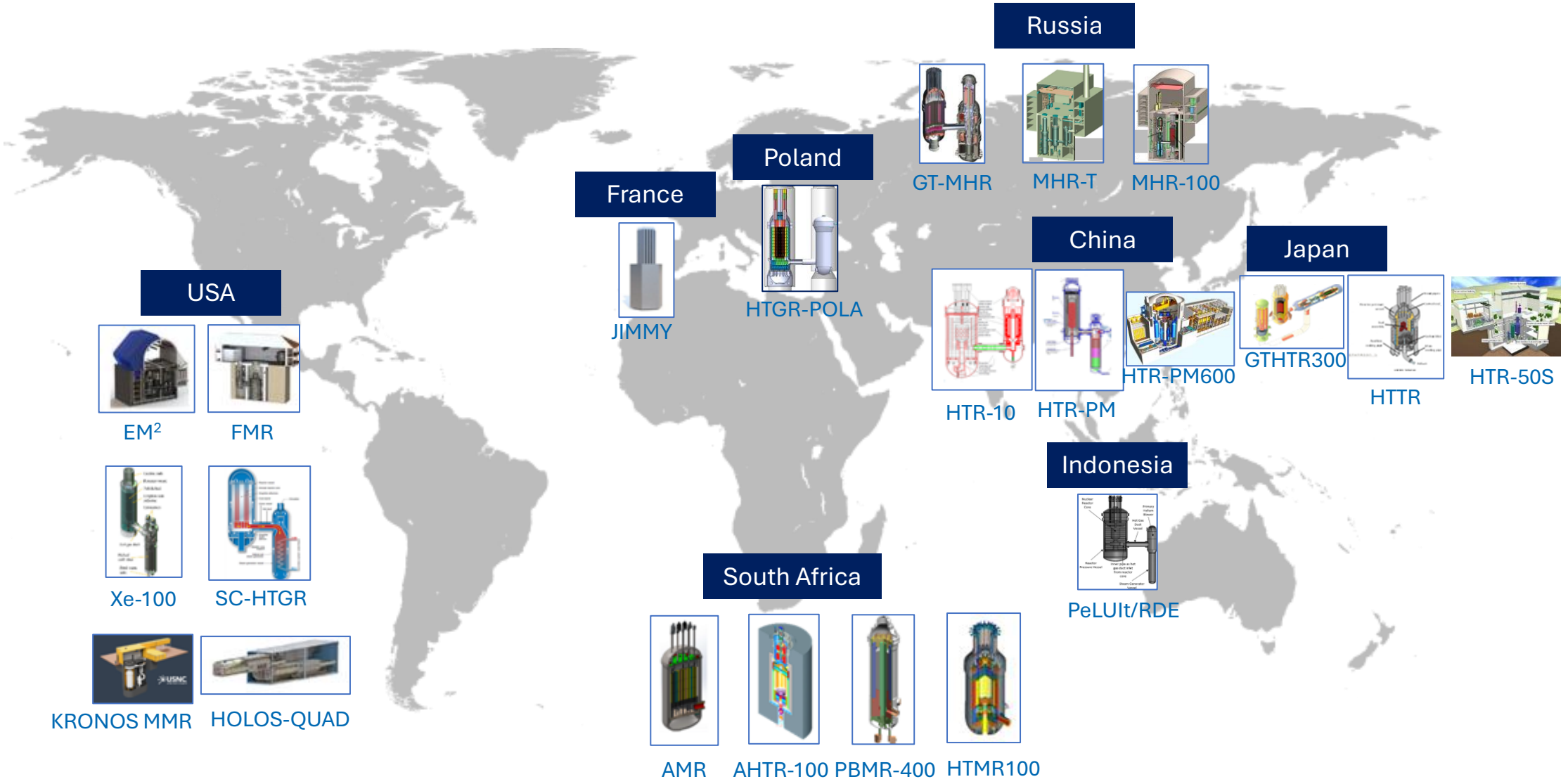
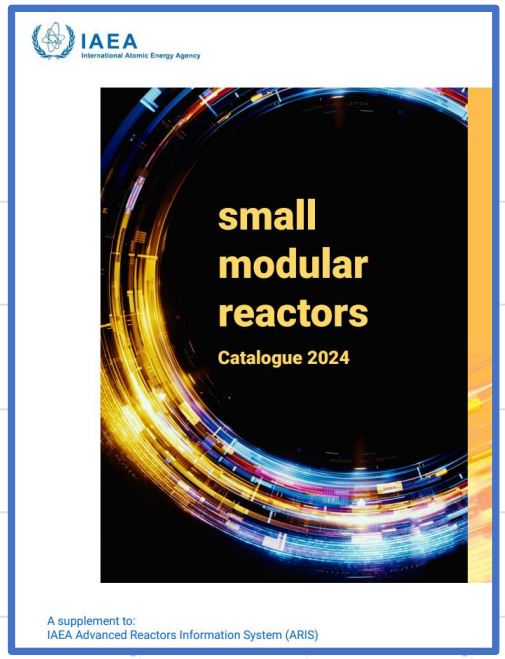
Nuclear Power Technology Development Section,
IAEA Division of Nuclear Power

Global Activities on HTGR-SMR development



SMR2024 Catalogue

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



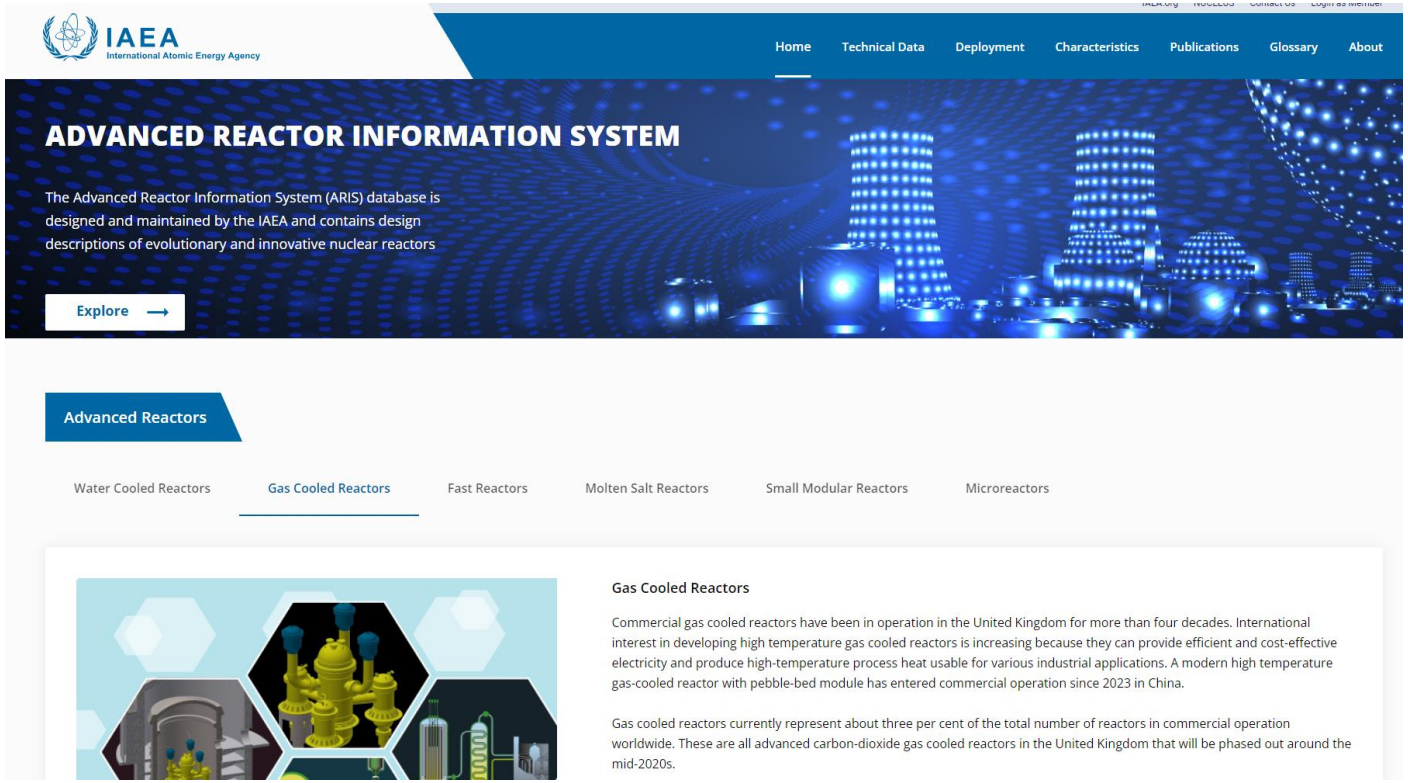
18 designs

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

IAEA Advanced Reactor Information System (ARIS)

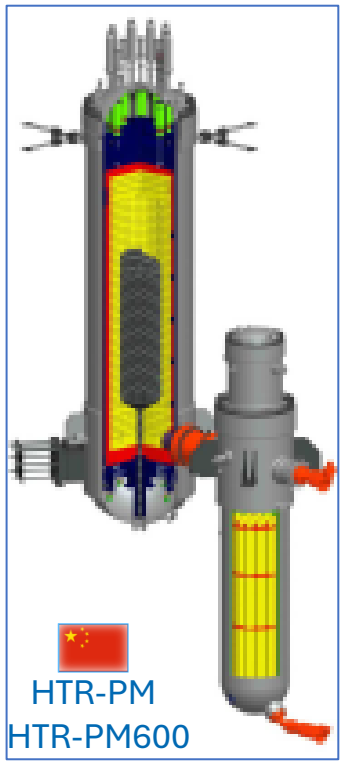
[Advanced Reactor Information System | Aris (iaea.org)](https://aris.iaea.org)

- Web-accessible database that provides Members 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



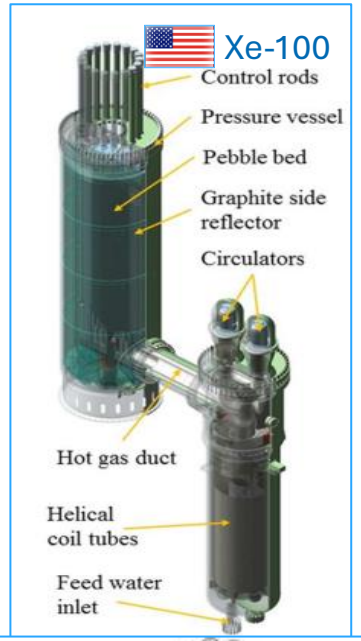
21 GCR designs
4 GFR designs

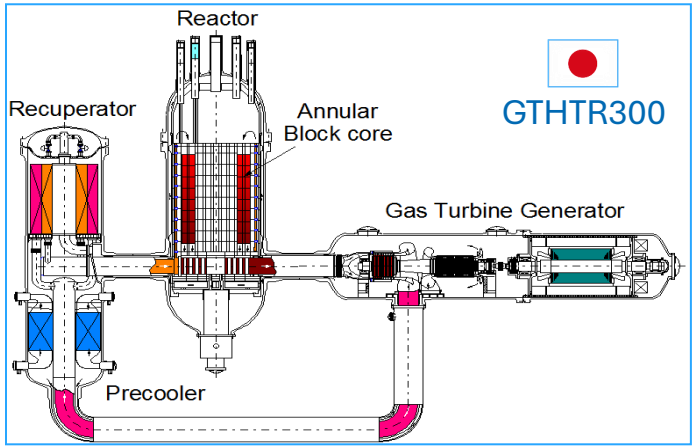
Multiple designs from Member States

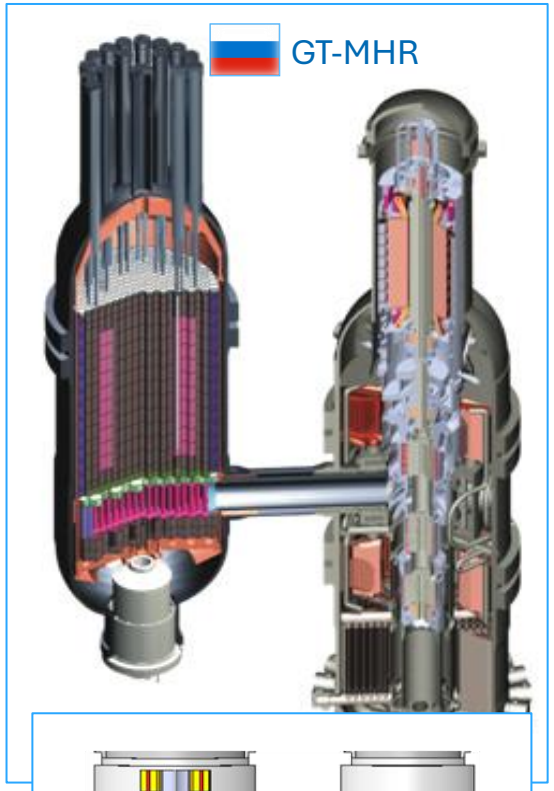


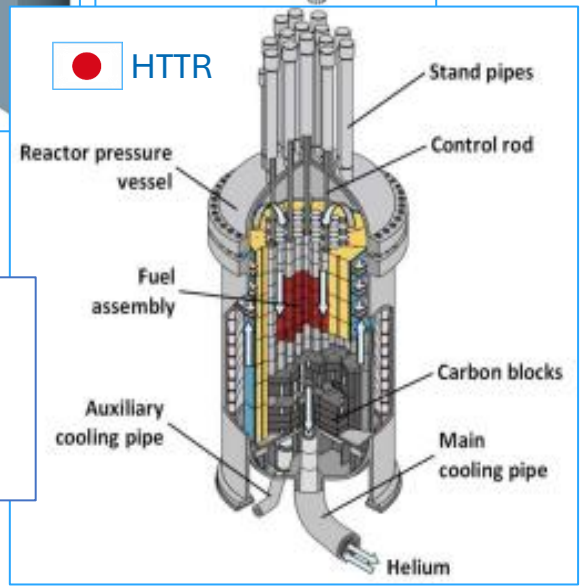
HTR-PM
HTR-PM600

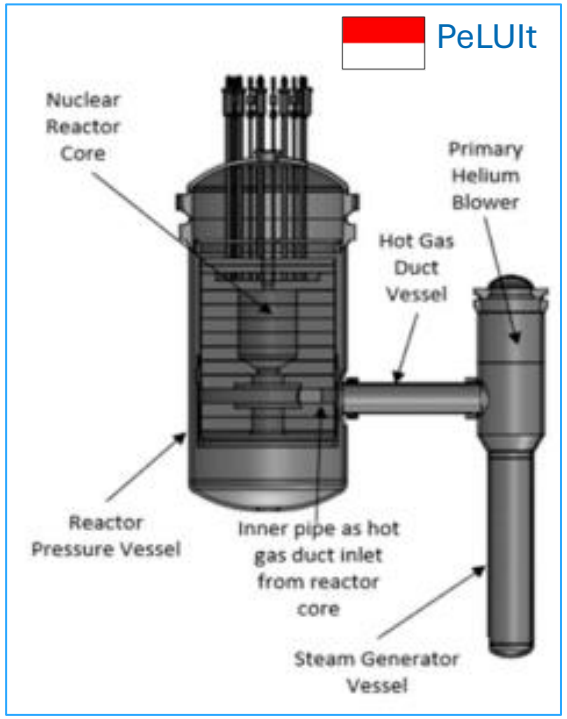
AHTR-100

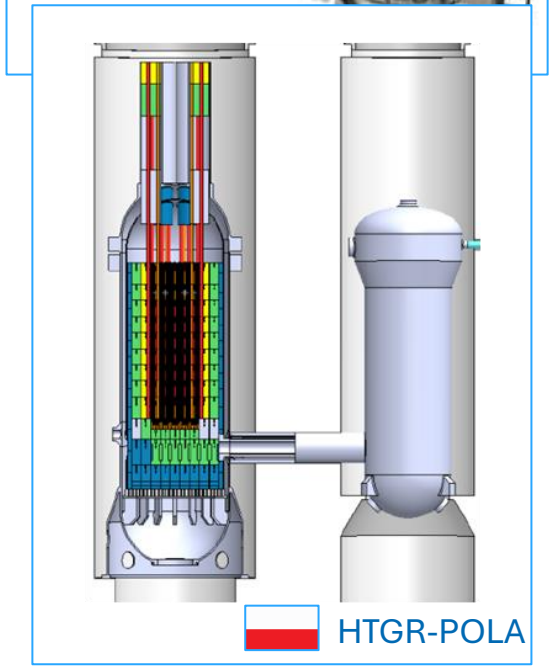


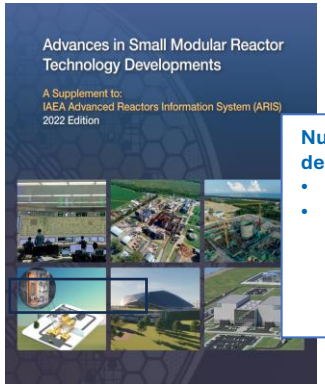












Number of SMR designs under development (2022)

- 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	Canada	**Mr Ali SIDDIQUI** Canada Nuclear Laboratories (CNL)
2	China *The Chair of TWG-GCR (2021-2024)*	**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)

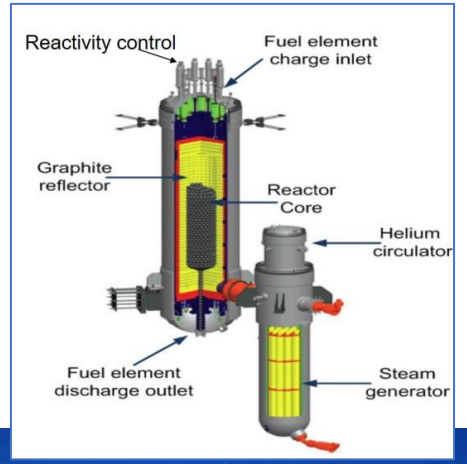
No	Country	Name and Affiliation
1	OECD/NEA	**Mr Brent WILHELM**
2	EC-JRC	**Mr Michael FUETTERER**

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**

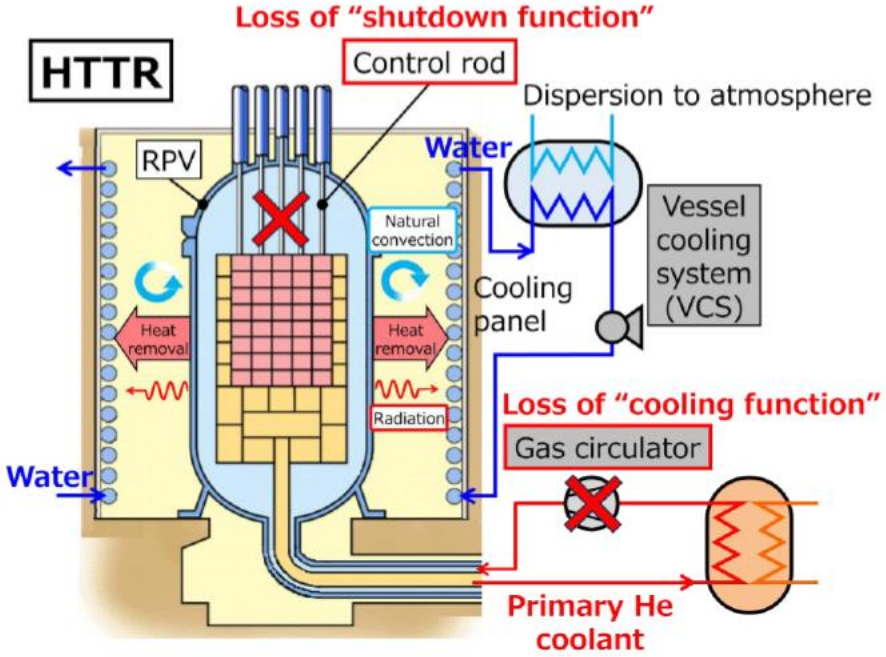
China

- 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

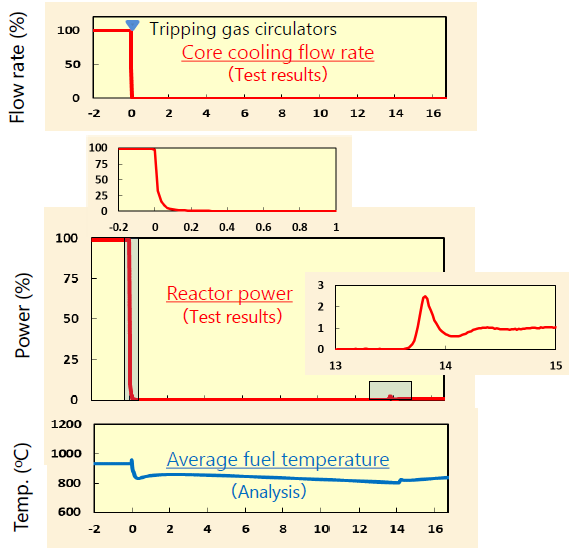


Japan

- 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

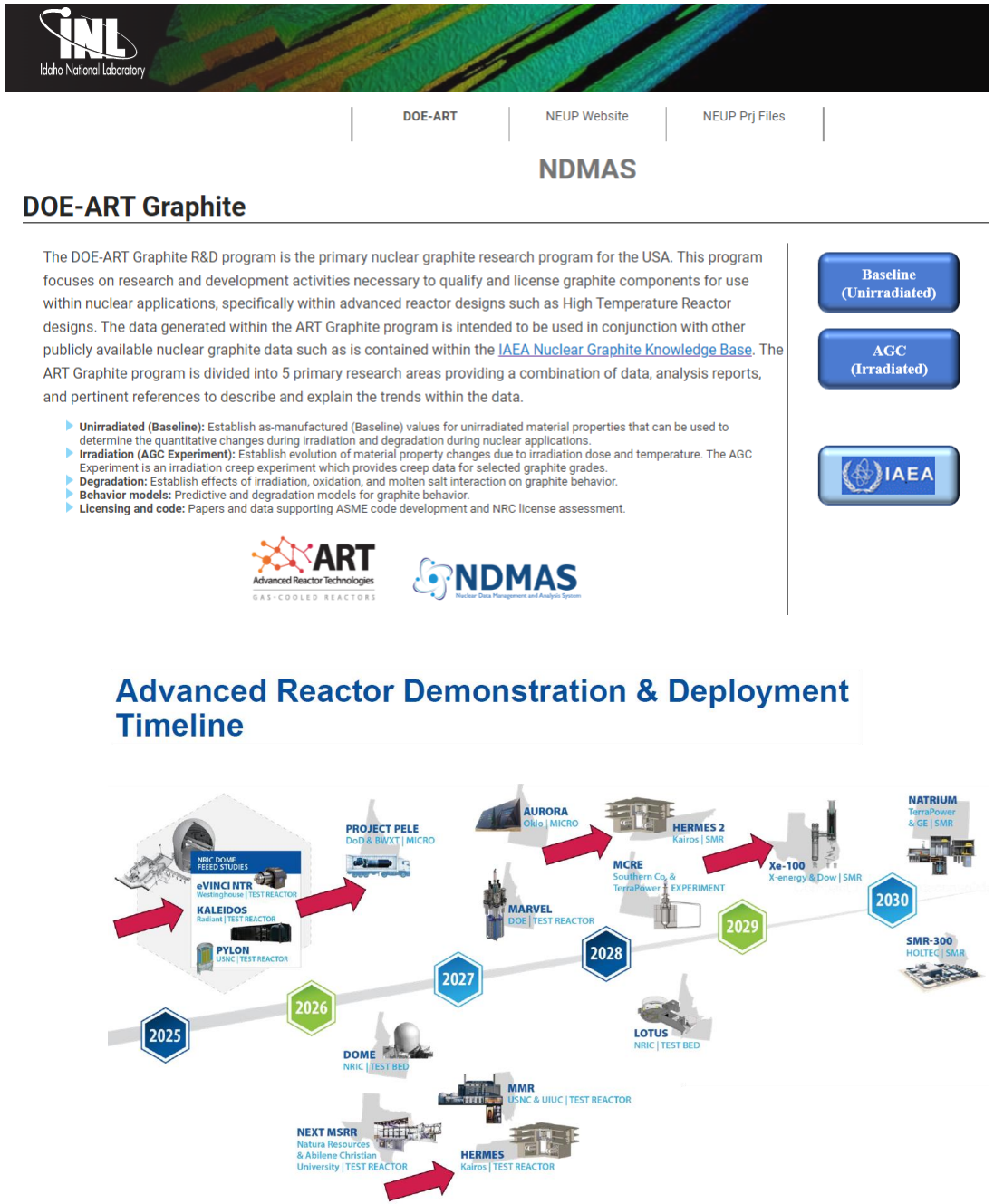


Loss of forced cooling test (All HGC stopped at 100% (30MWt)) March 2024



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



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 deigns 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

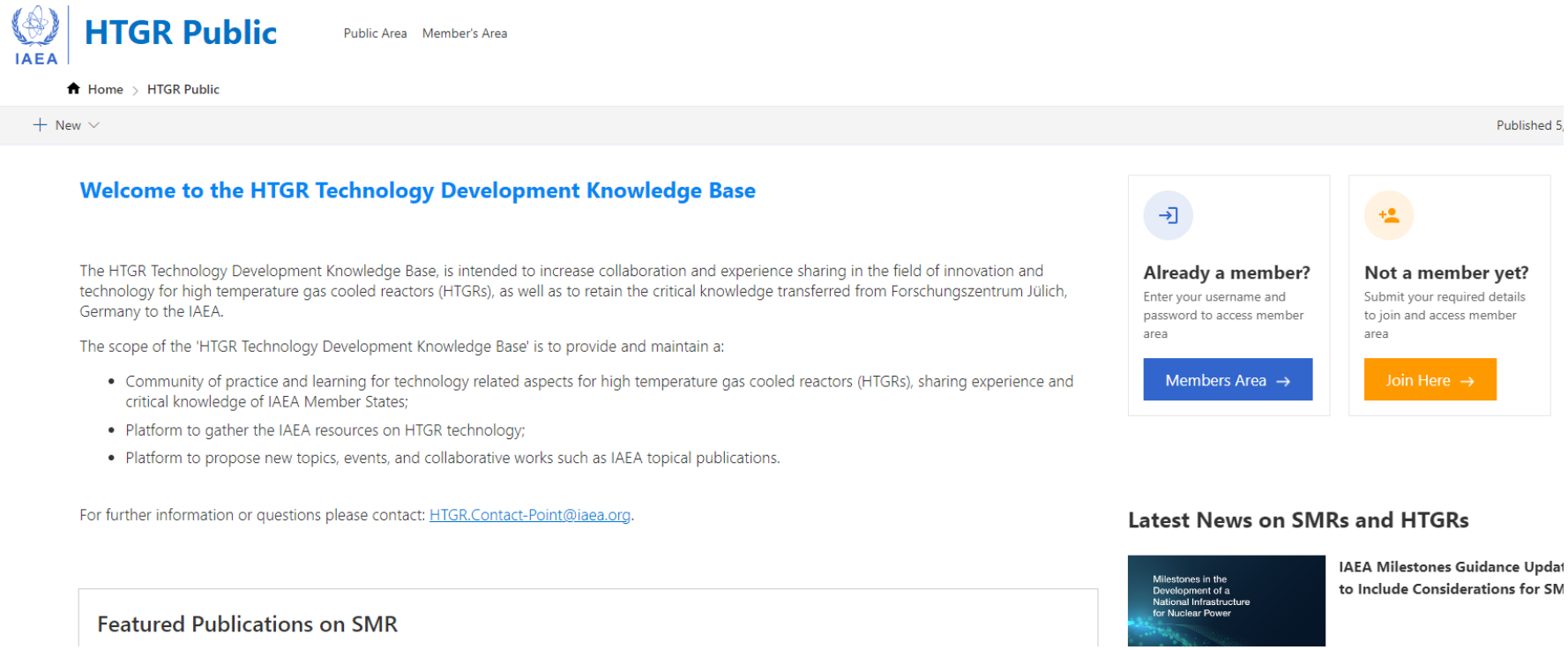
- North West University is conducted a study on the feasibility to restart the PBMR project (Oct 2024-Nov 2025).
- STLN designs: 100 MWt and 30 MWt pebble bed HTGR, and HTR fuel design and manufacturing using U and U/Th

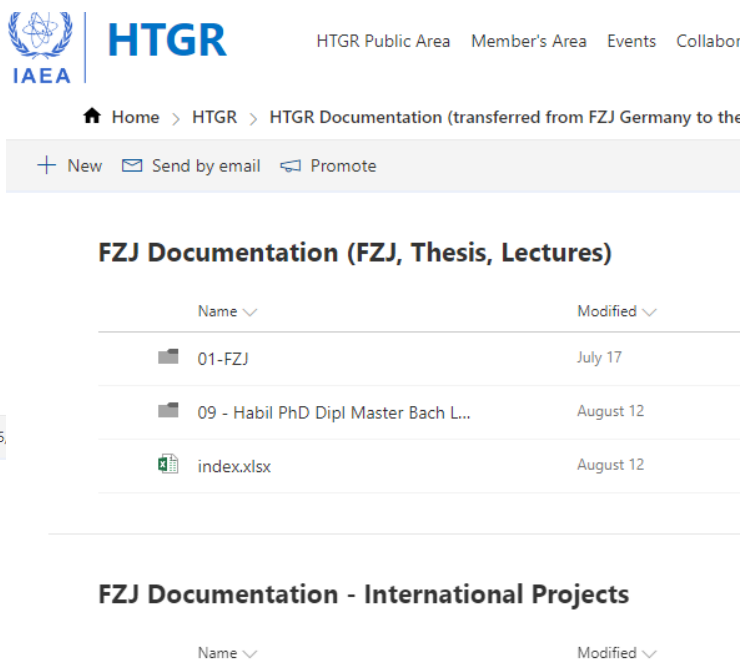
United Kingdom

- 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



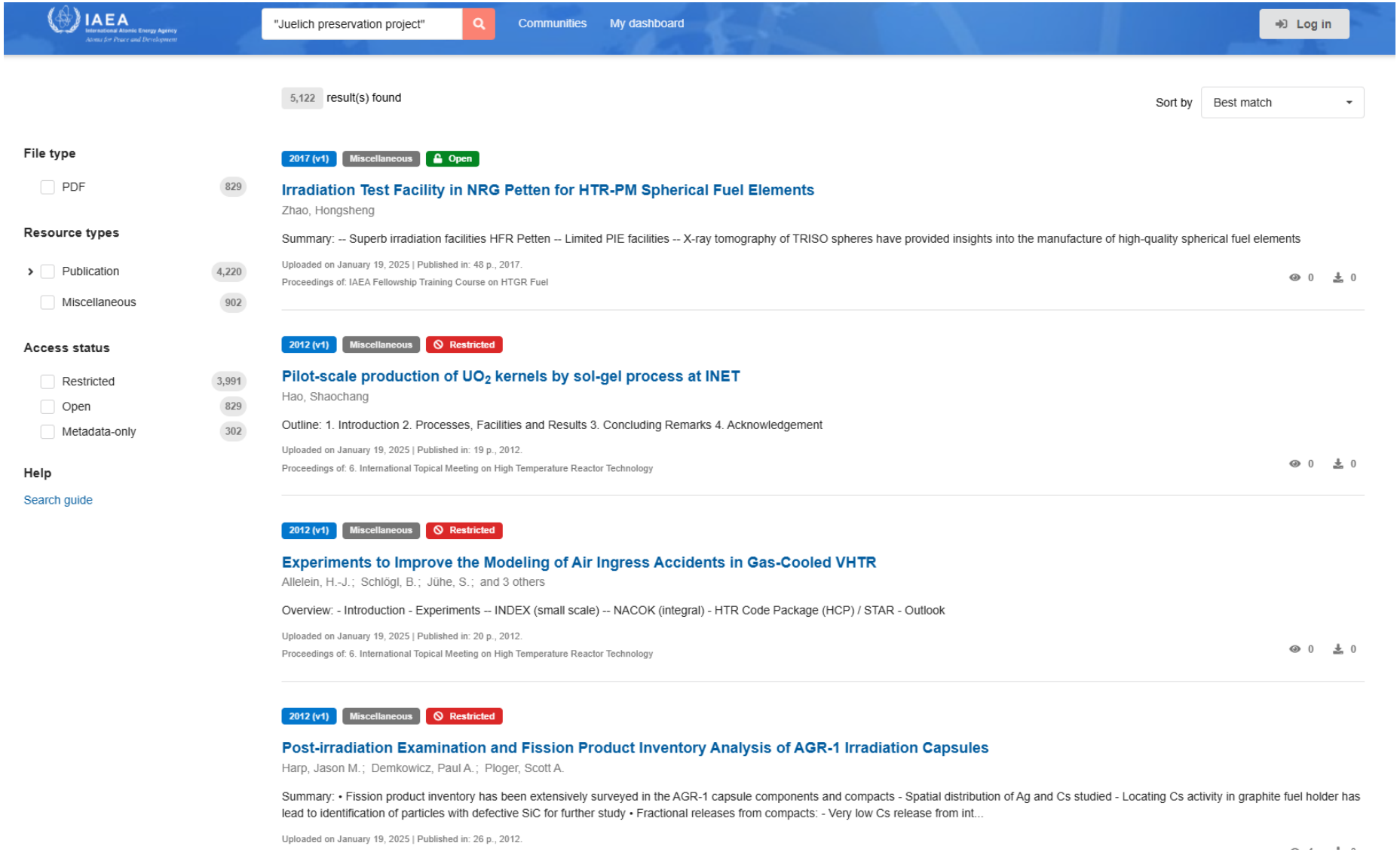


Members Areas (with access based on IAEA nucleus account and approval from the coordinators of the 'HTGR Knowledge Base')

FZJ Archive – indexing in INIS

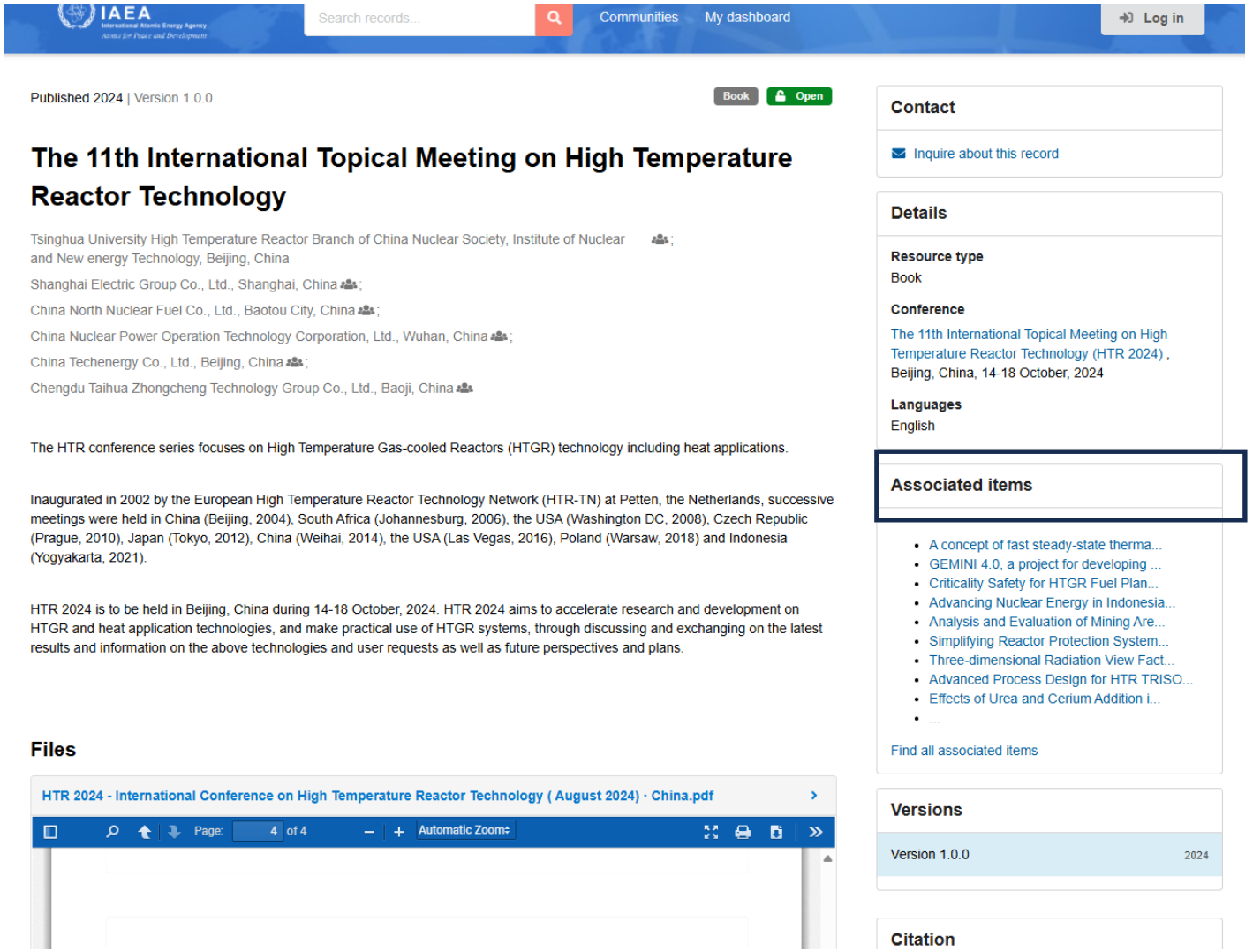
(~40 yr of experience documented in reports, articles, technical notes, etc. in ~20,000 files, 300 GB)

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



HTR2024 Proceedings – indexed in INIS

[The 11th International Topical Meeting on High Temperature Reactor Technology]



Papers [Search results]

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 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

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

Resources

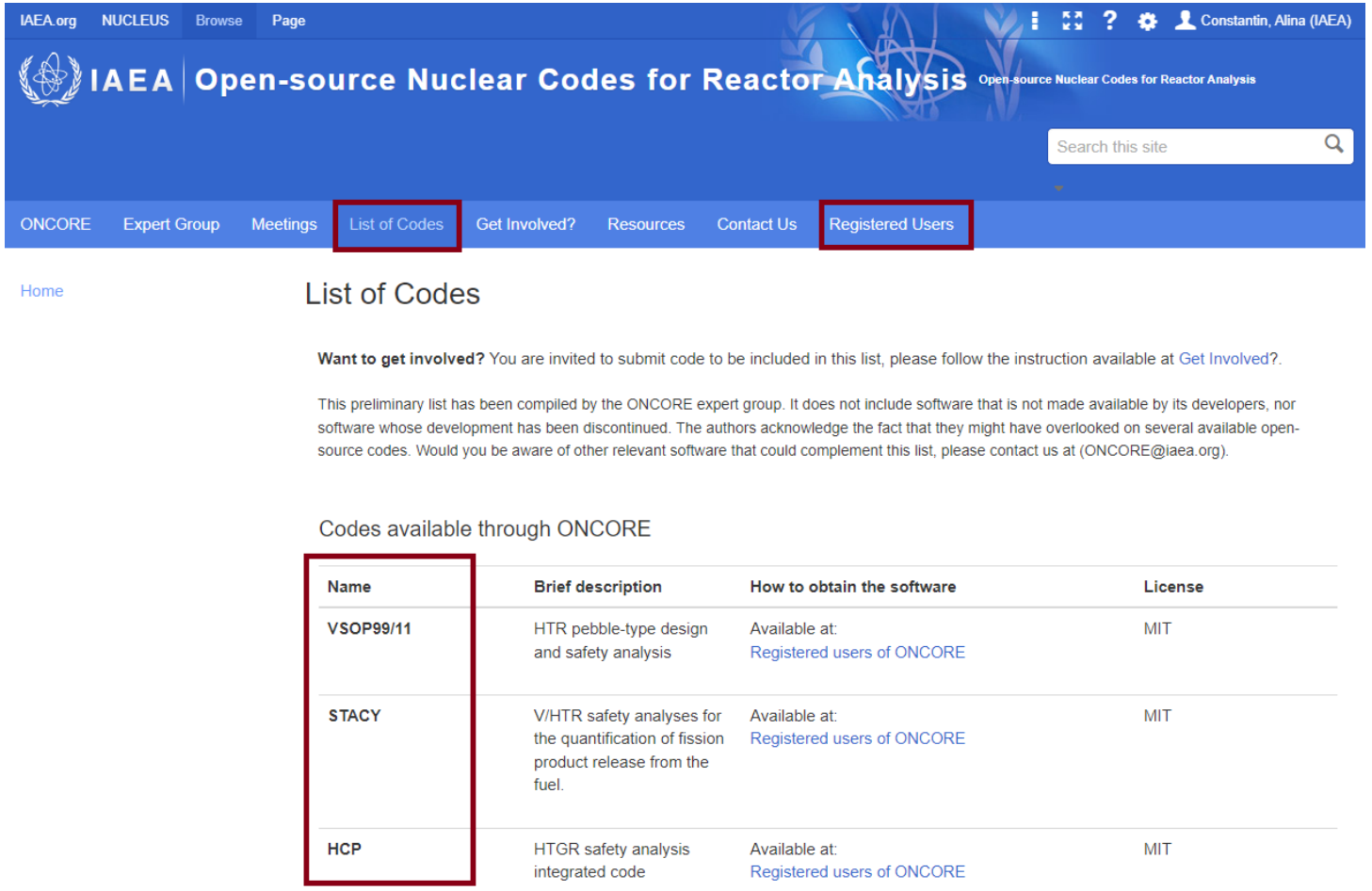
HTR codes documentation | HTR2024 | Publications | Experimental Facilities

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-oncore
  - https://nucleus.iaea.org/sites/oncore



Source code available in Github

If you need access to source code, please write an email to: oncore.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)

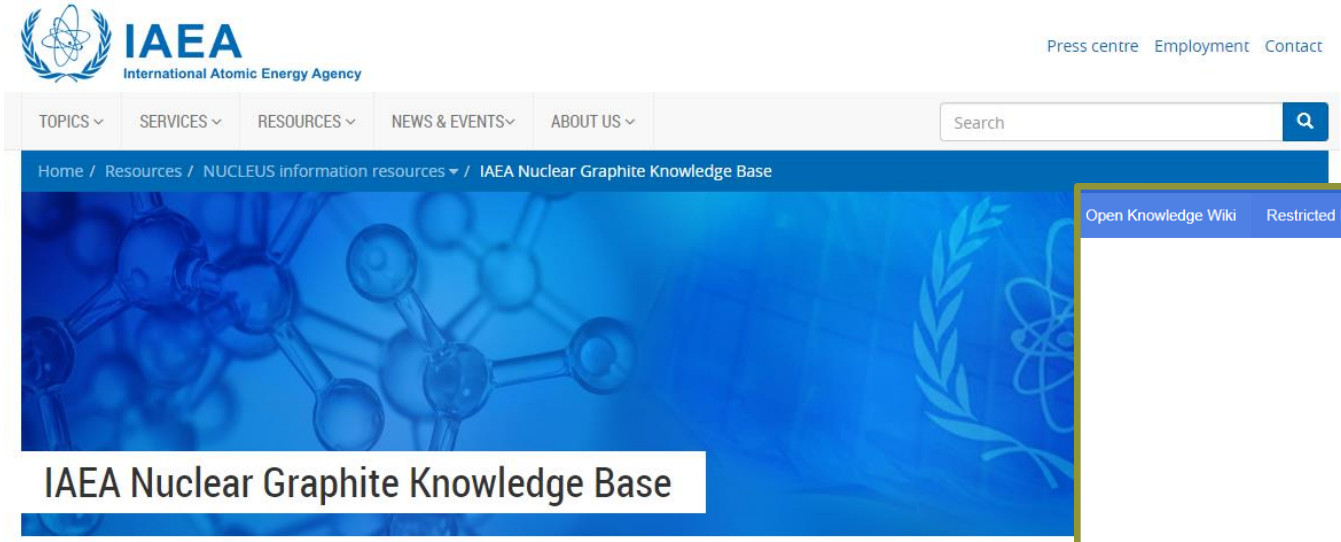
❑ Mr Chunyu Liu (Technical University of Munich)

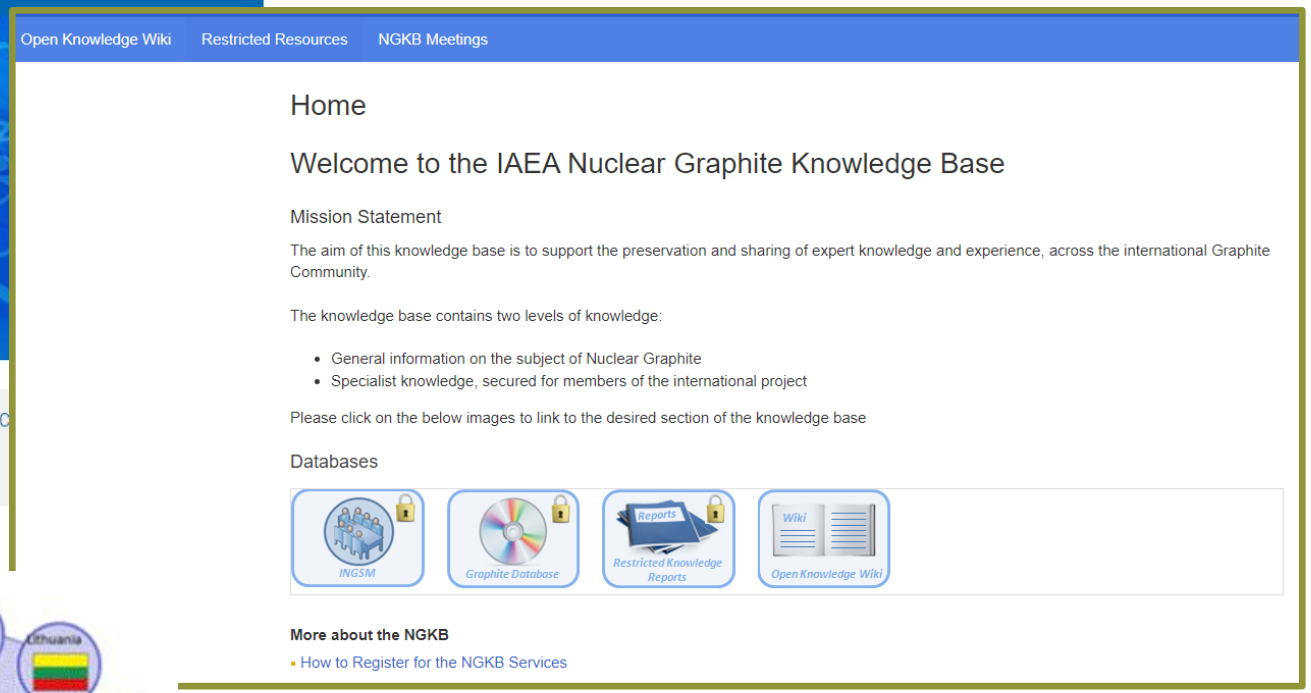
❑ Meryll Colomber (Becker Technologies, Germany)

- 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)

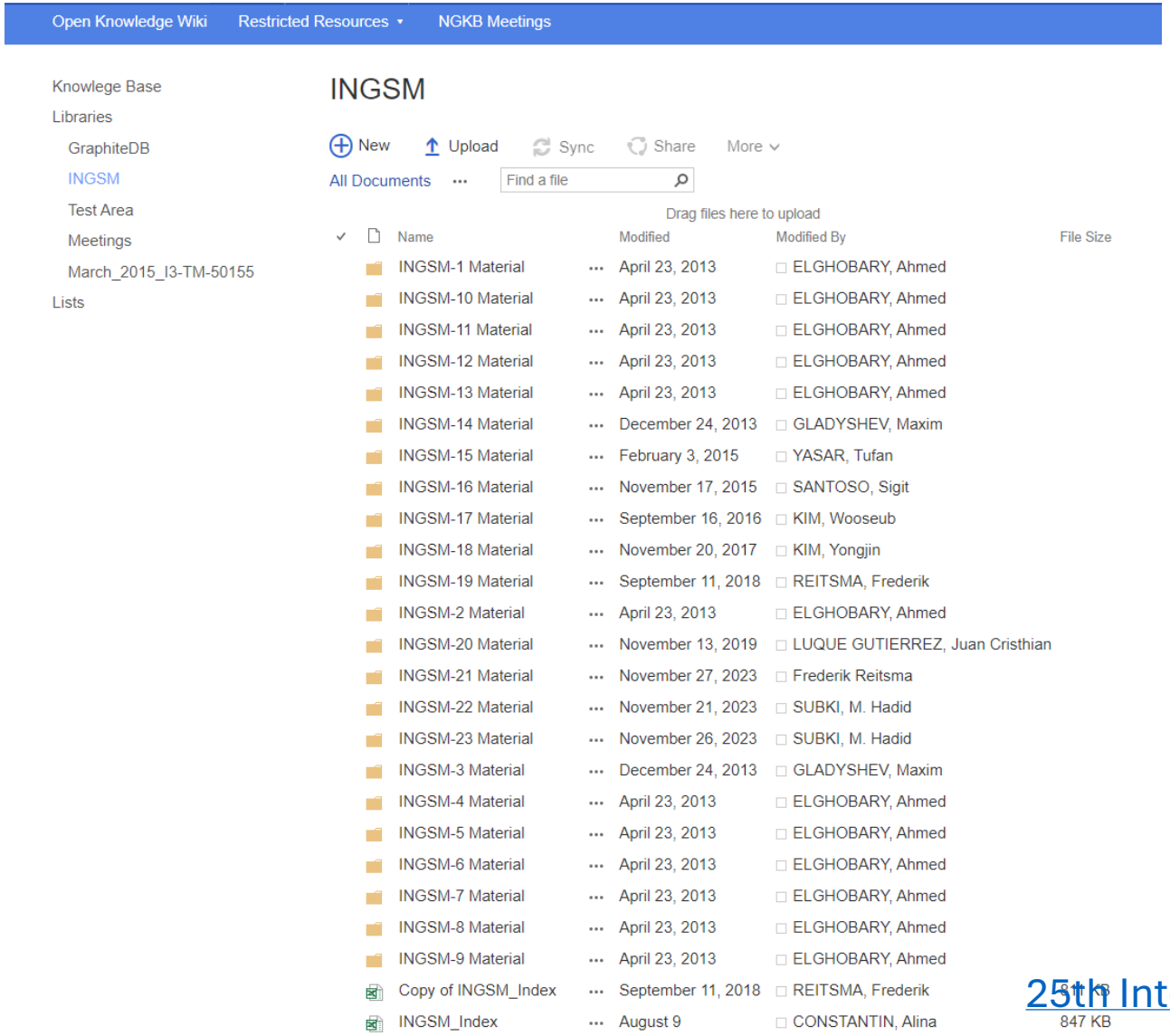
https://www.iaea.org/resources/databases/iaea-nuclear-graphite-knowledge-base





- Open knowledge wiki
- Restricted resources
- NGKB meetings

International Nuclear Graphite Specialists Meeting (INGSM)



24th International Nuclear Graphite Specialists Meeting (INGSM)

ingsm 2024 Berkeley UNIVERSITY OF CALIFORNIA

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

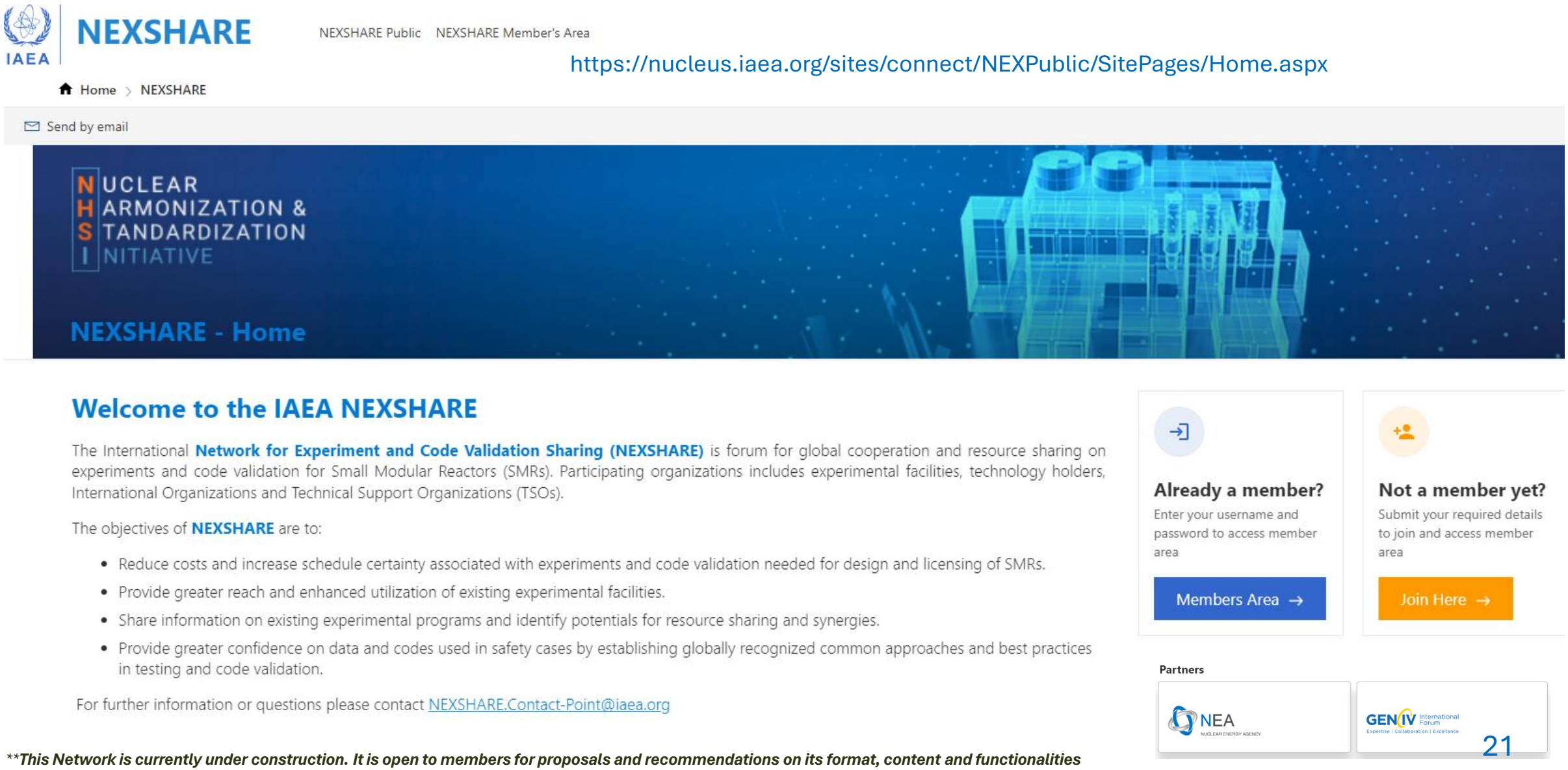
25th International Nuclear Graphite Specialists Meeting (INGSM)

29 Sept – 3 Oct 2025 (Vienna)

25th International Nuclear Graphite Specialists' Meeting

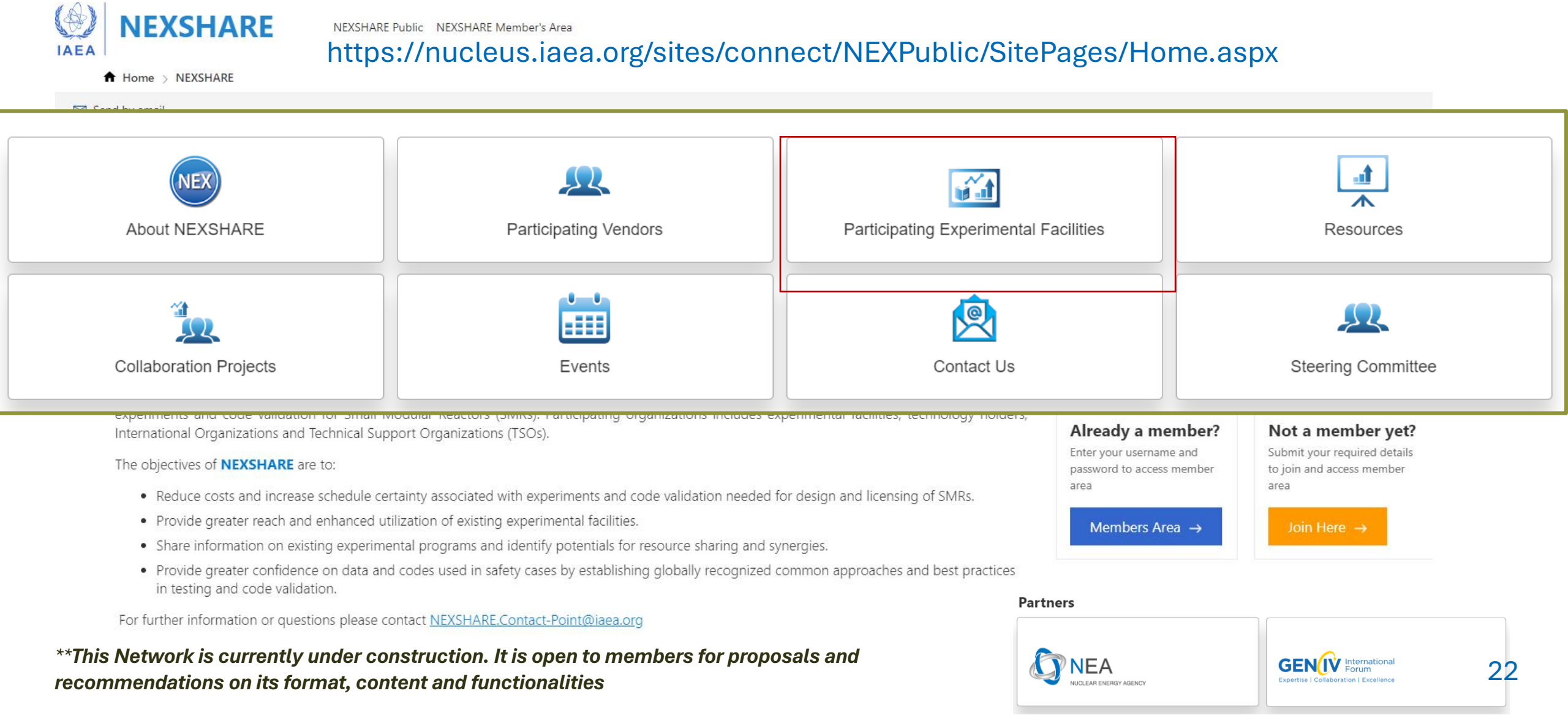
Abstracts must be received by 30th JUNE 2025

International Network for Experiment and Code Validation Sharing (NEXSHARE)



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

International Network for Experiment and Code Validation Sharing (NEXSHARE)



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

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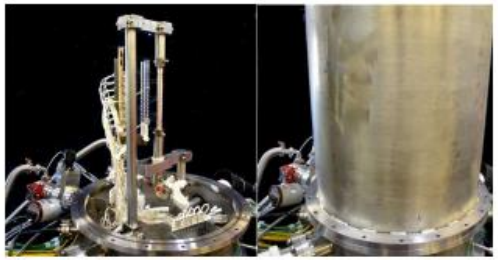
- Operator
- Applications
- Detailed technical description
- Past and planned experiments

Facility	Full Name	Country Name	Operating conditions	Max Power (kW)
Bell Jar	CNL Vacumm Bell Jar Apparatus	Canada	Components/Feature, Accident conditions	50
HANC	Helium-Air Natural Convection	Canada	hermalhydraulics - Accident conditions	130
BT			ature, Materials, Severe Accident conditions, Normal operation	
HT			Normal operation	30,000
HI			ature, Thermalhydraulics Normal operation	52
GC			Accident conditions, Normal operation	
M CTF	Experimental Test bed/Helium Component Test Facility		ature, Thermalhydraulics Normal operation , Thermalhydraulics -	250
PBRT	Pebble Bed Reactor Test facility	United States	cs - integral effects, cs - separate effects Accident conditions, Normal operation	
EXHALE	Experimental Helium Analysis and Laboratory for Extreme Conditions	United States	, Thermalhydraulics - Accident conditions, Normal operation	1.2

CNL Vacuum Bell Jar Apparatus

Canadian Nuclear Laboratories / Laboratoires Nucléaires Canadiens



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 ☒ High Temperature Gas Cooled ☐ Molten Salt ☐ Liquid Metal Cooled Fast Spectrum Other:
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, CO_2, oxygen mixture).
Dimensions/volume: 1.4×10^6 mm^2 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

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HTGR Plan – Scope

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

General Scope

1. **Working paper and webinar on the overview of relevant work form 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.

HTGR Plan – Deliverables & Teams

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

HTGR Plan – Publications & Events

Publications/Events	Date/Status
Webinar and working paper on *Agencies activities on experiments and code validation for HTGRs* **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