Overview of NEA Fast Reactors Activities

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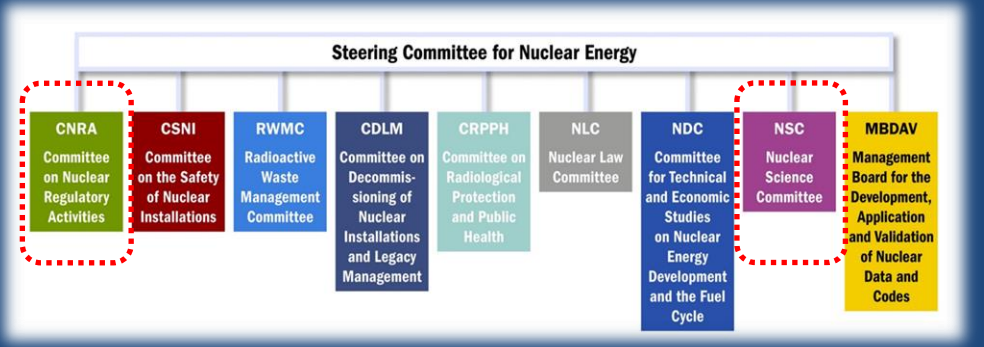
The NEA: 34 Countries Seeking Excellence in Nuclear Safety, Technology, and Policy

- 34 member countries and strategic partners
- The NEA is a framework for technical and policy cooperation in nuclear safety, stakeholder engagement, science, current and new and technology, economics, nuclear law, nuclear codes and data, waste management, decommissioning, legacy management, and radiation protection
- 8 standing committees and over 80 working parties and expert groups
- International joint projects



NEA countries operate about 85%
of the world's installed nuclear capacity

Disseminating Scientific Knowledge

- State-of-the-art reports and reports on benchmark studies
- World reference collections of integral experiments and databases
- Software tools and calculation parameters to support validation

Focus on data preservation

Goal is to preserve experimental data and ensure this data can support modern simulation and modelling infrastructure

International Fuel Performance Experiments Database	Integral Experiment database on Thermal Hydraulics	International Radiation Shielding Experiments Database	International Reactor Physics Experiments Database	International Criticality Safety Benchmark Experiments Database	Spent Fuel Isotopic Composition Database
IFPE*	**TIETHYS**	**SINBAD****	**IDAT**	**DICE**	**SFCOMPO****

* Developed jointly with IAEA; ** Developed in cooperation with RSICC, U.S.

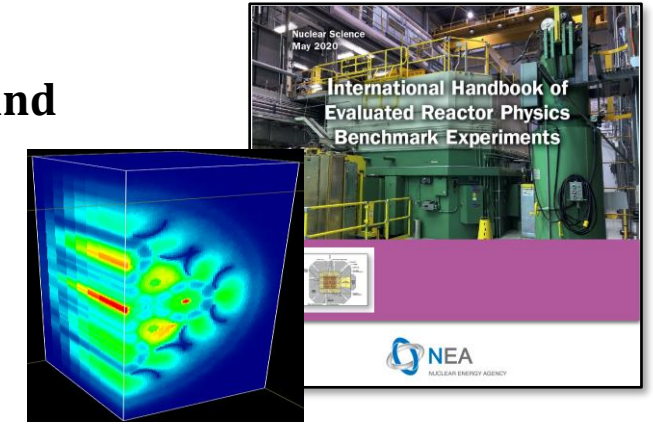
Reactor Physics Experiments

NEA International Reactor Physics Experiment Evaluation (IRPhE) Project

- IRPhE Handbook contains benchmark data for reactor-type experiments
- Contains 167 experimental series performed at 56 nuclear facilities
- Liquid Metal Fast Reactor benchmarks configurations assembled in BFS-1, BFS-2, BR2, EBR-II, FCA, FFTF, JOYO, SNEAK, ZEBRA, ZPPR, and ZPR
- Distributed on DVD, available on-line oe.cd/nea-irphe

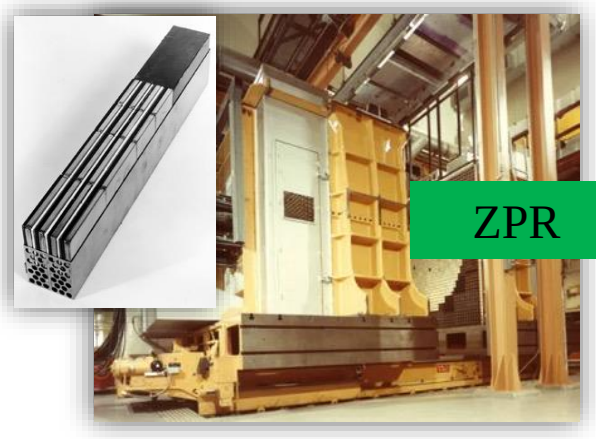
International Reactor Physics Handbook Database and Analysis Tool (IDAT)

- Allows easy access to benchmark data
- Includes supplemented calculated data
- Trends and identifies suitable benchmark experiments
- Included on the IRPhE Handbook DVD, available on-line



Experimental Infrastructure

A new task force on the need for Zero Power Reactors (ZPRs) has been launched to provide a document for policy makers describing critical needs and motivations for new ZPRs.



ZPR

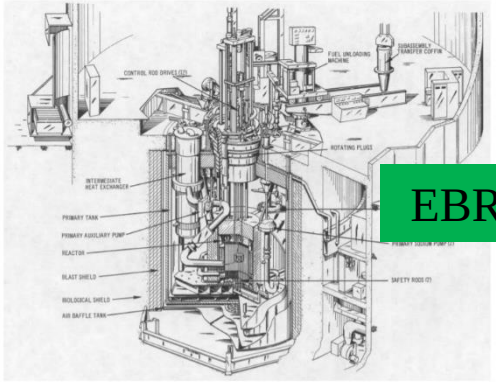
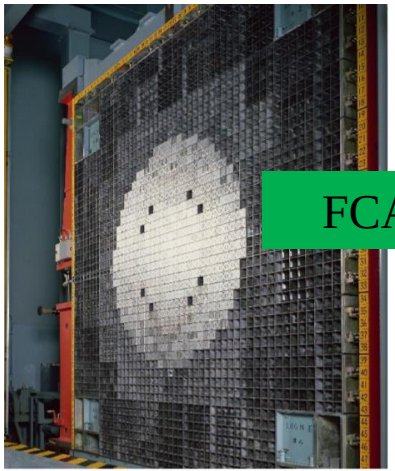


Figure 1.1.4. EBR-II Cross-sectional View.

EBR-II



FCA

Uncertainty Analysis for SFR Modelling

Uncertainty Analysis for Modelling (UAM)-SFR benchmark: 3600MWth oxide core and a medium 1000MWth metallic core

Phase I

- Cell Physics
- Sub-assembly Physics
- Core Physics (Large oxide, Medium metallic and Advanced ASTRID oxide cores)
- Experimental validation: Various criticality cores, β_{eff} measurements, SVRE (ZPR6+ZPPR2), Doppler (SEFOR)

Phase II

- Fuel Physics
- Time-Dependent Neutronics
- Bundle Thermal-Hydraulics

Phase III

- Unprotected Transients
- Control Rod inadvertent withdrawal
- Superphénix Start Up benchmark

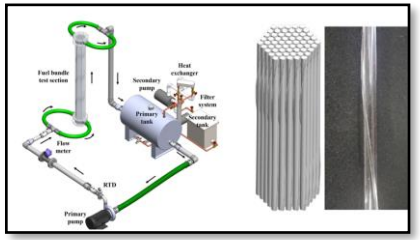
In red: specs to be finalised , in green : action in progress

Thermal-Hydraulics Benchmarks

Liquid Metal Fast Reactor Core Thermal-Hydraulics Benchmark (LMFR T/H)

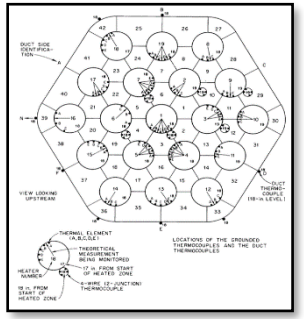
Phase I: Steady-state numerical predictions of Texas A&M University (TAMU) separate effect test and comparison to experimental results

- TAMU experimental facility
- Provides a detailed geometry of the bundle test section and boundary conditions
- Assesses the performance of numerical schemes and turbulent models in the CFD codes
- Establishes best practices for uncertainty quantification in the CFD codes



Phase II: Numerical predictions of the Thermal Hydraulic Out of Reactor Safety (THORS) integral effect tests

- ORNL facility operated from 1970 to 1984, initially the Fuel Failure Mockup (FFM) installation was built that later transitioned into the THORS and the Shutdown Heat Removal System (SHRS) facilities
- Provides a sodium turbulent flow and heat transfer database for CFD and sub-channel model validation
- Emphasises the importance of uncertainty analysis for simulations
- Establishes best practices for quantification of geometry modelling



Prepared jointly by North Carolina State University (NCSU) and Texas A&M University (TAMU), USA, in co-operation with the United States Nuclear Regulatory Commission (US NRC) and NEA.

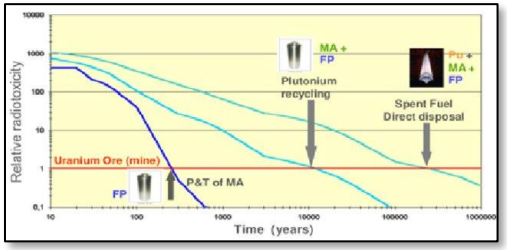
Fuel Cycle Physics and Chemistry

Fuel cycle activities for advanced systems

- Scenario study on TRU management, involving Gen-IV systems and ADSs
- Separation processes relevant to recycling technologies for spent nuclear fuel
- TRL assessment and identification of R&D gaps and needs to study the effect of liquid metal coolants (Pb, Pb-Bi, and Na) on reactor components

NEA Task Force on Demonstration of Fuel Cycle Closure including P&T for Industrial Readiness by 2050

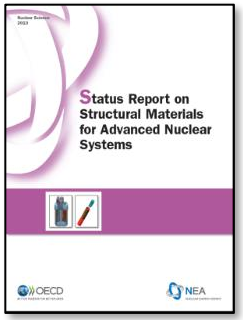
- A "High-level Report" assessing **technology, economics and societal aspects of the fuel cycle closure**
- A library of documents addressing the benefits of P&T, the technical challenges and developments in the field



Fuel Performance

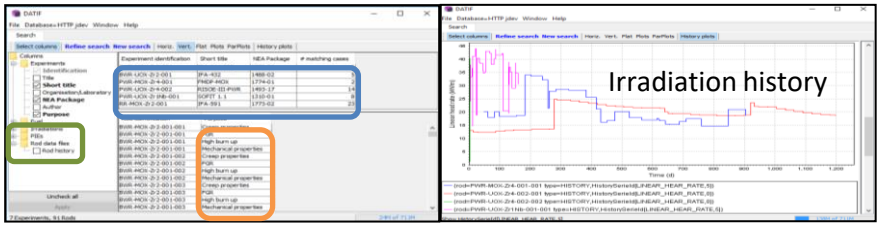
Advanced Fuels

- State-of-the-art reports on Innovative Fuels and Structural Materials for Advanced Nuclear Systems
- Benchmark studies and recommendations on properties of oxide and metal fuels for advanced reactors
  - *Code-to-code and code-to-experiment comparison for steady-state conditions*
  - *Code-to-code comparison for accident transient conditions*
  - *Recommendations for fuel properties for code performance codes for fast reactors*



International Fuel Performance Experiment (IFPE) Database

- A public domain data collection, developed jointly by the NEA and IAEA, on nuclear fuel performance experiments for the purpose of code development and validation
- New relational database DATIF
  - *Enhanced accessibility of data packages*
  - *Standardised format for experimental data*
  - *Plotting and uncertainty analysis capabilities*
  - *Automatic generation of inputs*
  - *DATIF GUI will be released in 2022*



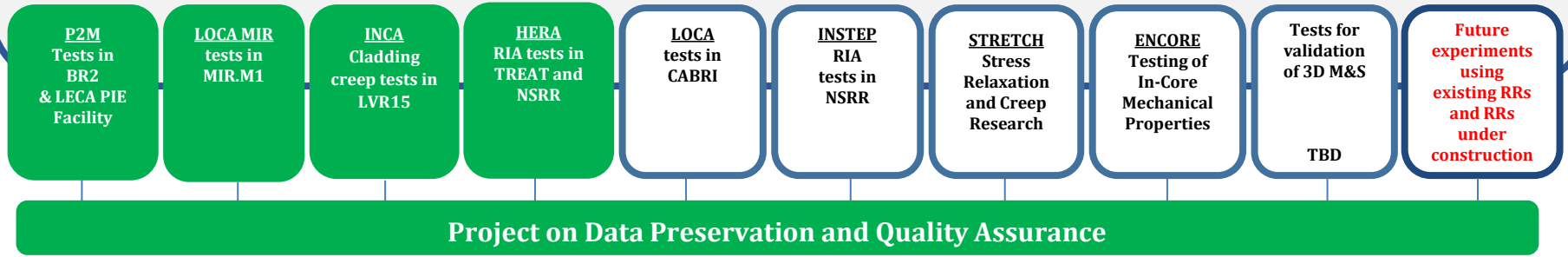
Enhancing Experimental Capabilities

New NEA Framework for Irradiation Experiments (FIDES)

- NEA joint undertaking, established pursuant to Article 5 of the NEA Statute
- A stable, sustainable, reliable post-Halden platform for fuel and material testing using nuclear research reactors and related facilities in NEA countries
  - Generates experimental results and expertise for shared costs
  - Enhances modelling and simulation, instrumentation, training and education
- **PoW 2021-2024: 4 JEEPs and Project on Data Preservation and Quality Assurance**

- Parties: 27 organisations from 12 countries and the EC
- Budget: ~ 23 M€/3 years
- Launched in March 2021
- Experiments are ongoing in 6 countries

Joint Experimental Programmes (JEEPs)



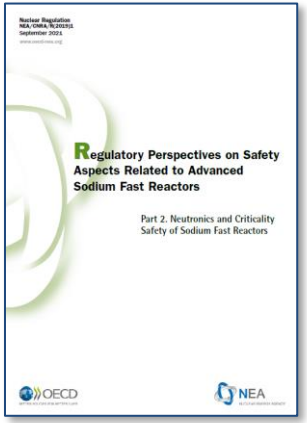
Safety of Advanced Reactors

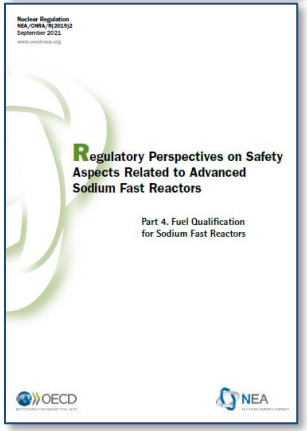
Recent and planned Technical Reports

- Regulatory Perspectives on Analytical Codes and Methods for Advanced Reactors
- Fuel Qualification for Advanced Reactors
- Severe Accidents Prevention and Mitigation Measures in SFRs
- Neutronics and Criticality Safety of SFRs
- Analytical Codes and Methods for SFRs
- Fuel Qualification for SFRs

Objectives:

- Exchange information and experience from licensing and oversight of past and current nuclear facilities
- Provide regulatory perspectives through the issuance of technical reports
- Take into consideration the GIF safety design criteria and the development of the GIF safety design guidelines





Ongoing and planned activities

- International benchmark considering a core damage scenario in LFRs
- Common regulatory practices to ensure appropriate qualification and through life performance of materials in advanced reactors
- Review of GIF SFR safety design guideline
- Review of GIF LFR safety design criteria

Training and Education

Nuclear Education, Skills and Technologies (NEST) Framework

Launched in February 2019

- A multinational framework to develop skills and nurture the next generation of nuclear subject matter experts through transfer of practical experience and knowledge

- Members: 15 organisations from 10 countries (adhesion of Romania has been recently approved)
- 6 ongoing projects
- 57 participating organisations
- Over 200 fellowships in 2019-2022

Working Areas/Groups

- Gender balance in nuclear technology and academic workforces
- Future of nuclear engineering education
- Relationship between nuclear energy and society
- Innovations in the nuclear sector to improve the competitiveness of nuclear energy

Global Forum on Nuclear Education, Science, Technology and Policy

Entered into force in January 2021

- Provides academic institutions around the world with a framework for interaction, co-operation and collective action
- Brings long-term, creative thinking to address international policy challenges that nuclear energy faces today as input to NEA processes