Second NEA Framework for Irradiation Experiments (FIDES-II)

NEA
NUCLEAR ENERGY AGENCY

Sustaining multinational nuclear fuel and materials testing capacities for safety, industry and science

The FIDES-II framework will help regulators, their technical support organisations, research organisations and the industry to consolidate their needs and resources in order to create a dynamic for implementing Joint ExpErimental Programmes (JEEPs) in key nuclear fuel and materials facilities around the world.

The safe, reliable and efficient operation of nuclear power plants requires nuclear fuel and materials (F&M) technology to evolve and for their performances to be optimised. Achieving this requires solid experimental evidence, which can only be obtained from test facilities with the ability to perform neutron irradiation under representative steady state or transient conditions. F&M test facilities are essential for:

- validating safety margins, simulation tools, and demonstrating operational performance;
- assessing material behaviour in the context of the long-term operation programmes;
- developing advanced F&M.

However, the number of available test facilities around the world is in significant decline. In the past five years, several major research reactors that provided testing services for the nuclear community were shut down. These included the Halden reactor in Norway, the OSIRIS in France, the JMTR in Japan and the NRU in Canada, among others. Many of these facilities served as reliable platforms for experimentation for many decades.

FIDES-II connects a global network of research facilities to perform high-priority experiments and builds on the first FIDES programme that began in March 2021. This initiative seeks to leverage the world's remaining test facilities and create a co-operative environment to help preserve them for years to come. Three Joint ExpErimental Programmes (JEEPs) are included in the 2022-2024 FIDES-II programme of work, which covers a wide range of research needs:

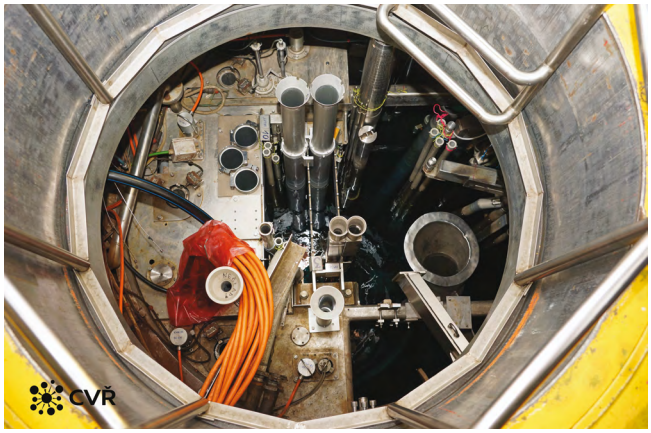
- fast power transients (HERA), slow power transients (P2M) and steady-state conditions (INCA);
- advanced fuel designs including coated claddings (INCA) and high burnup fuel (HERA);
- co-ordinated modelling efforts to complement experimental interpretation underway (P2M and HERA) and under discussion for additional JEEPs.

Participants: Belgium, the Czech Republic, Finland, France, Germany, Hungary, Japan, the Netherlands, Spain, Sweden, Switzerland, the United States, the European Commission (EC)

Project period: 2022-2024

Budget:

- Member contributions to FIDES-II fees: approximately EUR 9.5 million
- Work scope value: approximately EUR 20 million



The LVR-15 Reactor operated by CVR, where FIDES-II experiments on Cr-Coated ATF claddings are already loaded and generating data

Ongoing experimental programmes

High Burnup Experiments in Reactivity Initiated Accident (HERA)

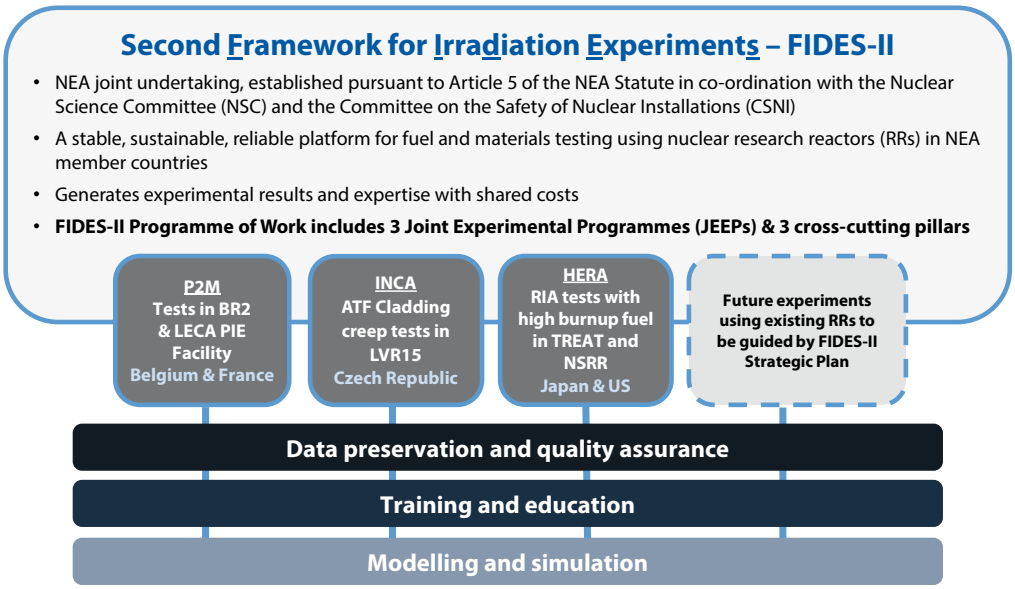
- Objective: Investigate the performance of modern high burnup fuel in Reactivity Initiated Accidents (RIA) transients at representative pulse widths.
- Facilities: TREAT reactor and hot cells (United States) and NSRR reactor (Japan).
- Core Group: DOE, NRC, Westinghouse (United States), JAEA (Japan), IRSN (France).

Power to Melt and Maneuverability (P2M)

- Objective: Quantify thermomechanical clad load mechanisms during LWR slow transient.
- Facilities: BR2 reactor and hot cells (Belgium) and CEA's LECA/STAR facility (France).
- Core Group: SCK•CEN (Belgium), CEA and EDF (France).

In-pile Creep Studies of ATF Cladding (INCA)

- Objective: Provide comparative data on the irradiation induced creep of current Zr alloys and Cr-coated samples.
- Facilities: LVR-15 Reactor and hot cells (Czech Republic).
- Core Group: CVŘ, ÚJV Řež, a. s. and Alvel (Czech Republic), VTT (Finland), and CEA (France).



Cross-cutting pillars

The FIDES framework is designed to do more than just produce data on transient fuel behavior and safety related issues. It is supported by three cross-cutting pillars:

- data preservation and quality assurance;
- modelling and simulation;
- training and education.

Data preservation and quality assurance

FIDES-II members recognise that storing experimental data in an organised manner is vital for effective collaboration within the framework. Moreover, trust in the data is equally, if not more important. FIDES-II seeks to elaborate the process and mechanisms of data quality assurance, analysis and preservation within the framework.

TREAT Reactor at INL (Copyright © INL).

Modelling and simulation

A key cross-cutting pillar of FIDES-II is the partnership between experimenters and modellers. It was envisioned to have a clear "feedback loop" between experiments and simulations in order to improve experimental design and research outcomes. To date, two JEEPs have launched modelling and simulation activities that will directly refine the experimental design.

P2M experimenters have collaborated with over 40 modelling experts in an exercise using archive data to assess their code's ability to predict fuel melting. Through this modelling exercise, a better understanding of the boundaries of existing models has been developed. The exercise also allowed experimenters to identify specific measurement and examination activities that could produce data to improve fuel melting behaviour models.

HERA experimenters are also collaborating closely with modellers. A modelling exercise is being conducted alongside the HERA experiments, beginning with blind simulation of the planned experiments. The results will help experiment designers finalise the details of the experiment. The exercise will also help modellers see where their models are good at predicting the complicated behaviour of fuel during an RIA and reveal where the models need improvement.

Training and education

When FIDES was first established, training and development was a second cross-cutting pillar, envisioned to be integrated into each JEEP. This goal is already being fulfilled through specialised training workshops, integration of students in experimental and modelling work and through peer-to-peer exchanges.

In addition to topical knowledge sharing, FIDES is also enabling inter-generational knowledge sharing. The experimental and modelling work taking place within each FIDES JEEP has attracted university students and is providing opportunities for exciting and practical educational experience.

Further information

For further information, please contact the NEA Secretariat:

Email: FIDES@oecd-nea.org or visit www.oecd-nea.org/fides-ii.