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NUCLEAR ENERGY AGENCY
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Workshop "Building Multinational Fuel and Materials Testing Capacities for Science, Safety and Industry"

WORKSHOP STATEMENT

4-5 October 2018
NEA Headquarters, Boulogne-Billancourt, France

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OECD NEA Nuclear Science Committee (NSC) and
Committee on the Safety of Nuclear Installations (CSNI)

STATEMENT OF THE WORKSHOP ON "BUILDING MULTINATIONAL FUEL AND MATERIALS TESTING CAPACITIES FOR SCIENCE, SAFETY AND INDUSTRY"

4-5 October 2018, NEA Headquarters, Boulogne-Billancourt

Forward

The workshop on "Building Multinational Fuel and Materials Testing Capacities for Science, Safety and Industry" was organised by the NEA under the auspices of the NSC and the CSNI, in line with NI2050[1], in order to develop a collective strategy for overcoming key challenges in the experimental support for advances in fuels and materials.

To achieve this, the workshop brought together and facilitated dialogue between regulatory bodies, safety and research organisations, and the nuclear industry. The dialogue contributed to the furthering of the participants' vision for integrated fuels and materials research that supports addressing emergent safety issues as well as the deployment of novel technologies.

This Workshop Statement represents the collective viewpoint of the participants and is intended to serve as a reference document for further activities in this field. It will be discussed within the NEA bodies and widely distributed among the NEA community to inform the decision process in this field.

Executive Summary

NEA Joint Projects, including the Halden Reactor Project (HRP), have greatly benefitted the participants and sustained test facility infrastructure in an era of declining experimental facilities. The loss of the Halden Reactor now presents a particular challenge for the experimental support of many areas in the field of nuclear fuels and materials. To address the existing needs of the nuclear sector and to ensure confidence in the safe and efficient use of nuclear technology, the participants identified that there are several areas that require continued fuel and materials research. It was recognised that these needs were and should be met with a cohesive, international programme to facilitate access to fuel and materials testing facilities worldwide.

After confirming the benefits of international collaboration for addressing the nuclear sector's strategic fuels and materials research needs, the participants recommend pursuing the establishment of a future co-ordinated international framework under which Joint Experimental Programmes should be proposed, reviewed and established. In the current environment, the participants also recommend maximising the value of future

[1] NI2050 is the NEA Nuclear Innovation initiative aimed at accelerating market deployment of nuclear innovations.

experimental programmes, as well as that of legacy data from NEA Joint Projects such as the HRP, by systematically collecting and critically evaluating data, as well as increasing the role of modelling and simulation.

The NEA will engage all relevant stakeholders to establish a multinational NEA Framework for In-pile Fuel and Material Testing, whose primary function will be to assist Framework members in developing Joint Experimental Programmes that optimise the use of infrastructure and experimental capabilities, analyse and preserve experimental data, and provide education and training opportunities that build expertise in fuel and materials testing.

1. Introduction

1.1 The nuclear sector has benefitted from and relied upon International Joint Projects (JPs), including the Halden Reactor Project, created and managed under the auspices of the NEA, for experimental data to support a variety of needs. NEA JPs have been instrumental in sustaining research infrastructure in a time where fuel and material testing capacity worldwide has been in decline. Through years or decades of continued research activities through these projects, trusted and unique sources of experimental data have been established.

1.2 The status quo has been disrupted by the recent closure of key test facilities, including the Halden Reactor. Through JPs, these have become significant sources of critical data for the nuclear sector. Their closures raise the question of how the community can address the lack of testing capabilities and capacity.

1.3 The continued evolution of fuel and materials technology, fuel utilisation and optimisation will require experimental evidence obtained from tests performed in fuel and materials (F&M) test facilities[2]. These facilities constitute a key piece of infrastructure for the demonstration of safe, reliable and efficient operation of Nuclear Power Plants (NPPs) and for the assessment of modified and/or long-term operation (LTO) scenarios. There is a need to transfer the fulfilment of those needs from previous JPs, such as the Halden Reactor Project, to new facilities.

1.4 Remaining infrastructure must be maintained and improved to meet the continuous needs of the nuclear sector and must offer a diversity of experimental capabilities that are utilised in a co-ordinated and cost-effective manner. This will require, amongst other things, multinational support via NEA joint undertakings.

2. Need for Integrated fuels and materials research

2.1. Regulators, technical support organisations, safety and research bodies, and industry require F&M testing capacities on a continual basis and they have clearly stated that the availability of testing facilities, particularly for LOCA, RIA and power ramps, is crucial.

[2] F&M test facility specifically refers in this document to a research reactor with the ability to perform neutron irradiation or transient tests.

2.2. The opinion was widely shared that, at the strategic level, F&M-testing facilities will continue to be essential to:

- validate safety margins and test beyond failure to explore source terms in severe accident scenarios;
- demonstrate safety and operational performance of existing nuclear fuel technologies, both within normal and abnormal operation ranges, including plant life extension;
- perform fuel cycle optimisation and fuel performance optimisation;
- fully explore the performance of fuels and materials up to and surpassing operational limits;
- develop advanced fuels and materials, and determine their performance;
- collect data required for the development and validation of simulation tools and development of new tools tailored to more complex fuel and material structures;
- expand fundamental understanding of fuels and other materials;
- provide on-line measurement capabilities unavailable at commercial power plants;
- provide testing capacity to respond to evolving data needs triggered by requirements from utilities and/or safety institutions; and
- obtain data to support long-term storage, transport and disposal needs.

2.3. The multinational framework approach has proven to be an effective means to address the types of issues listed above by way of being able to:

- obtain the best value from research infrastructures which have adopted service-oriented policies and a user facility approach;
- coordinate available capacities in order to fully address the needs of the international community, with access to facilities across borders;
- build consensus and consolidate knowledge, as a basis for shared standards;
- create the conditions that enable bilateral arrangements between facilities and end-users;
- ease the transport of fuels and accommodate export controls or other restrictions;
- facilitate the creation and transfer of prototypical samples from industry partners;
- trigger governments' investments and decisions by developing evidence-based proposals that provide the necessary argument in the associated value; and
- educate the future generation of experts and leaders through secondment programmes and other initiatives.

3. Strategic recommendations

3.1. To overcome the uncertainties resulting from the vacuum created by the closure of the Halden BWR reactor, it is vital that the international community works to consolidate views on irradiation programmes and related testing infrastructure into a shared mid- and long- term vision and strategy that addresses the needs of the nuclear community, including industry, regulators, research centres and any public organisations involved in policy making, by:

- bringing together end-users and related stakeholders to decide and implement a sound and robust multinational irradiation programme;
- establishing and describing which are the experimental infrastructures worldwide that can address relevant short-term experimental needs or are suitable for adaptation for providing long-term support;

- combining together and optimising the use of the available capacities for in-pile irradiation, out-of-pile tests and post-irradiation examination;
- formulating a strategy of long-term, sustainable experimental support;
- ensuring the sustainability of support, availability and utilisation of multiple F&M test facilities, subject to financial considerations.

3.2. New experimental data are nowadays more difficult to obtain, in part due to the decreased number of F&M facilities and increased constraints on those that exist today. To maximise the value of experimentation, multinational programmes should:

- systematically preserve and consolidate legacy experimental data and data generated from new experimental campaigns;
- review experimental data already obtained, including, but not limited to, those from the Halden reactor (quantifying uncertainties insofar as this is possible and the data are available);
- evaluate, peer-review and collect existing and new experimental results in a high-quality information system. Such a system can benefit from NEA's considerable experience in the area of data preservation and relational database implementation and modernisation;
- apply state-of-the-art knowledge and a systematic approach to designing experiments and optimising experimental campaigns;
- use modelling and simulation as a tool for optimising the design and the implementation of experimental campaigns and adding value to the experimental data obtained;
- develop and deploy effective instrumentation and measurement systems; and
- link with the HRP Board of Management to foster the preservation of the assets already generated by the HRP.

3.3. From a long-term perspective, it is necessary to:

- continue to address the experimental needs in the field of fuel and material irradiation;
- discuss the investments necessary for enhancing the experimental capability and capacity of both existing and new F&M test facilities and optimising their complementarity; and
- ease the implementation of irradiation programmes relying on available capacities to meet the current and anticipated future needs and to sustain a multinational programme that opens the pathway for bilateral programmes.[3]

3.4. The industry requests that operators of F&M research facilities consider and develop pathways for making testing capabilities available within the coming years and maintain them for longer-term use. It was acknowledged that a clear and collective

[3] In addition to providing a predictable source of financing, the HRP facilitated the creation of a stable partnership between the facility and its users, through the invention of two parallel entries: the HRP itself, co-financed by many countries under the auspices of the NEA, and the so-called bilateral projects, each one contracted with a single user and paid for by such user. This unique and valuable Joint Project was made possible due to the support of government. The tests for the Joint Project and for the bilateral projects were, in most cases, run in parallel. The synergy between the Joint Projects and the bilateral projects has made the technological fortune of the Halden Boiling Water Reactor (BWR), generating a solid technical basis through continued and deep interaction with the industry, the safety bodies and the R&D centres around the world.

agenda, developed in a multinational framework, for the utilisation of testing infrastructures will be instrumental in getting the support of relevant stakeholders to these pathways.

4. Establishing a new NEA Framework for In-pile Fuel and Material Testing

4.1. NEA will engage all relevant stakeholders to address the above needs and considerations, and to develop a Multinational Framework for In-pile Fuel and Material Testing proposal to complement the existing NEA Joint Projects.

4.2. The proposed Multinational Framework will enable the establishment of Joint Experimental Programmes (JEEPs) that may be proposed by Framework members and overseen by dedicated JEEP Boards organised by the participants.

4.3. These JEEP proposals should optimise the use of infrastructure and experimental capabilities, analyse and preserve experimental data, and provide education and training opportunities that build expertise in fuel and material experimentation.

4.4. A process to deal with Framework membership, submission and evaluation of Joint Experimental Programmes, and the governance of these Programmes, will be developed before and reviewed during the follow-up meeting in March 2019. A draft Framework portrait, proposed by the NEA, can be found in the Annex 1.

ANNEX 1

Draft Portrait of the Multinational NEA Framework for In-pile Fuel and Material Testing

Multinational NEA Framework for In-pile Fuel and Material Testing

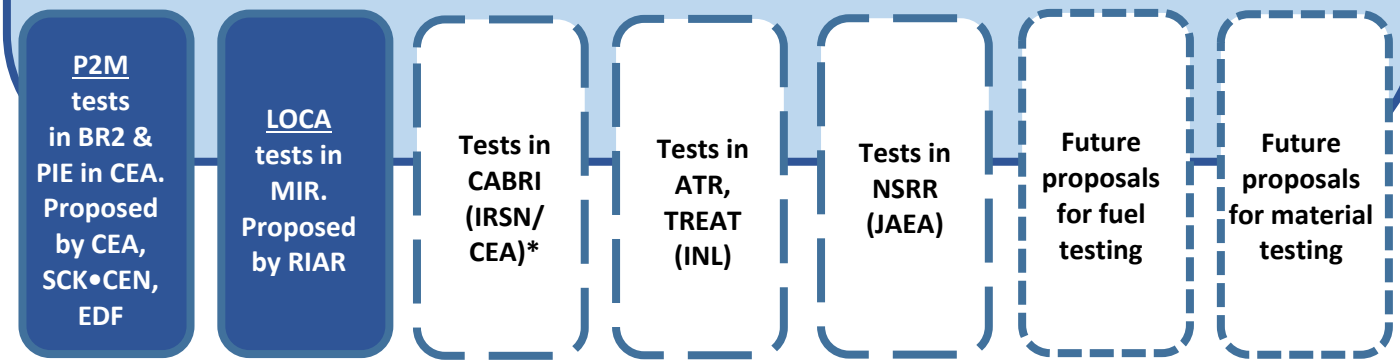
The Framework covers fuel and material behaviour studies under irradiation using in-pile experiments in test reactors and post-irradiation examination facilities.

Framework Members provide technical governance to the Framework that includes **Activities** and **Joint Experimental Programmes**. The Activities encompass:

- Advisory role for policy makers, industry and regulators
  - optimisation of the use of the infrastructures
  - optimisation of experimental capabilities to address needs
- Cross-cutting support to enhance the outputs of the JEEPs
  - preservation and management of experimental data
  - inclusion of educational component via NEST project

Joint Experimental Programmes (JEEPs)

Each JEEP will be governed by a group of interested Members who will set up a dedicated JEEP Board.



*Independent of the Cabri International Programme (CIP)

Legal Instrument

Pursuant to Article 5 of the NEA Statute, the NEA will establish the before-mentioned Framework as an international joint undertaking.

Financial Participation

Through financial participation, organisations can benefit from the NEA Framework for In-pile Fuel and Material Testing in two different ways:

Contribution to Framework

Participating Organisation pays an entry fee (a few tens of k€/year, according to capacity to pay) in order to:

1) support the Activities of the Framework;
2) initiate an JEEP via a lump sum;
3) access to qualitative overview of experimental data from all JEEPs.

Contribution to JEEP

Participating Organisation pays an entry to benefit as specified in 1)-3) and contributes to one or more JEEPs (a few hundreds of k€/year/JEEP to receive extra benefits:

4) close involvement in the definition and design of the JEEP;
5) access to and analysis of raw experimental data of the JEEP.