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Overview of the NEA Activities Related to Experimental Needs

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The Organization for Economic Cooperation and Development (OECD) Nuclear Energy Agency (NEA) performs works on experimental needs identification and prioritisation for potential applications including the safety and design of nuclear installations.

Thousands of experiments conducted in the past have been collected, documented and preserved to support benchmarking, general reactor physics and material science studies. Most of these data are stored in the relevant databases by the NEA Nuclear Science Division (NSD) and Data Bank teams.

A major source of data used for code validation in criticality safety and neutron physics are the NEA Handbooks of the International Criticality Safety Benchmark Evaluation Project (ICSBEP) and the International Reactor Physics Experiment Evaluation Project (IRPhEP). They provide the nuclear community with peer reviewed benchmarks that include critical, subcritical, shielding, radiation-transport, fundamental physics and reactor physics experimental data from nuclear facilities, worldwide. Selected data from each experimental configuration is entered into the corresponding databases: Database for the International handbook of evaluated Criticality safety benchmark Experiments (DICE) and the IRPhEP Database and Analysis Tool (IDAT). Research reactors have been an important source of information for the Projects. They contain evaluated cases of the experiments performed on the TRIGA type reactors, the Advanced Test Reactor (ATR), USA, the High Temperature Engineering Test Reactor (HTTR) and JOYO, Japan, the HTR-10, Chinese small pebble-bed test reactor and others.

More than 70 shielding benchmark experiments are collected in the SINBAD database that is jointly developed and maintained by the OECD/NEA Data Bank and Oak Ridge National Laboratory, Radiation Safety Information Computational Center (ORNL/RSICC). Many of these benchmarks were carried out at research reactors to validate shielding calculations, and are particularly useful for advanced shielding designs for new research or power reactors.

Research reactors play an important role in providing data for safety assessments. Several experimental projects are conducted on the research reactors under the auspices of the NEA Committee on the Safety of Nuclear Installations (CSNI). Major ones among them are the Halden Reactor in Norway, the Cabri reactor in France, the Japanese HTTR and the Loss-of-Fluid-Test (LOFT) reactor in the USA. Work on identification of experimental needs for safety of nuclear installations has been performed by the CSNI. Thus, a collection of internationally agreed matrices of experimental benchmarks derived from the separate and integral effect tests was developed for validation of best estimate thermal-hydraulic computer codes. These data support the validation process in order to increase confidence in the predictive capability of codes for existing and advanced systems, including the quantification of the uncertainty range for the simulation models and methods.

The CSNI working groups issued a series of state-of-the-art reports on fuel behaviour in various accident conditions where experimental needs were considered mainly for LWR requirements. The NSD activity on fuel behaviour - the Thermodynamics of Advanced Fuels - International Database Project - was established in 2013 to make available a comprehensive, internationally recognised and quality-assured database of phase diagrams and thermodynamic properties of advanced nuclear fuels.

With the new trends in nuclear power generation and regulation, design of nuclear installations, and experimental capabilities, the need for new integral experiments at large scale remains a high priority and requires a cross-disciplinary approach. Given these conditions, the periodic revision of experimental needs and available measurement capabilities are necessary in order to address the requests of industry, safety assessment, and the scientific community. In this context, a new NSD activity has been focused on identification of experimental needs for neutronics, thermal-hydraulics, material studies, fuel behaviour, and multi-physics. The anticipated output from this activity will be establishment of a framework that will bring together international experts in order to revise the experimental needs, rank priorities for validation and identify experimental facilities where the needs could be addressed.

The development of advanced simulation methods, particularly coupled multi-physics methods, has been a significant trend in recent years. Along with the progress made in computational capabilities, new requirements for integral data arise in order to meet the validation process demands. The operational flexibility of most research reactors allows them to address the major needs identified for the nuclear industry providing testing

and calibration experiments, integral experiments, benchmarking, code validation analyses, and cross-section measurements.

The NEA Research and Test Facilities Database (RTFDB) that contains description of about 700 experimental facilities, including research reactors was created in 2007. Recently, work has been started on database modernisation that is focused on checking and extending the data collection as well as providing users with easy access to the parameters of experimental facilities and links to the information available in existing NEA databases.

The full paper will describe progress the revision of experimental needs. It will provide a current status of the NEA databases and the projects related to safety assessment.

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