ADDENDUM
to
MEMORANDUM OF UNDERSTANDING
BETWEEN
U.S. NUCLEAR REGULATORY COMMISSION
and
U.S. DEPARTMENT OF ENERGY
on
NUCLEAR SAFETY RESEARCH OF
ADVANCED TECHNOLOGY FUELS

I. Introduction

The U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) are the Parties to a Memorandum of Understanding on Cooperative Nuclear Safety Research dated May 1, 2014 (the MOU). Pursuant to the MOU, to conserve resources and to avoid duplication of effort, the Parties agreed it is in the best interest of both Parties to cooperate and share data and technical information and, in some cases, the costs related to such research whenever such cooperation and cost sharing may be done in a mutually beneficial fashion. This Addendum to the MOU (the Addendum) is entered into by and between the NRC and DOE effective as of the date of signature of the last of the Parties to execute this Addendum (the Effective Date).

This Addendum is authorized pursuant to section V(a)(iii)(d) of the Principles of Cooperation of the MOU. The terms and provisions of the MOU are controlling for all activities under this Addendum. This Addendum does not obligate or commit funds and does not provide for the transfer of funds. The Parties to this Addendum will be responsible for their own expenses, if any, incurred under this Addendum.

This Addendum describes an agreement between the NRC's Office of Nuclear Regulatory Research (RES) and DOE's Office of Nuclear Energy (NE) for research on the safety and performance of new fuel designs being developed with enhanced accident tolerance. The principal areas of interaction will be:

- Testing of accident tolerant fuels (ATF) concepts under the direction of the DOE program including testing at the Advanced Test Reactor (ATR), Transient Reactor Test Facility (TREAT), High Flux Isotope Reactor (HFIR), Severe Accident Test Station (SATS), and Halden.

- Domestic and international efforts to develop and validate the material property and fuel phenomena correlations needed to update fuel performance codes to model ATF.

- Efforts to characterize the safety and risk significant characteristics of ATF as part of an integrated nuclear reactor system to support licensing.

II. Background

In the Senate Appropriations Committee Report (Senate Report 112-75), accompanying the Fiscal Year 2012 Energy and Water Development Appropriations Bill, the Committee recommended appropriations for the Department of Energy, Office of Nuclear Energy "to give priority to developing enhanced fuels and cladding for light water reactors to improve safety in the event of accidents in the reactor or spent fuel pools," and urged "that special technical emphasis and funding priority be given to activities aimed at the development and near-term qualification of meltdown-resistant, accident-tolerant nuclear fuels that would enhance the safety of present and future generations of Light Water Reactors." In the DOE's April 2015 Report to Congress on the Development of Light Water Reactor Fuels with Enhanced Accident Tolerance, the DOE stated, "It will be imperative that an excellent communication and data exchange be established as a key part of this effort to ensure that an independent NRC is well-informed in its public safety role in this R&D effort."

The DOE's research and development program is to be accomplished through public-private collaborative efforts of DOE, the DOE national laboratories, industry partners, and universities. The Office of Advanced Fuels Technologies within the DOE NE has the responsibility to coordinate, direct, and manage the collaborative efforts of participating organizations.

Candidate ATF cladding designs range from coatings (e.g., thin chromium layer bonded on zirconium); advanced steels (e.g., iron/chromium/aluminum alloys); coated/duplex/triplex molybdenum alloys; and ceramic tubing (e.g., silicon carbide). Candidate ATF fuel designs include pellets that are compliant in response to cladding hoop stress (e.g., doped UO_2), higher uranium density pellets (e.g., uranium nitride and uranium silicide), and TRISO composite fuel.

The NRC is also conducting work in the area of safety analysis for ATF to ensure adequate protection of public health and safety should ATF be placed in use. The NRC recognizes the need to identify key policy issues that arise with ATF that can be communicated to stakeholders clearly and early. The NRC intends to develop independent confirmatory analysis capabilities that support robust safety evaluations. The NRC also intends to have sufficient in-house expertise on the ATF technologies to support ATF licensing activities efficiently and effectively.

For the NRC to be prepared for ATF licensing activities on the schedule proposed by the industry, the NRC staff will need broad knowledge of the ATF timelines and technologies, to identify any policy issues associated with the technology early and to reduce the need for requests for additional information (RAIs) at the time of licensing review. The NRC also will need detailed information about the performance of each design under a wide range of operating and accident conditions to inform updates to the NRC's confirmatory analysis capabilities. The NRC's information needs largely overlap the planned DOE research and development program on ATF. Therefore, it is essential for the NRC to collaborate with DOE throughout their program, to avoid the need for confirmatory testing for licensing purposes.

III. Research Goals and Performance Objectives

DOE is currently in the second phase of a three-phase research and development program for ATF. DOE's goal of the second phase is to develop and qualify ATF designs, in part, through steady-state loop and capsule tests in the ATR, transient irradiation tests in TREAT, LOCA/furnace tests in SATS, and the development of fuel performance models. The goal of the third phase of the program is to commercialize one or more ATF concepts. The second phase

of DOE's research and development program will generate a large portion of the information required to support licensing[1] an ATF concept.

To prepare for the licensing of ATF concepts, the NRC will need to:

- Formulate regulatory policy and positions on a number of issues that may arise in various ATF designs.

- Develop analytical tools to support the licensing of ATF designs.

- Develop staff to review vendor design-specific fuel thermal-mechanical performance models and application methodology licensing topical reports (LTR) for ATF designs and to define the limits on fuel operation such as burnup, power level, etc., in the NRC Safety Evaluation Reports (SER) of the codes and methods topical reports.

- Develop the regulatory infrastructure to evaluate ATF designs from a holistic integrated manner focusing on the risk implications of usage.

IV. Scope and Nature of Collaboration

The goal of the NRC's engagement with DOE through this Addendum is two-fold: (1) for the NRC to obtain information from DOE necessary to prepare for licensing ATF concepts and (2) for the NRC to collaborate with DOE in a manner that helps ensure the program's research focus areas address key safety issues associated with the licensing of ATF for use in commercial nuclear power plants. The goal of DOE is to facilitate timely NRC licensing related support of advanced fuels with enhanced accident tolerant characteristics (ATF) being pursued by ATF vendor participants.

In this spirit, the NRC and DOE will coordinate in the following manner:

- The NRC staff will participate in DOE-led discussions with each ATF project team as they establish the materials and protocol for testing their materials in facilities such as the ATR, TREAT, SATS and Halden experimental projects.

- The NRC staff will collaborate with DOE on the development of specific plans for experimental projects.

- The NRC staff will collaborate with DOE on the NRC's data needs for code development, including access to the raw data obtained during the experimental and testing programs.

- The NRC staff will collaborate with DOE regarding general expectations and requirements of a technical basis for fuel design limits.

- The NRC staff will participate in periodic technical meetings and information exchange workshops related to the ATR, TREAT, SATS and Halden experimental projects.

[1] Licensing activities will include various pre-application interactions between the NRC, fuel vendors and utility ATF partners, topical reports and potentially, license applications submitted for review/approval by the NRC, and regulatory oversight by the NRC. The expectations and scope of these fuel vendor and utility interactions is out of scope of this Addendum.

- The NRC staff will have the opportunity to observe experiments, tests, simulations, and demonstrations related to the ATR, TREAT, SATS and Halden experimental projects.

- The NRC staff will participate in training or education workshops offered by DOE on particular ATF concepts.

- The NRC and DOE will share information about modeling approaches for ATF designs, possibly including code comparison and validation exercises.

- The NRC will collaborate with DOE on the NRC's ongoing efforts to build the regulatory infrastructure necessary to review and license ATF designs.

- To the extent legally permissible, DOE will provide the NRC with access to DOE developed computer codes used in ATF analysis.

- DOE has no objection to the NRC requesting from its program participants copies of quarterly program reports received from ATF concept teams.

- To the extent legally permissible, DOE will provide the NRC with access to material properties handbooks and other reports that do not contain intellectual property.

- To extend DOE will provide the NRC with experimental results obtained in the ATR, TREAT, SATS and Halden experimental projects that contain intellectual property necessary to draw regulatory conclusions (with adequate protections in place including vendor program participant approval).

- The NRC and DOE will coordinate on efforts to characterize the safety, security and risk associated with ATF as part of an integrated nuclear reactor system to support licensing.

As stated previously, the goal of the NRC's engagement with DOE through this MOU addendum is to obtain information to, among other things, develop the capability to perform fuel performance analysis of ATF designs. Under the circumstances the expectation is that the NRC will rely on, and have access to, DOE data for material properties, correlations, neutronics, and cross-sections.

The sharing and use of cooperative research program results from the research conducted under this Addendum is governed by the MOU. The sharing and use of all other technical data and information under this Addendum will be exchanged consistent with each Parties' legal obligations.

While both Parties desire to keep as much of the data publicly available as possible, both Parties also recognize the need to protect from public disclosure data and information exchanged between them that falls within the definition of trade secrets; privileged, confidential commercial, or financial information; or other information that is exempted from public disclosure under the Atomic Energy Act of 1954, as amended; the Freedom of Information Act, as amended; and other applicable law. All DOE data and materials subject to commercial or other use restrictions will be appropriately marked and submitted to NRC under separate cover to ensure they are identified and segregated from non-restricted data, documents, and materials.

If one Party provides the other with non-public information, the recipient agency will not release the information without the written consent of the other agency. This provision will apply to information obtained from either agency or its contractors. It will also apply to the posting of information on the NRC's Agencywide Documents Access and Management System (ADAMS) and on other publicly available Web sites or document rooms. Freedom of Information Act requests, congressional requests, or other requests for documents will be referred to the Party that provided the non-public information for resolution.

V. Deliverables and Products

This collaboration is primarily centered around sharing of information, progress reports and perspectives on potential regulatory issues and approaches. There are no formal or written deliverables.

VI. Resource and Funding Responsibilities

The NRC does not intend to provide funding to DOE to support the ATR, TREAT, SATS, Halden or code development projects. The Parties to this Addendum will be responsible for their own expenses, if any, incurred under this Addendum.

VII. Other Provisions

Nothing in this MOU shall limit the rights or ability of either agency to exercise its authority independently with regard to matters that are the subject of this MOU.

This addendum will be effective upon the date of the last signature from both parties and will remain in effect throughout the DOE/Vendor industry/NRC cooperation program.

VIII. Project Direction and Coordination

A kick-off meeting will be organized once this MOU addendum is implemented. The NRC and DOE staff expect to meet periodically to discuss progress and any emergent issues. All technical interactions will be managed through a single point of contact for each party. Technical meetings to coordinate this effort will be arranged through the project contacts. The project contacts are:

NRC:
Michelle Bales

DOE:
William McCaughey

AGREEMENT

/RA/
Michael F. Weber
Director of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

Date: ***9/25/2017***

/RA/
John Herczeg
Deputy Assistant Secretary for Nuclear Technology Research and Development
Office of Nuclear Energy
U.S. Department of Energy

Date: ***10/26/2017***

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