

**ADDENDUM NO. 3 TO THE
MEMORANDUM OF UNDERSTANDING
BETWEEN UNITED STATES DEPARTMENT OF ENERGY AND
NUCLEAR REGULATORY COMMISSION
ON NUCLEAR ENERGY INNOVATION**

Radiological Source Term and MELCOR Collaboration

I. Purpose and Scope

The purpose of the United States (U.S.) Department of Energy (DOE)/Nuclear Regulatory Commission (NRC) Memorandum of Understanding dated October 7, 2019 (MOU) on Nuclear Energy Innovation is to coordinate DOE and NRC technical readiness and to facilitate the sharing of technical expertise and knowledge on advanced nuclear reactor technologies and nuclear energy innovation, including regulatory assessment of risks arising from nuclear facility radiological release accidents.

To ensure the proper sharing of technical expertise and information between DOE and the NRC, this Third Addendum to the MOU (Addendum) addresses the technical coordination of DOE and the NRC regarding MELCOR severe accident computer code to perform non-Light Water Reactor (non-LWR) source term evaluation. The collaboration between DOE and the NRC will balance the need to assure the NRC's independence to avoid compromising its regulatory role with the respective responsibilities of each agency to cost-effectively develop the technical bases for the safe and secure operation and regulation of advanced nuclear energy facilities.

This Addendum does not alter the authorities or independence of the NRC and DOE or their abilities to fulfill their responsibilities.

II. Authority

DOE and the NRC enter into this Addendum to the MOU pursuant to Section V. Organizational Implementation of the MOU dated October 7, 2019.

III. Background

Since the publication of "NRC Non-Light Water Reactor (non-LWR) Vision and Strategy – Staff Report: Near-Term Implementation Action Plans," in November 2016, there has been dialogue between NRC staff, Advisory Committee on Reactor Safeguards (ACRS), DOE, and industry representatives on computer codes and tools to perform non-LWR source term evaluation. The NRC staff's approach for non-LWR applications is technology-inclusive because it relies on MELCOR, incorporating the suite of physics models needed for the different non-LWR technologies. A detailed description of these codes and the development process, including identification of technical gaps, is provided in NRC's "Non-Light Water Reactor (Non-LWR)

Vision and Strategy, Volume 3 – Computer Code Development Plans for Severe Accident Progression, Source Term, and Consequence Analysis” (ADAMS Accession No. ML20030A178).

The NRC uses MELCOR as its primary tool to assess accident progression and radiological release. These capabilities have proved valuable across a range of regulatory decision-making efforts. MELCOR was instrumental in achieving rapid resolution of a range of post-Fukushima Daiichi safety issues. It is currently being enhanced to support independent assessments necessary to license a range of advanced nuclear energy technologies proposed to recover U.S. nuclear energy leadership. Collaboration between DOE’s Office of Nuclear Energy (DOE-NE) and the NRC is of value to support MELCOR technical bases for:

- MELCOR modelling of a range of accident phenomena relevant to new nuclear energy technologies.
- Enhancement of the state-of-knowledge to a level appropriate to determining with reasonable assurance the protection of public health and safety.

Accordingly, this effort will be focused on severe accident phenomenology and source term development. Currently, MELCOR is being used to demonstrate how source terms can be characterized for three selected non-LWR design concepts. The three designs, which have publicly available data, are: (1) a high-temperature gas-cooled reactor, (2) a liquid-metal-cooled heat pipe reactor (Los Alamos National Laboratory Mega-Power reactor), and (3) a molten-salt-cooled pebble bed reactor (University of California-Berkeley’s Mark I Pebble Bed Fluoride-Salt-Cooled High-Temperature Reactor). In addition, the NRC has formed a panel of experts to address the significant phenomenological issues impacting core degradation and radiological releases under severe accident conditions for various Accident Tolerant Fuel (ATF) designs under consideration (including the impact of burnup/enrichment). The objective of the panel’s work is to improve MELCOR for source term characterization with advanced fuel designs.

The following represent areas of collaboration between DOE-NE and the NRC that can enhance the technical bases for MELCOR for application to advanced nuclear energy technology assessments, although collaboration on other topics related to severe accident phenomena and radiological source term may be undertaken.

- Material thermochemistry data relating to advanced technologies (e.g., ATF, non-LWR).
- Fission product release data relevant to Molten Salt Reactors.
- Thermophysical properties of fluids significantly different from water.
- Thermal hydraulic response data relevant to passive safety measures in support of MELCOR lumped parameter modeling validation.

IV. Roles and Responsibilities of Each Party

This collaboration is primarily centered around sharing of information and research activities and does not include formal or written deliverables. Both DOE and the NRC will identify Points of Contact (POCs) to coordinate DOE-NRC interactions as listed below.

DOE

DOE will provide oversight and direction of its own work, funding authorization, and DOE-NE's mission and objectives.

The following are anticipated DOE Roles and Responsibilities:

- Identify a single DOE POC (Program Manager for Advanced Modeling & Simulation, NE-5) to coordinate DOE-NRC interactions.
- Provide technical information to NRC from DOE and national laboratory subject matter experts having appropriate experience and expertise.
- Provide NRC technical staff with access to analysis and insights that can support MELCOR code development activities that could include facilitating acquisition of data and information for models implemented in MELCOR.
- Conduct technical review meetings as needed and invite staff from various DOE national laboratories who are involved in code development and experimental research.

NRC

The NRC, consistent with its role as an independent safety and security regulator, is responsible for providing accurate and current information on NRC's regulations, licensing processes, and/or information that supports the development of confirmatory tools such as computer codes.

Consistent with Section IV of the MOU, NRC's role as an independent safety and security regulator, and within the bounds of NRC's statutory mandate and available budgeted resources, the NRC will identify and communicate to DOE important information gaps in advanced reactor methodologies and models that are used in MELCOR.

The NRC will neither make recommendations regarding specific commercial reactor design concepts nor participate in any concept selection process.

The following are the anticipated NRC Roles and Responsibilities:

- Identify a single POC (Sr. Reactor System Engineer, NRC-RES) within the NRC to work with the DOE POC to coordinate DOE-NRC interactions;
- Provide the latest information on MELCOR modeling approach that could inform DOE-NE research efforts in experimental and analytical activities;
- Provide updates to MELCOR computer code for source term characterization and use in the DOE facilities safety assessment;

- Provide information on licensing and regulatory reviews of advanced technologies to prioritize regulatory needs; and
- Share technical information on safety analysis from NRC subject matter experts having appropriate experience and expertise, as necessary.

V. Funding Authorization

This Addendum is neither a fiscal nor a funds obligation document and does not authorize expenditure or reimbursement of appropriated funds. To the extent activities discussed in this Addendum would require resources beyond the NRC’s existing appropriated authorities, the parties may agree to enter into Implementing Interagency Agreements, supplemental to the MOU and this Addendum, that address such activities.

VI. Organizational Conflicts of Interest

DOE and the NRC are aware of the organizational conflict of interest requirements and obligations of the respective agencies under those requirements including Section 170A of the Atomic Energy Act of 1954, as amended. DOE and the NRC will work together to resolve any organizational conflicts that may arise.

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