



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 20555-0001

Grant # 31310021M0009

Grantee: North Carolina State University

Title of Grant: OECD/NRC Liquid Metal Fast Reactor (LMFR) Core Thermal-Hydraulic Benchmark for Verification, Validation, and Uncertainty Quantification (VVUQ) of Sub-Channel and Computational Fluid Dynamics (CFD) Codes

Period of Performance: 11/30/2020-11/29/2023 (FY2020 Notice of Funding Opportunity NOFO)

Executive Summary

The primary goal of this project is to develop a benchmark for LMFR core TH prediction methods based on data from the Thermal-Hydraulic Out-of-Reactor Safety (THORS) experiments at Oak Ridge National Laboratory and the 61-pin LMFR test facility at Texas A&M University. This benchmark will provide a pathway for accelerated collaboration towards the improvement of wire-wrap fuel bundle TH modeling and simulation research. The results of the proposed benchmark will reveal the best predictions methods that may be used towards LMFR safety calculations. The proposed project is in line with the US Nuclear Regulatory Commission (NRC) strategy and plan for advanced non-Light Water Reactor research with a focus on developing core TH modeling and simulation capabilities for confirmatory analysis of LMFRs, including Sodium Fast Reactors (SFRs).

Principal Investigator: Maria Avramova, mnavramo@ncsu.edu

Presentations and Publications

The list of publications was submitted with the final report after grant expiration.

The benchmark activities were reported at the U.S. Nuclear Regulatory Commission's 34th Annual Regulatory Information Conference (presented by M. Avramova):

D. Holler, M. Avramova, C. Takasugi, R. Vaghetto, Y. Hassan, "Development of LMFR Core Thermal-Hydraulic Benchmark for VVUQ of Sub-Channel and CFD Codes", U.S. NRC's 34th Annual Regulatory Information Conference, March 8–10, 2022, TH26-Mission Related Research Projects: Preparing for Future Challenges

The Phase I specifications have been published in the ANS PHYSOR 2022 conference, and the current citation has been included below.

D. Holler, M. Avramova, C. Takasugi, R. Vaghetto, Y. Hassan, "Phase I Specifications and Preliminary Sensitivity Analyses of the OECD-NRC Liquid Metal Fast Reactor Core

Thermal-Hydraulics Benchmark," In proceedings of the International Meeting on Physics of Reactors (PHYSOR) 2022, American Nuclear Society (2022).

The following conference manuscripts have been submitted to the 14th International Topical Meeting on Nuclear Reactor Thermal-Hydraulics, Operation and Safety (NUTHOS-14), Vancouver, BC, Canada, August 25 – 28, 2024:

D. Holler, M. Iffat Faizee, M. Avramova, "Computational Fluid Dynamics Analysis of Phase One of the OECD-NEA / NRC Benchmark on Liquid Metal Fast Reactor Thermal Hydraulics"

D. Holler, J. Geymer, M. Avramova, "Computational Fluid Dynamics Analysis of Phase One of the OECD-NEA Benchmark on CANDU Thermal-Hydraulics"

D. Holler, M. Avramova, "Subchannel Analyses of 61-Pin Isothermal Pressure Drop Tests Performed at the Thermal Hydraulic Out of Reactor Safety (THORS) Facility".

Patents

N/A