I/UCRC Executive Summary - Project Synopsis	**Date**: April 2022
Center/Site: CANFSA/Colorado School of Mines	
Tracking No.:61: Casting Modeling and Quality of Metallic Alloys	**E-mail :** nsurghani@mines.edu
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Center/Site Director: CANFSA/A. Clarke/K. Clarke, LLNL/J. McKeown	**Type: (Continuing)**
Project Leader: Nadira Surghani	**Proposed Budget**: $160,000 Leveraged

Project Description: Modeling is integral to casting research as it can be useful in improving mold designs and reducing product cycle time and cost. There is a particular focus on modeling castings of high-density metallic alloys used for nuclear energy and defense applications for the US to stay competitive in the global economy. Ultimately, model predications can inform future mold designs and casting processes to optimize manufacturing.

Experimental plan: FLOW-3D, a computational fluid dynamics (CFD) software, will be used to develop a hemispherical uranium casting model of interest to LLNL along with other models of different mold geometries and processing variations on other high-density metals. The casting predictions will be compared to publicly available instrumented casting data. Small castings of selected geometries will be produced using surrogate metallic alloys which will be characterized and rationalized in terms of FLOW-3D model predictions

Related work elsewhere: An instrumented uranium casting experiment has been conducted at Los Alamos National Laboratory (LANL). The geometry and casting set-up will be used to inform the parameters of the casting model. Thermal history data during mold heating, filling, solidification, and cooling will be used to verify the model predictions.

How this project is different: Computer modeling programs using finite element analysis (FEA) lead the way in three-dimensional modeling of industrial mold filling and solidification problems, but casting modeling is critical skill that is currently lacking across the U.S. DOE Complex. This project aims to address this need though university collaboration, by developing a future work force with background and experience in casting modeling.

Milestones for the current proposed year: Casting simulations will be set up and run with various geometries for a range of metallic alloys with available model inputs. Develop model of interest to LLNL that simulates mold heating, filling, solidification, and cooling of a uranium casting in a hemispherical graphite mold.

Deliverables for the current proposed year: Compare thermal history data from the model predictions to the experimental data from instrumented castings performed by LANL such as rod and hemispherical castings.

How the project may be transformative and/or benefit society: This project will train a U.S. citizen with the knowledge, skills, and abilities needed to perform casting modeling with FLOW-3D, which will be directly translatable to modeling of high-density metallic alloys of interest to LLNL and more broadly to the NNSA.

Research areas of expertise needed for project success: Access to FLOW-3D software; instrumented casting data from LANL; x-ray cabinet with capabilities to perform in-situ solidification radiography for small-scale experimental castings.

Potential Member Company Benefits: Casting research aims to improve part quality, decrease rejection rate, and cut manufacturing costs to stay competitive in the economy. Modeling is integral to casting research as it can be useful in improving mold designs and reducing product cycle time and cost.

Progress to Date: The developing model can simulate the filling and solidification of uranium in graphite molds of various geometries, such as a cylinder (rod), small plate, and hemisphere. Thermal probe data in various locations throughout the casting model has been verified by instrumented casting data provided by LANL.

Estimated Start Date: Fall 2021	**Estimated Knowledge Transfer Date**: May 2023