Natura Resources
partnered with
Idaho National Laboratory

NE-20-23935, RELAP5-3D Development and Assessment for Liquid-fueled Molten Salt Reactor Licensure

YEAR AWARDED: 2020

TOTAL PROJECT VALUE: $619,000 (DOE: $495,000, Natura: $124,000)

STATUS: Completed

PRINCIPAL LAB INVESTIGATORS: Theron Marshall (INL), Jordan Robison (Natura)

DESCRIPTION: Natura Resources is working toward commercializing advanced liquid-fueled molten-salt reactors (MSRs) to support global needs for energy solutions that are inherently safe, sustainable, and environmentally responsible. Developing the ability to license a novel low-power Molten Salt Research Reactor (MSRR) using a fluoride-based salt fuel mixture poses unique challenges to the data boundaries and functionality of current modeling software tools. These software tools are required in design decisions and in licensing review. Their scarcity poses a significant design and licensing challenge to understanding MSRR response in normal and accident conditions. Under this voucher, Idaho National Laboratory supported modification, and assessment of the RELAP5-3D code for application to the company's MSRR design.

BENEFIT: Better data and modeling software will open a licensing pathway to resolve limitations that currently exist, for both the input models for the plant design and models specific to the liquid fuel molten salt core. An advanced RELAP5-3D code is an important capability for Natura in reaching its goals and will provide additional benefit to other molten salt reactor companies seeking to advance MSR technology.

IMPACT: Although it originated in 1979 as "Reactor Excursion and Leak Analysis Program" to study transients for commercial Light Water Reactors, RELAP has evolved to successfully model thermal and fluid performance of high-temperature gas-cooled, super-critical CO_2, sodium fast reactors, and MSRs.

NEXT STEPS: On Sept. 1, 2023, Natura Resources opened a 28,000-square-foot research facility at Abilene Christian University, where it plans to demonstrate its MSR technology as early as 2026. In mid-June, the U.S. Nuclear Regulatory Commission announced it would complete the safety assessment and construction permit issuance for Natura Resources MSRR by Sept. 30. The MSRR is the first advanced reactor constructed at a U.S. university in decades and the site where Natura will first demonstrate its MSR technology. By the early 2030s, the company plans to deploy commercial-scale MSRs that are factory-built modular construction and fully walk-away safe.