FY 2026 CINR Topic Area 4-Fuels

December 17, 2025

U.S. DEPARTMENT OF ENERGY

Advanced Fuels Campaign

FY 2026 CINR Topic Area 4 – Fuels

Introduction

Advancements in nuclear fuel, fabrication processes, cladding concepts, and evaluation techniques are needed to ensure robust, resilient, well-characterized, innovative and optimized fuels are light-water reactors (LWRs), Small Modular Reactors (SMRs) and other advanced reactor designs.

Topics of interest include, but are not limited to:

- Accident Tolerant Fuels (ATF) for LWRs, water-cooled SMRs
- Silicon Carbide (SiC) fuel cladding,
- TRISO coated particle fuels, Next Generation TRISO
- Metallic fuels, and Molten Salt Fueled Reactors

SiC clad pin after ATF-2 irradiation

- *Aspects of fuel fabrication, design, irradiation performance testing, and post-irradiation evaluation methods will be considered.*
- *Proposals for this call should deal with concepts significantly different than those already under development in current and past NEUP awards,* NEUP - Home (inl.gov)
- *Collaboration with the DOE labs and reactor fuel and cladding vendors is encouraged.*
- *Use of NQA-1 quality assurance approach is encouraged.*

Reference: 2025-AFC-Accomplishments-Report.pdf

Sub-Topic: Accident Tolerant Fuels

Accident Tolerant Fuels (ATF) Potential Research Focus Areas:

ATF enhances accident tolerance for current operating LWRs and future water-cooled SMRs

Research Proposals are sought for:

- Doped UO2 fuel pellets
- Coated cladding
- Small increase in enrichment (6-7%, LEU+)
- Increased burnup levels from 62 to 75 GWd/MTU

Industrial Partners: Framatome, Westinghouse, Global Nuclear Fuels

Laboratory Partners: Idaho, Oak Ridge, Los Alamos, and Pacific Northwest National Laboratories

Reference: 2025-AFC-Accomplishments-Report.pdf

Federal POC – Frank Goldner, Lab POC – Dan Wachs

Twenty-five irradiated ATF fuel rods from the Byron Reactor being received at Idaho National Laboratory.

Sub-Topic: Silicon Carbide Cladding

Silicon Carbide (SiC) Fuel Cladding Potential Research Focus Areas:

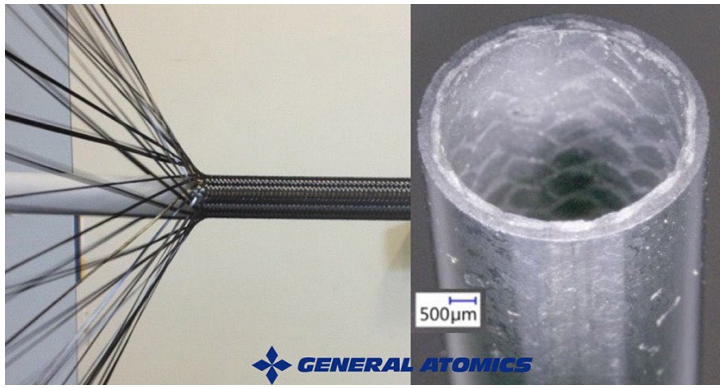
SiC fuel cladding can be used in LWR and helium-cooled fast and thermal reactor concepts

Research Proposals are sought for:

- Irradiated and unirradiated SiC Cladding materials properties measurement methods
- Development of novel Non-Destructive Evaluation (NDE) methods
- Advances in SiC fuel cladding fabrication methods, especially SiC tows (threads) fabrication
- Novel manufacturing characterization and post-irradiation evaluation (PIE) methods.

Industrial Partners: General Atomics, Framatome, Westinghouse, Ceramic Tubular Products, etc.

Laboratory Partners: Idaho and Oak Ridge National Laboratories



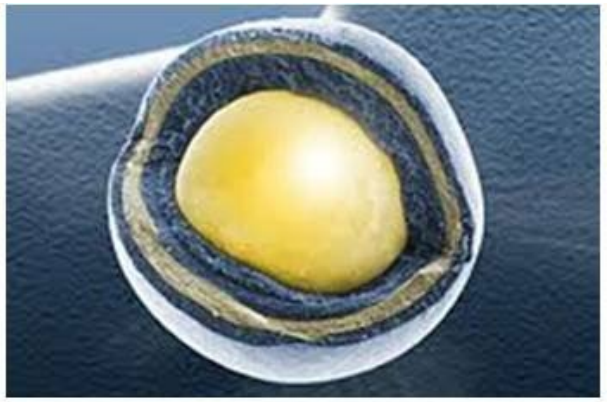
Reference: Takaaki, Koyanagi, Yutai Katoh, SiC/SiC Development Strategy and 5-Year Execution Plan, Oak Ridge National Laboratory, March 2023, ORNL/SPR-2023/2890

Federal POC – Madeline Feltus, Lab POC – Dan Wachs

Sub-Topic: TRISO Fuel

TRISO-Particle Fuel Potential Research Focus Areas:

- Unirradiated and irradiated TRISO coated particle fuel and matrix properties
- Development of novel TRISO fuel designs, for Next Generation Fuels, e.g., UN kernels, refractory metal coatings, non-graphitic matrix materials, fission product getters
- Use of TRISO fuel in non-helium coolant environments, e.g., FliBe coolant
- New fabrication characterization and post-irradiation evaluation (PIE) methods
- Higher and lower temperature operational issues.



TRISO coated particle fuel

Industrial partners: X-energy, BWXT, Kairos, Standard Nuclear Fuels, etc.

Laboratory partners: Idaho and Oak Ridge National Laboratories

References:

- AGR TRISO Program Licensing Topical Report: https://www.nrc.gov/docs/ML1915/ML19155A173.pdf
- IAEA TRISO FUEL HTGR Report: https://www.iaea.org/publications/10451/advances-in-high-temperature-gas-cooled-reactor-fuel-technology

Federal POC – Madeline Feltus Lab POCs– Dan Wachs, Paul Demkowicz (INL)

Sub-Topic: Metallic Fuels for Advanced Reactors

Metallic Fuels Potential Research Focus Areas:

Metallic fuels for advanced sodium-cooled fast reactors can operate in open or closed fuel cycles:

- Baseline Fuel: U10Zr EBR II fuel, SS clad, sodium bonded, injection cast
- Reactor – pool type, sodium cooled

Research proposals are sought for:

- Developing next generation metallic fuel fabrication and design for improved fissile utilization and fuel management
- Improving metallic fuel performance, post-irradiation operations
- Metallic fuel innovations and optimization.
- Developing sodium bond-free metallic fuel, annular fuel forms, so metallic fuel/cladding chemical interactions are mitigated

Reference: Our Work - Advanced Fuels Campaign

Federal POC – Ming Tang, Lab POC – Dan Wachs

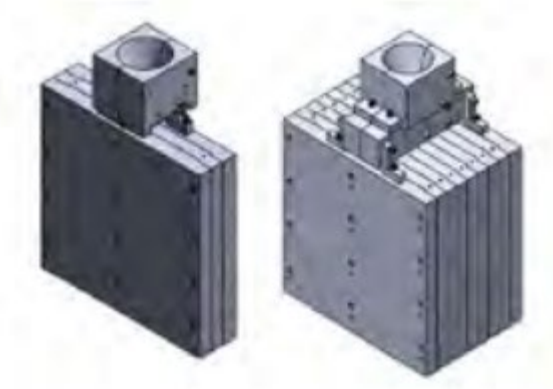


Figure 1. Left) 5 kg final mold design Right) 20 kg final mold design.

Sub-Topic: Molten Salt Fuels

Molten Salt Fuel Research Focus Areas:

- Molten Salt Reactor (MSR) designs:
  - Fuel salt will be molten chloride or molten fluoride, e.g., FLiBe
  - The molten salt serves as the MSR primary coolant using flowing fuel
  - Different matrix salt compositions
  - Fuel salt will require blending and purification, recovery and transmutation of long-lived isotopes, fission product recovery, safeguards,
  - Conversion of fissile source material to appropriate halide in appropriate redox state:

    $UF_6 \rightarrow UF_4$; $UF_6 \rightarrow UCl_3$; $UO_2 \rightarrow UF_4$; $UO_2 \rightarrow UCl_3$
  - Fissile source conversion can be designed to produce pure halide or produce fissile halide in a molten salt solution.

- Research needed:
  - Characterizing, modeling thermophysical, thermochemical properties
  - Chemistry and composition of molten salt solutions and fuel specifications
  - MSR operational and safety issues

Reference: *https://publications.anl.gov/anlpubs/2024/02/187645.pdf*

Federal POCs Nathan Philipovich, Ming Tang INL POC – Dan Wachs

Disassembled fuel salt irradiation capsule with $NaCl—UCl_3$