

PNNL Points of Contact:

Tara O'Neil
Nuclear Regulatory Sub-Sector Manager
tara.oneil@pnnl.gov
(541) 738-0362

Bruce McDowell
Advanced Reactors Program Manager
bruce.mcdowell@pnnl.gov
(509) 375-6668

nuclearenergy.pnnl.gov

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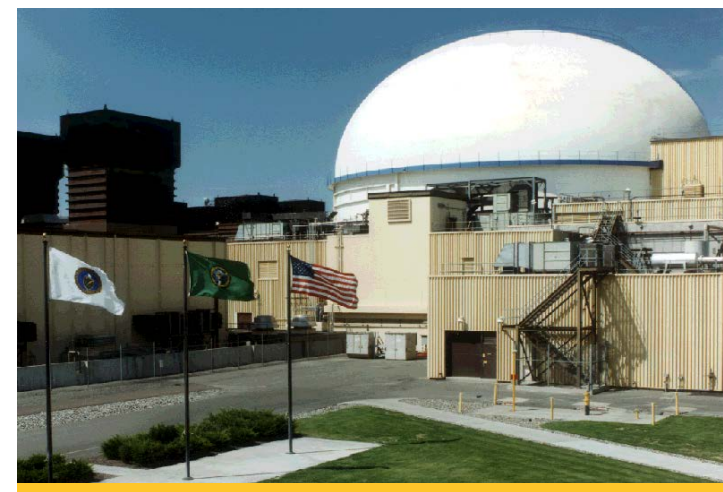
**PACIFIC NORTHWEST NATIONAL
LABORATORY'S EXPERIENCE IN
ADVANCED REACTOR AND
SMALL MODULAR REACTOR
LICENSING INFRASTRUCTURE**

For more than 30 years, the Nuclear Regulatory Commission has reached out to Pacific Northwest National Laboratory at critical stages of nuclear plant design for assistance in developing and applying new standards for safety reviews of new plant designs.

PNNL's key recent experience relevant to advanced reactor regulatory infrastructure development includes:

- Assisted NRC's Advanced Reactor Program in developing their licensing infrastructure for advanced non-LWR design applications, include molten salt, liquid metal, and high-temperature gas-cooled designs. PNNL is currently evaluating safety hazards associated with uranium metal or uranium alloy fuel preparation and processing operations.
- Assisted NRC's Advanced Reactor Program in developing their licensing infrastructure for planned small modular reactor (SMR) applications, including developing Design-Specific Review Standards (DSRSs) and Safety Evaluation Report templates for the mPower and NuScale designs. These DSRSs provide guidance to NRC staff on risk-informed review procedures for design and siting subject areas, using current knowledge of the proposed designs.
- Supporting advanced reactor designs with PNNL senior staff members who hold extensive fast reactor experience gained during the design, testing, and operation of the Fast Flux Test Facility (FFTF), a 400 MW liquid sodium-cooled test reactor that operated from 1982 to 1992 at the Hanford Site in Eastern Washington. This includes expert retrieval of FFTF information and analysis of metal fuel experiments performed in FFTF so that the results are applicable to—and can be interpreted in terms of—designs being developed by advanced reactor vendors.

- Supported the development of the Next Generation Nuclear Plant (NGNP) High Priority Regulatory Topical Reports related to NGNP Licensing (see SECY-10-0034, Potential Policy, Licensing, And Key Technical Issues for Small Modular Nuclear Reactor Designs).
- Provided recommendations to NRC on modifications of health physics codes for SMRs, and to update the Gaseous And Liquid Effluent (GALE) codes.
- Supported development of American Nuclear Society (ANS) 53.1 Nuclear Safety Criteria and Safety Design Process for Modular Helium-Cooled Reactor Plants, and ASME/ANS S1.4, Standard for Probabilistic Risk Assessment for Advanced Non-Light Water Reactor Nuclear Power Plants.
- Prepared "High Temperature Gas Reactors: Assessment of Applicable Codes and Standards" (PNNL-20869, October 2011) in support of NRC's Advanced Reactor Program.
- Providing NRC's Office of New Reactors the leadership and complete technical team responsible for the preparation of the Environmental Impact Statement for TVA's Early Site Permit for siting one or more SMRs at the Clinch River Site in Tennessee.
- Assisting NRC in preparing for anticipated license applications and commercial use of accident tolerant fuel (ATF).
- Developing the fuel rod analysis code (FAST) to be NRC's independent analysis tool for review of license applications of ATFs. FAST is the next evolution of FRAPCON and includes material properties, performance models, non-cylindrical geometry modeling, and coolant options.



The Fast Flux Test Facility (FFTF), located on the Hanford Site north of Richland WA.



Fuels and Materials Examination Facility adjacent to FFTF, a few miles north of PNNL

Other Support for the Department of Energy Advancing Nuclear Energy

PNNL currently supports the DOE Office of Nuclear Energy (NE) mission to advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration as appropriate. This support by PNNL includes:

- Teaming with Fluor Energy as part of the DOE-NE funding opportunity announcement. PNNL and Fluor Energy were awarded a molten salt processing opportunity to examine the use of nitrogen trifluoride as an agent to remove uranium from a molten-salt fuel mixture as a preliminary step for the removal of fission products.
- Participating in DOE's Gateway for Accelerated Innovation in Nuclear (GAIN) Program. PNNL and the Columbia Basin Consulting Group (Kennewick, WA) were awarded two vouchers to conduct a regulatory gap analysis for their Lead-Bismuth SMR design, and to evaluate functional containment requirements.

- Supporting TerraPower nuclear fuel development programs, under the auspices of DOE-NE, including hot cell research into the mechanical properties of irradiated cladding.
- Supporting advanced Instrumentation and Controls (I&C) development, advanced materials and cladding development, accident tolerant fuel and transmutation fuel technology, and metal fuel extrusion technology under the DOE-NE Advanced Technology Program
- Led, participated in, and reviewed an array of PRAs on U.S. and international nuclear reactors. This includes being part of a team that provided training in PRA and safety analysis to the former Soviet bloc states for the DOE and Department of Defense in multi-year projects titled the International Nuclear Safety Program and the Core Conversation programs.