Accelerated Fuel Qualification

Sustainable Nuclear Power Initiative

Focus Area Fact Sheet

Pacific Northwest
NATIONAL LABORATORY

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Focus Area Description

The Accelerated Fuel Qualification (AFQ) Focus Area, within the Sustainable Nuclear Power Initiative, seeks to develop new tools, methodologies and capabilities which can be used to reduce the time and expense associated with development and qualification of new fuels and materials to support eventual licensing. New fuel designs are essential to enable the development, licensing, and deployment of next generation reactors.

Fuel Qualification Process

Science and Technology Capabilities

Fuel development and qualifications efforts are complex and require a multi-disciplinary approach with experienced staff utilizing highly unique irradiation test capabilities and facilities capable of handling irradiated materials and new fuel forms and compositions. The Pacific Northwest National Laboratory is well positioned to support development and qualification of new fuels and materials due to extensive radiological research laboratories, instrumentation, and senior research staff which have supported previous DOE nuclear missions associated with nuclear fuel technology, post irradiation examination campaigns in support of materials qualification, and waste storage licensing support efforts. Such facilities are limited and truly unique in their capabilities.

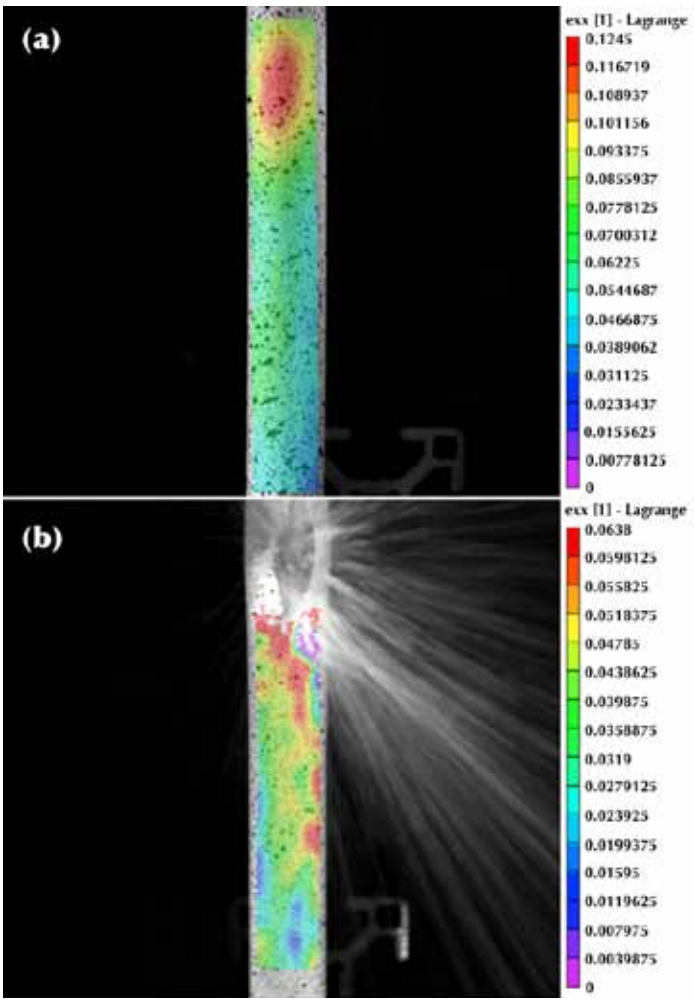
A sampling of PNNL's nuclear R&D infrastructure includes: 400 square feet of internal hot cell floor space in 12 hot cells with shield thickness ranging from six-inch steel to four feet of dense concrete; 500,000 square feet of radiological and nuclear facility space, including one Hazard Category II nuclear facility, equipped with fume hood, glove box, hot cell and high-bay laboratories; radiological material processing facilities and post-irradiation examination capabilities; a new Laser Flash Thermal Diffusivity system (FY08 installation); complete radiochemical, organic, and physical properties analysis capabilities; isotope production and separation; computational modeling and analysis of radiation damage and effects in materials and ceramics. In addition, the Lab has expertise in neutronics, thermal hydraulics, materials testing and development, fuel performance modeling, actinide and analytical chemistry, and licensing processes.

Accelerated Fuel Qualification Focus Area Objectives/Project Criteria

To reduce the time and expense associated with new nuclear fuel development and qualification, AFQ will invest in research projects designed to support the nation's near, mid and long-term needs to support the continued operation of existing LWRs and the development and deployment of advanced next generation reactors.
In the near-term, industry will continue to explore avenues for greater fuel performance at reduced costs while ensuring the safety of today's reactors. To this end, AFQ will invest in research related to new and innovative LWR fuel concepts which allow for greater fuel burn up without adversely affecting fuel reliability.

The Sustainable Nuclear Power Initiative Supports national priorities for:

- Energy Security
- Carbon Management
- Nonproliferation
- Sustainability



In concert with new fuel development for future reactors is testing of new materials for fuel cladding performance. PNNL research capabilities allow for speckle pattern analysis to identify strains or cracks in fuel cladding using burst testing. In this example, strain localization prior to burst (a) and actual burst (b) captured and analyzed using digital image speckle pattern analysis. This variation in uniform strain will be used to determine an imperfection number for each tube variant.

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In the mid-term, new fuel development and qualification efforts will be undertaken to enable the design, licensing, and deployment of advanced reactors. Advanced reactors will offer improved overall plant efficiency and safety, and production of high quality process heat which can be used to improve the efficiency of various processes (e.g., hydrogen production, coal-to-liquids and ethanol production). To support this, AFQ will invest in research to develop new concepts, methods, and capabilities that will allow more timely access to knowledge which may provide early insights into the behavior of particular fuel forms and composition prior to making the investment in long and costly irradiation experiments. In addition, research is being conducted on new tools, experimental and analytical, test methods, and capabilities needed to support elements of fuel development and qualification.

In the long-term, the nuclear fuel cycle will evolve to include fuel recycling and destruction of long lived fission products in fast reactors. New fuels will be developed, qualified and licensed to support this need. AFQ will invest in research to generate new ideas, concepts, methods, and capabilities that will improve early screening techniques for viability of new fuel forms and compositions and cladding materials that will reduce the risk associated with investment in long irradiation experimentation. Other focus area research includes studying the processes needed for reliable and cost effective fuel fabrication methods for power plants that would use this type of fuel; and, creating concepts to allow ramp testing or assessment of fuel performance under simulated accident conditions using existing, but limited capabilities.

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