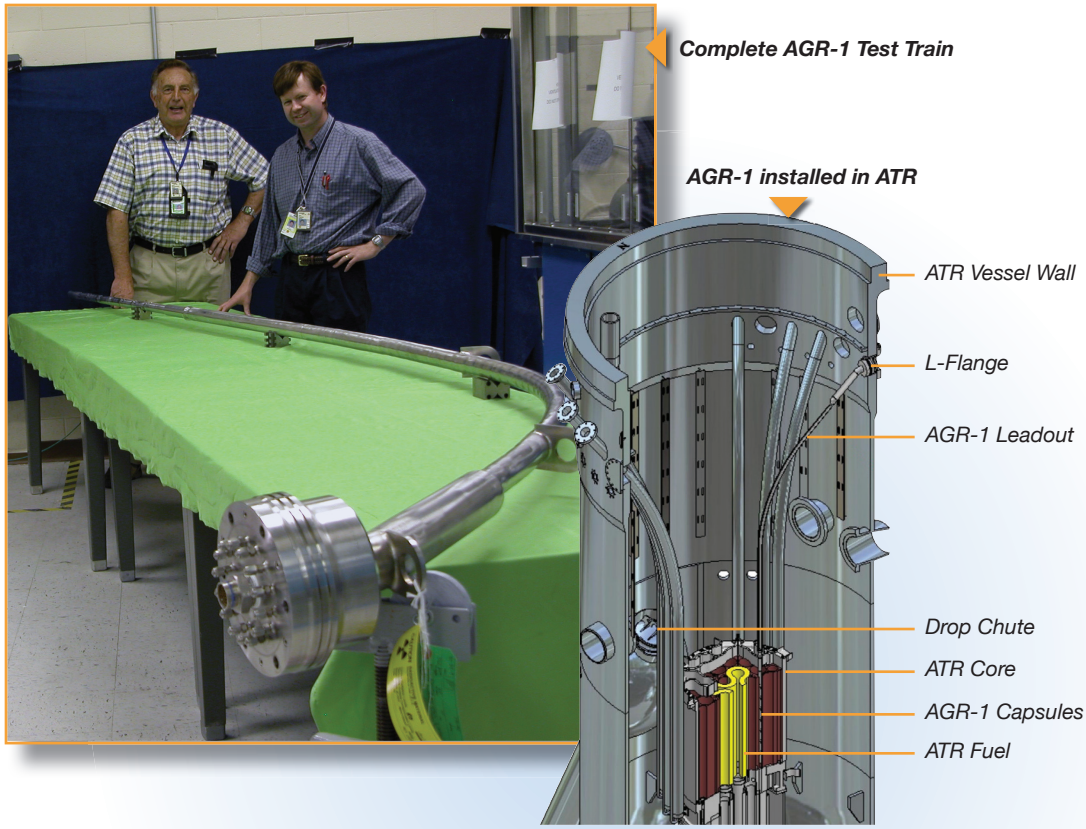

Fuel Irradiation Experiments

Next Generation Nuclear Plant

The Next Generation Nuclear Plant (NGNP) program is working to develop high temperature gas-cooled reactor (HTGR) technology that will meet the commercial needs of a wide range of industrial end-users. The Idaho National Laboratory (INL) manages the research and development of NGNP for the Department of Energy.

A key element of the NGNP is irradiation of new fuel being developed to support next generation reactors in the United States. The Advanced Gas Reactor (AGR) Fuel Development and Qualification Program, part of the NGNP Program, will irradiate a total of eight experiments (designated AGR-1 thru AGR-8) over the next 10 years to demonstrate and qualify new low-enriched uranium tri-isotropic coated particle fuel for use in HTGRs like NGNP. The intent of these experiments is to provide irradiation performance data to qualify fuel for normal operating conditions, to provide irradiated fuel and materials for post-irradiation examination and safety testing, to support uranium oxycarbide (UCO) and uranium dioxide (UO_2) fuel process development, and to support development and validation of fuel performance and fission product transport models and codes. AGR-1 is currently irradiating fuel fabricated at laboratory scale in the Advanced Test Reactor (ATR), and in October 2009 will complete a two-and-a-half year irradiation. AGR-2 irradiation is anticipated to begin in early 2010.

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NGNP Next Generation Nuclear Plant

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Experiment test trains for both AGR-1 and AGR-2 consist of six separate stacked capsules vertically centered in the reactor core. Each capsule has its own custom blended gas supply and exhaust for independent temperature control. The sweep gas has online fission product monitoring of its effluent as a means of tracking fission gas release, thus inferring the performance of the fuel in each individual capsule during irradiation. The remaining six AGR experiments are currently planned to be performed in a different, larger ATR irradiation position with a higher neutron flux rate in order to achieve burn-up and fast fluence requirements in less time. The test trains for these later experiments will be doubled-up, therefore different in size and shape, with twice as many fuel compacts as AGR-1 and AGR-2. This will reduce the overall time required by the program to obtain all necessary irradiation data.

Development and irradiation of the AGR-1 experiment has provided valuable insights and lessons learned as it completes its primary mission as a shakedown of the experiment design and operating characteristics as well as the temperature control and fission product monitoring systems. A valuable added bonus of the experiment is the data being gained on the irradiation performance of the fuel developed by the AGR program. The insights and lessons learned on AGR-1 are being incorporated into the design of AGR-2, which will provide additional data on the irradiation performance of both UCO and UO_2 fuel. The results of both of these experiments will be used to support qualification of particle fuel for use in HTGRs like NGNP.

Fuel Irradiation - Experiments

AGR-1	Shakedown of the design, fabrication and operation of a multicompartment, individually controlled test train that will reduce the chances of test train and/or capsule failures in subsequent irradiations. Tests the behavior of early lab scale TRISO fuel using different types of coatings that mimic those found on the successful German TRISO fuel.
AGR-2	Performance demonstration of high burnup of UCO and UO_2 TRISO fuel fabricated from larger scale fuel production.
AGR-3 and 4	Tests designed to measure fission product release from designed-to-fail fuel and subsequent retention in compact matrix and graphite. Performed at relevant temperatures, burnup and fast fluence levels will establish fission product behavior in the fuel system for use in safety analyses.
AGR-5 and 6	Qualification tests of the NGNP fuel design. Fuel irradiated in large enough quantities to draw statistically significant conclusions about anticipated fuel performance.
AGR-7 and 8	Tests to provide data which will be used to establish margins and to validate fuel performance and fission product transport models.

For more information

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