In the coming decades, increased energy supplies and an upgraded energy infrastructure will be needed to meet growing demands for electric power. The Generation IV project identified reactor system concepts for producing electricity that excelled at meeting the goals of superior economics, safety, sustainability, proliferation resistance, and physical security. The DOE has selected one of these systems, the Very High Temperature Gas Cooled Reactor System (VHTR), for the Next Generation Nuclear Plant (NGNP) Project, a project to demonstrate emissions-free nuclear-assisted electricity and hydrogen production by 2015. The NGNP reference concept will be a helium-cooled, graphite moderated, thermal neutron spectrum reactor with a design goal outlet temperature of 900-1000°C and a thermal power of about 600 MWth. The reactor core could be either a prismatic graphite block type core or a pebble bed core. The fuel cycle will be a once-through very high burnup low-enriched uranium fuel cycle.

The Department of Energy has established the Advanced Gas Reactor Fuel Development and Qualification Program Plan to address the following overall goals:

- Provide a baseline fuel qualification data set in support of the licensing and operation of the NGNP. Gas-reactor fuel performance demonstration and qualification comprise the longest duration research and development (R&D) task for the Next Generation Nuclear Plant (NGNP) feasibility. The baseline fuel form is to be demonstrated and qualified for a peak fuel centerline temperature of 1250°C.
- Support near-term deployment of an NGNP by reducing market entry risks posed by technical uncertainties associated with fuel production and qualification.
- Utilize international collaboration mechanisms to extend the value of DOE resources.

The Advanced Gas Reactor Fuel Development and Qualification Program consists of five elements: fuel manufacture, fuel and materials irradiations, postirradiation examination (PIE) and safety testing, fuel performance modeling, and fission product transport and source term.

An underlying theme for the fuel development work is the need to develop a more complete fundamental understanding of the relationship between the fuel fabrication process, key fuel properties, the irradiation performance of the fuel, and the release and transport of fission products in the NGNP primary coolant system. Fuel performance modeling and analysis of the fission product behavior in the primary circuit are important aspects of this work. The performance models are considered essential for several reasons, including guidance for the plant designer in establishing the core design and operating limits, and demonstration to the licensing authority that the applicant has a thorough understanding of the in-service behavior of the fuel system. The fission product behavior task will also provide primary source term data needed for licensing. An overview of the program and recent progress will be presented.