U.S. DEPARTMENT OF ENERGY
INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE
United States/European Union

ABSTRACT

Lead Fast Reactor Engineering and Analysis

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Project Number: 2004-003-E (U.S. 1.11)

Project Start Date: April 2004

Project End Date: April 2007

Lead-Cooled Fast Reactors (LFRs) are ideally suited for the development of modular nuclear power plants for the production of electricity, hydrogen, and optionally desalinated water that meet the requirements of a future sustainable world energy supply architecture optimized for nuclear rather than fossil energy. Those requirements include features that facilitate deployment in developing as well as developed nations such as proliferation resistance, sustainability, economy, nearly autonomous operation, and a range of plant power levels compatible with widely varying extents of national nuclear infrastructure and local electric grid development.

The Secure Transportable Autonomous Reactor (STAR) project at Argonne National Laboratory (ANL) has been developing suitable LFR concepts for the future world energy supply architecture:

- STAR-LM (Liquid Metal) for electric power generation with optional desalinated water production at a 400 MWt power level;
- STAR-H2 (Hydrogen) for the production of hydrogen and fresh water at a 400 MWt power; and
- SSTAR (Small Secure Transportable Autonomous Reactor) for electricity and desalinated water production to serve remote sites as exist in Alaska, Hawaii, and elsewhere at about a 25 MWt power level.

The LFR thus forms the basis for a portfolio of plant concepts to match customer needs in developing and developed nations.

Specific features of LFRs as embodied by STAR-LM include proliferation resistance, small modular reactor size, sustainable closed fuel cycle, high power conversion efficiency at low temperatures, efficient production of fresh water, nearly autonomous operation, passive safety, natural circulation primary coolant heat transport, and factory fabrication, transportability, and modular assembly at the site.

The objectives of the joint U.S./European Union project are to advance the development of LFRs and supporting analyses applicable to the STAR concepts in the U.S. Successful outcomes will include core neutronics calculations, system thermal hydraulic and computational fluid dynamics (CFD) code calculations, meaningful validation of CFD codes under regimes and conditions relevant to LFRs, analyses of operational transients or postulated accidents, and approaches for in-service inspection and maintenance of LFRs during operation.

Lead Fast Reactor engineering and analysis shall be initiated on the U.S. side within the framework of the Generation IV Nuclear Energy Systems Initiative in the areas of System Design and Evaluation, Instrumentation and Control, Safety, Fuels, and Components. The Work Package involved is A0501J01, "LFR System Design and Evaluation - ANL."