

International Nuclear Energy Research Initiative

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

ABSTRACT

Safety Calculations for Gas-Cooled Fast Reactors (GFRs)

Principal Investigator (U.S.): T. Y. c. Wei,
Argonne National Laboratory (ANL)

Project Number: 2004-008-E (EC10)

Project Start Date: October 2004

Principal Investigator (Euratom): H. U. Wider,
Joint Research Center of the European Commission
Institute for Energy

Project End Date: October 2007

The objective of this GEN IV project is to perform safety calculations for the Gas-Cooled Fast Reactor (GFR). This will be carried out in coordination with the current ongoing US - France I-NERI GFR development project between CEA-Cadarache and ANL. The project shall be initiated within the framework of the Generation IV Nuclear Energy Systems Initiative in the area of System Design and Evaluation under the Work Package, A0401J01 "GFR safety system optimization and transient analysis support". The EU participation is covered by the USDOE/Euratom contract pursuant to the DOE/EURATOM proposed action sheet JRC/IE Neutonic Rev1. This was confirmed at the first USDOE/EURATOM co-operation meeting at Brussels, February 23rd, 2004.

- Task 1 - Core Design Optimization: For the larger plant unit size currently under consideration, optimize the design to enhance core performance, increase fuel margins and improve safety system response. (ANL).
- Task 2 - Primary System/BOP Interfacing: Provide interfacing with the development of the primary system and balance of plant layout to establish key features and requirements for the performance of the decay heat removal systems (DHRS). This will include the delineation of the various accident sequences. (ANL).
- Task 3 - Reactivity Coefficient Study: JRC/IE has already performed many steady state calculations with HEXNODYN for a CEA fast gas-cooled reactor with block-type fuel elements. IE could provide the geometrical data, isotopic mixtures and temperatures that were used. Particularly, a comparison of the reactivity coefficients is relevant for IE because it gets a considerably smaller reactivity effect for an assumed gas de-pressurization than comparable analyses. IE will also perform MCNP calculations for taking into account the neutron streaming effects.
- Task 4 - Control Rod Ejection Accident: JRC/IE will also perform HEXNODYN calculations with an agreed upon reactivity excursion and with the Doppler as the only negative reactivity feedback. This transient calculation should be compared to similar ANL analyses.
- Task 5 - ATWS Evaluation: JRC/IE will perform GFR safety calculations with the STAR-CD and the multi-channel European Accident (EAC2) Codes concerning unprotected Loss-of-Flow, Depressurization, Loss-of-Power and Reactivity Accidents and emergency decay-heat removal. The EAC-2 code will be limited to the treatment of GFRs with fuel pins. A simplified few channel model using block-type fuel elements may be developed.
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- Task 6 - DHRS Evaluation: Evaluate and implement the Integrated System type thermal-hydraulic models required for the DHRS analysis. Perform the analysis of decay heat removal capability for candidate designs under various postulated accident conditions. The performance of the secondary (guard) containment will be included. (ANL)
- Task 7 - System Design Integration: Integrate the candidate DHRS design into the evaluation of the primary system and BOP definition, the core performance and the assessment of the transient and ATWS response of the plant. (ANL)
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