U.S. DEPARTMENT OF ENERGY
INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE
DOE/CEA

ABSTRACT

Development of Generation IV Advanced Gas-Cooled Reactors with Hardened/Fast Neutron Spectrum

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CEA and ANL have had similar reflections aimed at designing high temperature gas cooled fast/hardened spectrum reactors with a high degree of safety and an integrated fuel cycle. The work will be performed in a collaborative program to develop advanced gas-cooled reactors with a hardened or fast neutron spectrum which meet the Gen IV goals of economics, safety, sustainability and non-proliferation. To achieve this objective, the driving task for this project will be an advanced gas-cooled reactor concepts design/safety effort (WP1.2.1) with the associated integrated fuel cycle. A safety-in-the-design approach will be taken. There will be an exploratory phase where exploratory core/fuel forms/primary system concepts will be investigated to scope innovative design concepts. The initial focus will be on the Gen IV goal of safety with examination of various core, fuel form and primary system concepts which could achieve decay heat removal at low pressure conditions and Anticipated Transients without Scram (ATWS), essentially through passive or semi-passive cooling means. A certain level of active systems are not to be excluded, especially to control the initial phase of accidental transients. Sustainability concerns will also be factored into these designs, especially through the use of fast/hardened neutron spectrum and integrated fuel cycle. Economics and non-proliferation will be used as screening criteria. Those design concepts which are deemed of high potential will then be the subject of trade studies where secondary side, balance-of-plant, multifunction usage and size range issues will be considered. Simultaneously, a research and development plan will be drawn up to address the technical issues identified by the exploratory phase. Key among these will be the area of fuel development (WP1.2.2) and high temperature gas systems technology development (WP1.2.3). As the design trade studies are being conducted, parallel design support R&D work and safety support R&D work will be conducted to resolve these key technical issues. At the conclusion of the trade studies, design concepts which are selected will become the subject of a point design characterization effort where key design parameters will be established. The results of the project effort can therefore be utilized in a conceptual design study. To achieve this end goal, it has been mutually decided between CEA and ANL that the optimum R&D route would be to closely integrate the three CEA/ANL work packages into one comprehensive work plan. The three packages are:

(1) WP1.2.1: Advanced Gas-Cooled Reactor Concepts
(2) WP1.2.2: Fuel Development and Associated Fuel Cycle Processes (Treatment and Refabrication)
(3) WP1.2.3: High-Temperature Gas Systems Technology (Postponed for future consideration)