

## Development Plan and R&D Status of China Lead-based Reactor

Yican Wu<sup>1</sup>, Yunqing Bai<sup>1</sup>, Yong Song<sup>1</sup>, Yazhou Li<sup>1</sup>, and FDS Team<sup>1</sup>

*<sup>1</sup>Institute of Nuclear Energy Safety Technology, China*

Chinese Academy of Sciences (CAS) launched an engineering project to develop ADS system and lead-based reactors named China LEAd-based Reactor (CLEAR) series. The Institute of Nuclear Energy Safety Technology (INEST) will be responsible for the CLEAR design and R&D. In this project, CAS plans to develop the lead-based reactors through 3 phases which are 10MWth lead-based research reactor (CLEAR-I), 100MWth lead-based experimental reactor (CLEAR-II), 1000MWth lead-based demonstration reactor (CLEAR-III). As a pre-testing facility, a lead-based zero-power reactor (CLEAR-0) is required to be built before CLEAR-I construction and operation. The new conceptual design of lead-based reactors, including hydrogen production, tritium production for fusion energy and thorium utilization, is also on-going. Lead-lithium cooled fusion reactor blanket design and lead-lithium experimental loops have been developed more than 10 years.

CLEAR series reactor conceptual design has been finished and detailed engineering design for CLEAR-I is underway. The R&D activities for CLEAR reactor including design and safety software, key components, structural materials, lead-based experimental loops and neutronics experimental platform are developing. Series of liquid lead-based experimental loops named DRAGON (Lead-Lithium) and KYLIN (Lead-Bismuth) have already been built or on constructing to performed experiments investigating the structure material corrosion issues and the thermal-hydraulic properties of lead-based coolant. The Highly Intensified D-T Neutron Generator HINEG for neutron experiment and software validation will be constructed. Series advanced reactor design software and nuclear library have been developed for lead-alloy cooled reactor, including CAD-based Multi-Functional 4D Neutronics Simulation System (VisualBus), Monte Carlo Automatic Modeling Program for Radiation Transport Simulation (MCAM), Super Monte Carlo Simulation Program (SuperMC), Nuclear Radiation Virtual Simulation and Assessment Program (RVIS), Neutronics and Thermal-hydraulics Coupling Safety analysis Program (NTC) and Hybrid Evaluated Nuclear Data Library (HENDL). China Low Activation Martensitic (CLAM) steel is being developed and tested in lead-based coolant and neutron irradiation environment are in progress to validate the feasibility using for CLEAR reactor. These experiment devices and the software will support CLEAR design and construction.

In this contribution, the CLEAR series reactor design and R&D activities including development of design and safety analysis software, structural materials, lead-based experiment loops, key components and high intensified neutron source will be presented.