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The zero power CLEAR-0 facility project and future programs

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Lead-based reactor is one of the most promising nuclear energy systems for Accelerator Driven subcritical System (ADS) and Generation-IV reactors. Chinese Academy of Sciences (CAS) had launched a project to develop ADS and lead-based fast reactors technology since 2011. China LEAd-based Reactor (CLEAR) was selected as the reference reactor for ADS and fast reactor system, which was performed by Institute of Nuclear Energy Safety Technology (INEST/FDS Team), CAS. The program consists of three stages with the goal of developing 10MWth lead-based research reactor (CLEAR-I), 100MWth lead-based engineering demonstration reactor (CLEAR-II) and 1000MWth lead-based commercial prototype reactor (CLEAR-III) on each stage. To promote the CLEAR project successfully, INEST places more emphases on reactor design, reactor safety assessment, design and analysis software development, lead-bismuth experiment loop, key technologies and components R&D activities.

Detailed conceptual design of CLEAR-I has been completed and the engineering design is underway, which has subcritical and critical dual-mode operation capability for validation of ADS transmutation system and lead cooled fast reactor (LFR) technology. KYLIN series Lead-Bismuth Eutectic (LBE) experimental loops have been constructed to perform structural material corrosion experiments, thermal-hydraulics tests and safety experiments. The key components including the control rod drive and tested. In order to validate the test and key components and integrated operating technology of lead-based reactor, the lead alloy cooled non-nuclear reactor CLEAR-S, the lead-based zero power nuclear reactor CLEAR-0, the lead-based virtual reactor CLEAR-V and the high intensity neutron generator HINEG are being constructed.

In addition, HINEG and CLEAR-0 are coupled together to form a fusion neutron generator driven zero power subcritical fast reactor (FDS-0). The experiment results from FDS-0 can be used to validate the design and software in ADS and fusion-fission hybrid reactor.

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