

## Recent Progress on Structural Materials Development for China LEAd-based Research Reactor

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### Abstract

China LEAd-based Research Reactor (CLEAR-I) is the first stage of the reference reactor for the ADS (Accelerator Driven subcritical System) program of Chinese Academy of Sciences (CAS). Liquid lead-bismuth eutectic (LBE) is chosen as the coolant, which brings significant challenge to structural materials of CLEAR-I, such as compatibility. Thus, INEST•FDS Team (Institute of Nuclear Energy Safety Technology, CAS) had made great efforts on selection, evaluation and improvement of structural materials for CLEAR-I. The paper presents the main recent progress of these activities and some representative results.

Three main candidate structural materials in CLEAR-I are: 316L for the main vessel and internal structures, 316L/T91 for the heat exchanger and 15-15Ti for the fuel cladding. Besides, an optimized 15-15Ti has been designed and fabricated to improve the service performance in LBE. The fabrication technologies of cladding tubes are being developed and several batches of cladding tubes have been produced. The performance improvement has been preliminarily proved by experiments.

To obtain the corrosion behaviors and mechanical properties of the steels, KYLIN series corrosion loops and series mechanical facilities including slow strain rate tensile (SSRT), creep and fatigue facilities had been developed. A 10000h corrosion test (1m/s,  $1\sim 3 \times 10^{-6}$  wt% oxygen, 500 °C) in KYLIN-II is under way and 7000h has already been reached. The tensile properties and liquid metal embrittlement susceptibility of T91 and 316L steels in LBE had been assessed between 200 and 600 °C. Also, the low cycle fatigue behavior of optimized 15-15Ti steel had been compared in LBE and air at 550 °C.

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