# System Safety Assessment of Generation IV Lead-COOLED Fast Reactor SYSTEMS

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**Abstract**

The Generation IV International Forum (GIF) Lead-cooled Fast Reactor (LFR) provisional System Steering Committee (pSSC) has assessed, in collaboration with the GIF Risk and Safety Working Group (RSWG), the safety characteristics of reference Generation IV LFR systems [1]. The objective was to review and identify the main safety advantages and potential challenges of the technology, to assess the current status of safety-related research and development (R&D) activities, and to identify future R&D needs for LFR systems. The assessments included: (i) a general overview of the safety performance goals; (ii) a historical review of, and feedback from, past construction and operation experiences; (iii) description of the level of ongoing safety-related R&D; (iv) discussion of pathways to achievement of the fundamental safety functions; (v) consideration of approaches for management of design extension conditions; (vi) review of the safety of LFR fuel cycles; and (vii) identification of other risks, including non-radiological risks. In performing these evaluations, the LFR pSSC placed emphasis on the assessment of the fulfilment of the Generation IV goals, to highlight the advantages and potential challenges of LFR technology for future implementation. This paper summarizes results of the assessment, providing also an outlook on further progress and safety-related R&D efforts needed to bring LFR systems to industrial deployment.

## Introduction

The Generation IV International Forum (GIF) Lead-cooled Fast Reactor (LFR) provisional System Steering Committee has conducted an assessment of safety characteristics of Generation IV LFR systems the full details of which are included in [1].

## Safety Assessment report

In the assessment, the four goal areas specified by the GIF were analysed comprehensively with the aim to show how the LFR systems can implement such high-level goal areas through specific aspects of the technology. A historical review of, and feedback from, past construction and operation experiences is followed by the description of the level of ongoing safety-related research and development (R&D) activities. Pathways to accomplishment of the fundamental safety functions in LFRs are further discussed together with consideration given to potential approaches for management of design extension conditions. In addition, the safety-related risks of LFR operations as well as those of LFR fuel cycles are reviewed. Finally, the R&D needs arising from the foregoing analyses are highlighted and the resulting safety-related R&D efforts needed to bring LFR systems to industrial deployment are identified.

The report was prepared in close collaboration with the GIF Risk and Safety Working Group (RSWG) and subsequently reviewed and approved by the GIF Experts Group. The detailed safety-related analysis, assessments and study conclusions are available on the GIF website [1]. These assessments also formed a basis for the formulation of the LFR-specific Safety Design Criteria (SDC), the report of which was issued in March 2021 [2].

As highlighted in the Safety Assessment document, LFR systems offer several safety and performance advantages vis-à-vis the four GIF goal areas. LFR systems specifically benefit from intrinsic characteristics of the coolant (such relative inertness in contact with air and water and high thermal inertia) as well as from the implemented design and safety choices.

In order to further improve safety, reliability and operational performance of LFRs, gaining experience feedback from licensing and operation of LFR demonstration plants is considered essential. A first important step towards this goal has recently been achieved by approval for and initiation of construction of the BREST-OD-300 LFR pilot and demonstration unit in the Russian Federation on 8 June 2021 [3].

## Conclusions

The GIF LFR pSSC conducted a system safety assessment of LFR systems highlighting the attractiveness as well as potential challenges of LFR technology for industrial deployment. Further focus areas for safety-related R&D were also identified in the document. This comprehensive assessment was prepared jointly with the GIF RSWG, and can be consulted by readers on the GIF website [1].

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