## CENTRALIZED FACILITY FOR SPENT FUEL AND WASTE MANAGEMENT: A KEY ENABLER FOR LEAD-COOLED FAST REACTOR DEPLOYMENT IN EUROPE

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The development of Lead-Cooled Fast Reactors (LFRs) within the Small Modular Reactor (SMR) framework is crucial for Europe's transition to low-carbon energy. However, to fully realize their potential, it is essential to enhance existing nuclear infrastructures and safeguards, considering the unique characteristics of these reactors. This study identifies gaps in current nuclear waste management systems and proposes the creation of a centralized spent fuel and waste management facility specifically tailored for LFRs. The management of this facility is paramount as it would oversee the reprocessing of high-plutonium MOX fuels, optimize the secure transport of nuclear fuel to and from the facility, and ensure compliance with international non-proliferation standards. Effective management of this centralized facility will be key to improving logistical efficiency, safety measures, and cost-effectiveness. The research focuses on the strategic deployment of LFRs in Europe. Consolidating reprocessing capabilities within a centralized management framework will reduce operational costs, improve safety protocols, and provide a secure mechanism for managing nuclear waste. The centralized facility is not only essential for ensuring adherence to non-proliferation regulations but also enhances Europe's energy resilience by providing the infrastructure required for safe waste disposal. Moreover, the proposed management of this facility will contribute to optimizing the nuclear fuel supply chain, ensuring that LFRs can operate sustainably and effectively. This infrastructure will allow LFRs to become a key component in Europe's energy transition, supporting the region's clean energy goals and fostering international cooperation. The study concludes that a centralized facility for spent fuel and waste management is key for sustainable and efficient deployment of LFRs while improving economic viability and the overall impact of Europe's nuclear energy strategy.

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