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Environmental Aspects of Recent Trend in Managing Fusion Radwaste: Recycling and Clearance, Avoiding Disposal

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Since the inception of the fusion projects in the early 1970s, the majority of power plant designs have focused on the disposal of the low-level waste in geological repositories as the main option for handling the replaceable and life-of-plant components, adopting the preferred fission waste management approach. It is timely to develop a new radwaste management framework that takes into account the lessons learned from numerous studies and the environmental, political, and present reality. Along with the political difficulty of constructing new repositories worldwide, the current reality suggests reshaping all aspects of handling the continual stream of fusion radwaaste, replacing the disposal option with more environmentally attractive approaches, such as recycling and clearance. These approaches became more technically feasible in recent years with the development of radiation-hardened remote handling (RH) tools and the introduction of the clearance category for slightly radioactive materials by IAEA and national nuclear agencies. We applied all scenarios to selected U.S. fusion studies. While recycling and clearance appeared technically attractive and judged, in some cases, a must requirement to control the radwaste stream, the disposal scheme emerged as the preferred option for a specific IFE component for economic reasons. This suggests that the technical and economic aspects, along with the environmental and safety related concerns, must all be addressed during the selection process of the most suitable waste management approach.

To make fusion a viable energy source with minimal environmental impact, we highly recommend recycling and clearing all fusion components, if economically and technologically feasible, avoiding the geological burial approach. Additional tasks should be investigated to enhance prospects for a successful fusion management scheme. These include the key issues and challenges for disposal, recycling, and clearance, the limited capacity of existing repositories, the status of the recycling infrastructure, the development of advanced RH equipment, the notable discrepancies between the various clearance standards, the need for new clearance guidelines for fusion-specific radioisotopes, the availability of a commercial market for cleared materials, and the acceptability of the nuclear industry to recyclable materials.