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Perspective

Management of Nuclear Waste in Developing Countries

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1. Description

Nuclear waste is generated by any action associated with the nuclear fuel cycle that produces or utilizes radioactive materials. The management of radiation-emitting radioactive material is a serious concern, and it is what distinguishes nuclear waste from other types of waste. The government's approval of nuclear energy is heavily dependent on public promises about the safe disposal of radioactive waste. In comparison to other toxic industrial wastes, not all nuclear wastes are particularly harmful or difficult to manage. From the beginning of our nuclear energy project, safe handling of radioactive waste has been a top priority. A cohesive, complete, and uniform set of principles and standards for waste management is being implemented all across the world in compliance with international criteria. Radioactive waste might be handled in such a way that it did not provide an unreasonable radiation danger to workers, the general public (including current and future generations), or the environment. The management of these wastes includes everything from processing, treatment, conditioning, transportation, storage, and disposal. In India, recent technological advancements have enabled the recovery of valuable radionuclides from radioactive waste for societal applications while also assuring the highest level of safety in radioactive waste management.

Radioactive waste is produced as a result of various nuclear fuel cycle processes, as well as the manufacture and utilization of radionuclides for diverse social uses. Different types of radioactive waste are produced by anthropogenic sources and processing nuclear fuel ore, fabrication of nuclear fuel, generation of electricity in nuclear reactors, processing of spent nuclear fuel, management of radioactive waste, production and use of radionuclides for various industrial and medical applications, research involving radioactive material, and so on. Radioactive waste might be in the form of a gas, liquid, or solid, with varying levels of radioactivity. For a few hours, months, or even hundreds of thousands of years, the waste can be radioactive. Nuclear wastes are categorized as exempt waste, Low and Intermediate level waste, and High Level Waste, depending on the level and nature of radioactivity. Its radioactive danger potential lowers with time-base based on the 1/2 lifetimes of radionuclides contained in the waste,' is the most important and useful attribute of radioactive waste. This distinguishes them from traditional chemical or industrial waste, whose hazard potential or toxicity somehow doesn't change over time and remains constant until it has been transformed into another acceptable form.

Low and Intermediate Level Waste (LILW) radioactive waste has been produced in radioactivity infrastructure and nuclear fuel cycle operations ranging from uranium processing, fuel fabrication, nuclear power plants, research reactors, radiochemical facilities and fuel reprocessing.

LILW contain high volumes and low amounts of radioactivity in general. They are divided into groups based on their physical characteristics, and different management strategies have been developed to treat them effectively. They are further categorized as short lived and long lived wastes depending on their radioactivity as well as the half-life of the radionuclide. Different nuclear power plants generate a significant amount of LILW of various types. During

the recycling of nuclear waste, High Level Radioactive Liquid Waste (HLW) is created, which contains the majority (80%) of the radiation in the entire fuel cycle. The aqueous radioactive waste formed during the first cycle of spent fuel processing is a primary source of this waste. Solid waste that is not acceptable for disposal in near-surface disposal facilities due to excessive concentrations of long-lived radionuclides or decay heat over the permissible limits may also be classified as high level waste. The issue of long-lived radioactive waste has been a hot topic of controversy for nuclear power's development. The need for proper separation from the biosphere and sustained monitoring for long periods of time covering many descendants is therefore factored into future HLW management plans. To achieve this goal in the long run, waste isolation systems with numerous barriers are used to prevent radionuclides from returning to the human environment.

Since the beginning of our nuclear energy program, safe handling of nuclear waste has been a top priority. An exceptional track record for safe treatment of radioactive waste in India has been proved for more than five decades as a result of tough design with 'defense in depth' concept, well-established methods, and safety evaluation by independent agency. Consistent R&D efforts have enabled the indigenous development of novel processes and technologies in the field of radioactive waste management, as well as their deployment to achieve waste volume minimization, effective isolation of radionuclide in engineered matrix, discharge minimization, and waste extraction wealth by separating useful radionuclide from radioactive waste for societal applications. As a result of these accomplishments, the country is now a global leader in the field of nuclear waste management.