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A Review of Radioactive Waste Management

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Abstract: *Radioactive waste is the waste that is left out after use of radioactive materials in nuclear reactors , during the production of nuclear weapons. Since, exploitation of radioactive materials was done on a large scale in the past few decades which resulted in production of tremendous amount of radioactive waste, radioactive waste management is a necessary step to deal with it. If not properly disposed, irradiation from radioactive waste will cause serious problems to humans and to the environment t. While preparing this paper sincere effort was taken to give succinct account of:1. radioactive waste generation in different parts of the world. 2. Classification. 3. Processing. 4. Storage & Treatment of radioactive waste.*

Keywords*— HLW, LLW, Radioactive waste, spent nuclear fuel.*

I. INTRODUCTION

The Radioactive wastes entail radioactive materials which are usually by-products of nuclear power generation and other applications of nuclear fission or nuclear technology, used in fields such as research and medicine. Radioactive waste is deleterious to most forms of life as well as the environment, and is regulated by government agencies in order to protect human health and the environment.

1.1 GENERATION OF RADIOACTIVE WASTE

Radioactive waste is generated from a number of sources like nuclear fuel cycle and nuclear weapons reprocessing, medical wastes, industrial wastes, as well as naturally occurring radioactive materials (NORM). Amongst all these nuclear fuel cycle and nuclear weapons produce majority of waste.In nuclear fuel cycle radioactive waste is generated in front end as well as at back end of the cycle.

1.2 TYPES OF RADIOACTIVE WASTE

There are five general types of radioactive waste according to The Environmental Protection Agency (EPA) which are as follows:

1.2.1 Low-level waste (LLW)-contaminated industrial waste.

1.2.2 Transuranic waste (TRUW) from the production of nuclear weapons.

1.2.3. Uranium mill tailings from mining and milling of uranium ore.

1.2.4. Spent nuclear fuel (SNF) from reactors and High-level waste (HLW) Spent reactor fuel and other highly radioactive wastes generated at reprocessing plants.

1.2.5. Naturally occurring radioactive materials (NORM)

1.2 CLASSIFICATION OF RADIOACTIVE WASTE

Classification of radioactive waste differs from country to country. However, The INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) which publishes the Radioactive Waste Safety Standards (RADWASS), has classified the radioactive waste into six categories which are as follows:

A.Exempt waste (EW)

Exempt waste contains radioactive materials at a level which is not considered harmful to people or the surrounding environment. It consists of small concentrations of radio nuclides that it does not require provisions for protection from radiation. It consist material such as concrete, plaster, bricks, metals produced during operations on nuclear power sites. Such materials are not harmful and hence do not require disposal facility for it.

B. Very short lived waste (VSLW)

Very short lived waste (VSLW) has radio nuclides of very short half-life. This type of waste is harmful for short period of time as it undergoes radioactive decay in short period of time. Such waste is stored until the activity falls to level of exempt waste where it is not harmful to an environment. Radioactive waste from industrial and medical applications which usually has short half-lives is examples of very short lived waste.

C. Very low level waste (VLLW)

The waste which arises from the operation and decommissioning of nuclear facilities with levels of activity concentration in the zone near or slightly above the levels specified for the clearance of waste material from regulatory control is called as VLLW. Waste with such a limited hazard, which above or close to the levels for exempt waste, is termed very low level waste. Safety from radiations of such waste is achieved by its safe disposal in engineered surface landfill type facilities.

D. Low level waste (LLW)

Low level waste (LLW) is generated from hospitals and industry, as well as the nuclear fuel cycle which mainly comprises of paper, rags, tools, clothing, filters, reactor water treatment residues, medical tubes, injection needles, syringes, etc. It contains mostly short-lived radioactive material in very small amount. It does not require shielding during handling and transport and is suitable for shallow land burial

E. Intermediate level waste (ILW)

Intermediate level waste is defined as waste containing long lived radio nuclides in quantities that need more isolation from the environment and generally require shielding. For example, the reactor's metal cladding, resins, chemical sludge is classified as intermediate-level waste. Disposal of ILW is carried out at a depth ranging from a few tens to few hundred of meter.

F. High level waste (HLW)

High-level waste, such as that produced from reprocessing of spent nuclear fuel, accounts for just 3% of the volume, but 95% of the radioactivity, of the world's radioactive waste. High-level waste (HLW) is generated from the uranium fuel and transuranic elements present in the nuclear reactor core.

2.METHODOLOGY

The basis of radioactive waste management is not difficult. Although, radioactive materials become less radioactive over a given time, the best way to dispose radioactive waste is to store them till they lose their radioactivity. Different radioactive materials have different half-lives, implying different storage times.For example, cobalt-60, a radioactive isotope having a half life of 5 years has been used widely in medical field for cancer treatment. Thus, 2 pounds of radioactive cobalt-60 five years later would decay to a one pound. 1. Filtering.

2. Routing through demineralizers,

3. Boiling off the water leading to evaporation which leaves solid particles which are further treated as solid radioactive wastes.

4. Storing the liquid for a specific time thereby allowing Decay in storage (DIS).

2.1 STORAGE AND DISPOSAL OF RADIOACTIVE WASTE

A. Deep geological repository

A deep geological repository is provided beneath the ground level so as to provide storage for the HLW and to ensure safety from the radiations which can be deleterious to humans. By providing such a facility it is made sure that the storage of radioactive waste is not affected by the human activity. It consists of a series of barriers naturally existing or technical built.

B. Spent fuel pool (SFP)

Spent fuel pools contain thermally controlled water, since, water serves as a natural and effective barrier to radiation [9]. As a result, spent fuel generated from nuclear fuel cycle is stored in these pools.When the spent fuel is removed from the reactor to be exchanged with new fuel, it is required that it is stored for a period of.

C. Dry Cask Storage

After the HLW is cooled inside the spent fuel pool the radioactive waste is transferred to dry cask storage at the ground level. Casks are fabricated with steel which are either welded or bolted closed. The fuel rods inside are surrounded by inert gas. Ideally, the steel cylinder provides leak-tight containment of the spent fuel. Each cylinder is surrounded by additional steel, concrete, or other material to provide radiation shielding to workers and people moving around it. Some Casks can be used for transportation as well storage purposes.

D. Ducrete

Depleted uranium concrete (DUCRETE) was developed at Idaho National Engineering and Environmental Laboratory (INEEL) [10] to restrain the neutrons emitted from materials of spent fuel pool and High level wastes, as a neutron shield.

2.3 TREATMENT OF RADIOACTIVE WASTE

A. Radioactive waste Transmutation

In simple words, radioactive waste transmutation is method in which radioactive isotopes are converted into non radioactive isotopes. One example of radioactive waste transmutation is the radioactive isotope of iodine-129 which is a long lived and requires difficult disposal strategies.

3.FIGURES

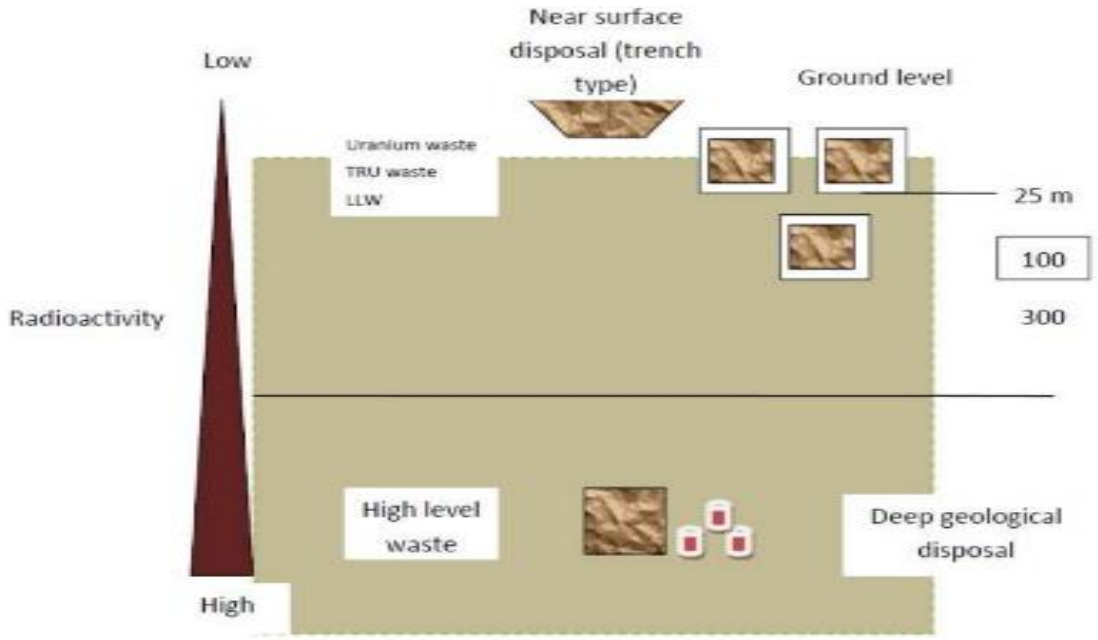

Fig 1. DESPOSAL OF REDIOACTIVE WASTE

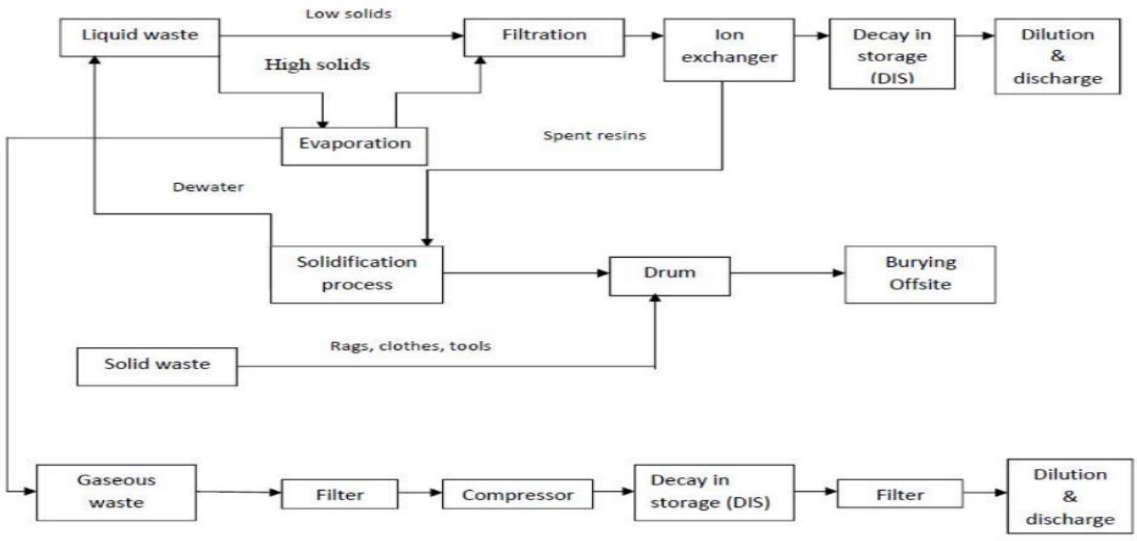

Fig 1. FLOW OF REDIOACTIVE WASTE FILTERATION

4. CONCLUSION

Radioactive waste must be diligently identified, classified, stored, transported, and disposed off after treatment. With the growth in number of nuclear reactors and mass production of nuclear weapons in different parts of the world, the radioactive waste generation has seen a significant increase. It is important to reduce the radioactivity of the high level waste which can be achieved by nuclear transmutation

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