Review on Research of Nuclear Waste Disposal

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Abstract- *Nuclear power is characterized by a very large amount of energy available from a very small amount of fuel. the amount of nuclear waste is relatively small much of it is highly radioactive and must therefore be carefully managed as hazardous waste. The problems and solutions of nuclear waste disposal are becoming a major concern in the 21st Century. Many nuclear power plants particularly in the developed countries around the world are nearing the end of their operating lives. Nuclear power is the only energy industry which takes full responsibility for all its wastes. The cost of waste disposal is included in the cost of the power produced.*

Nuclear waste comprises a variety of materials requiring different types of management to protect people and the environment. One of the factors in managing nuclear wastes is the time that they are likely to remain hazardous. This depends on the kinds of radioactive isotopes in them and particularly the half-life characteristic of each of those isotopes. The half-life is the time it takes for a given radioactive isotope to lose half of its radioactivity.

The disposal of high-level nuclear waste [1-3] is gaining a new momentum [4] due to the need for more electricity with minimal emission of CO2 and other greenhouse gases to limit global warming.

Keywords- Radioactive waste, nuclear waste, nuclear fuel cycle, waste disposal

I. INTRODUCTION

Nuclear Waste

Nuclear waste is the material that nuclear fuel becomes after it is used in the reactor. Before Producing power the fuel was mostly uranium or thorium, oxygen and steel. The waste sometimes called spent fuel is dangerously radioactive and remains for thousands of years .In the practice the spent fuel is never unshielded. It is kept underwater because water is an excellent shield for a few years until the radiation decays to levels that can be shielded by concrete in large storage casks. The final disposal of this spent fuel is a hot topic and is often an argument against the use of nuclear reactors. That include deep geologic storage and recycling. The sun would consume if we could get into space but since rockets are costly we cannot afford to risk atmospheric dispersal.

II. CLASSIFICATION

Nuclear waste is classified into several types as follows

- Low level waste (LLW)
- Intermediate level waste (ILW)
- High level waste (HLW)

Low-level waste

Low-level waste (LLW) is generated from hospitals and industry as well as the nuclear fuel cycle. It comprises paper, rags, tools, clothing, and filters which contain small amounts short-lived radioactivity. It does not require shielding during handling and transport and is suitable for shallow land burial. To reduce its volume, compacted or incinerated before disposal. It comprises some 90% of the volume but only 1% of the radioactivity of all radioactive waste..

Intermediate-level waste

Intermediate-level waste (ILW) contains higher amounts of radioactivity and some requires shielding. It include resins, chemical sludge's and metal fuel cladding as well as contaminated materials from reactor decommissioning. Smaller items and any non-solids may be solidified in concrete or bitumen for disposal. By the definition radioactive decay generates heat of less than about 2 kW/m^3 so does not require heating in disposal facilities.

High-level waste

High-level waste (HLW) arises from the burning of uranium fuel in a nuclear reactor. It contains the fission products and transuranic elements generated in the reactor core. It is highly radioactive and hot due to decay heat so requires cooling and shielding. It has thermal power above about 2 kW/m^3 and can be referred as the ash from burning uranium. It accounts for over 95% of the total radioactivity produced in the process of electricity generation. There are two distinct kinds of HLW.The volume of nuclear waste produced by the nuclear industry is very small compared with other wastes generated. nuclear power generation facilities produce about 200,000 m^3 of low- and intermediate-level radioactive waste and about 10,000 m^3 of high-level waste including used fuel designated as waste.

In the Standard country, the total amount of radioactive waste is about 4.7 million m^3 or around 5 million tones. The most important problem for the nuclear industry is managing their toxic nature in a way that is environmentally sound and presents no hazard to both workers and the general public.

III. METHODS OF NUCLEAR WASTE STORAGE INCLUDE

1. Short Term Storage
2. Long Term Storage
   a) Space
   b) Under the sea bed and
   c) Large stable geologic formations on land.
3. Transmutation.

1. Short Term Storage of Nuclear Waste

Radioactive material decays in an exponential fashion. Short-term storage will reduce the radioactivity of spent nuclear fuel significantly. Ten-year storage can bring a 100 times decrease in radioactivity. reduction of radioactive emissions similar to that of the first ten years which would take another hundred years of storage. Storing the waste for at least ten years is better. The reduction in radioactivity during short-term storage makes handling and shipment of the waste much easier. After short term storage the waste will be sent for transmutation or long-term storage.

2. Long Term Storage for High Level Radioactive Waste

There are some methods of significantly reducing the amount of high level radioactive waste, some are the high level radioactive waste must end its journey in long term storage because of long term refers to a security of the radioactive waste must be assured over geologic time periods. The waste must not be allowed to escape to the outside environment by any accident, malicious action, or geological activity. This includes accidental uncovering, removal by groups intending to use the radioactive material in a harmful manner, leeching of the waste into the water supply and exposure from earthquake or other geological activity.

The problem arises some of this waste is plutonium, and other actinide elements produced as byproducts of uranium fission. These elements are not only highly radioactive but highly poisonous. The toxicity of plutonium is among the highest of any element known.

Areas currently being evaluated for long-term storage of nuclear waste are:

a) Space
b) Under the sea bed and
c) Large stable geologic formations on land.

a) Disposal of Nuclear Waste in Space

Outer space is the most appropriate long-term storage option for high-level nuclear waste. This indicates that its safe removal from humans regardless of the activities of nature or man on earth. Delivery of the waste into space has a crippling drawback .the rocket used to deliver the waste into space to provide enough power to escape the earth's gravity. This is necessary for two reasons: a) to leave the waste in orbit creates space garbage and b) the large delivery rocket would be expensive and an accident during launch.

b) Storage of Radioactive Waste in the Sea Bed

A possibility for long-term storage on the earth is burial in the seabed. The rock formations in the seabed are more stable than those on land reducing the risk of exposure.

Table 1 shows Heavy metal composition of 4.2% enriched nuclear fuel before and after running for about 3 years.Minor actinides include neptunium, americium

	Charge	Discharge
Uranium	100%	93.4%
Enrichment	4.20%	0.71%
Plutonium	0.00%	1.27%
Minor Actinides	0.00%	0.14%
Fission products	0.00%	5.15%

c) Long Term Storage of Radioactive Waste on Land

Long term storage in tectonically stable rock formations on land is the better solution for high level radioactive waste. The radioactive material may be vitrified and buried in caverns created in a large rock formation. When use of the storage area is complete that are sealed again with stone. While still extremely expensive and considerably unsafe , this is the most viable storage option currently available. Using methods that reduce the amount of radioactive waste could further enhance safety levels…

IV. RECYCLING USED FUEL

Any used fuel contain some of the original U-235 as well as various plutonium isotopes which have been formed inside the reactor core. In total these account for some 96% of the original uranium and over half of the original energy content reprocessing, undertaken in Europe and Russia separates this uranium and plutonium from the wastes so that they can be recycled for re-use in a nuclear reactor. Plutonium arising from reprocessing is recycled through a MOX fuel fabrication plant where it is mixed with depleted uranium oxide to make fresh fuel European reactors currently use over 5 tons of plutonium a year in fresh MOX fuel. major commercial reprocessing plants operate in France, UK, and Russia with a capacity of some 5000 tons per year A new reprocessing plant with an 800 ton /year capacity at Rokkasho in Japan is undergoing commissioning.

V.CONCLUSION

Over last twenty years radioactive waste disposal techniques are changed regularly. Evolving environmental protection considerations have provided methods to improve disposal technologies. Designs for new disposal facilities and disposal methods must meet environmental protection and pollution prevention standards that are stricter than were foreseen at the beginning of the atomic age. Disposal of radioactive waste is a complex issue because of the nature of the waste and strict structures for dealing with radioactive waste. All different types of country achieved self-reliance in the management of all type of radioactive waste. Decades of safe and successful operation of our waste management facility stand to prove international standards and we are trying to upgrade our technology to minimize radioactive discharge.

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