



## Nuclear Waste Facility at the Kudankulam

**For Prelims:** Away From Reactor (AFR) facility, Kudankulam Nuclear Power Project (KKNPP), nuclear waste, radioactive pollution (spread of radioactivity), effects of radioactive pollution on Health.

**For Mains:** Nuclear Disaster, Effects of radioactive pollution on Health.

### Why in News?

- Recently, the **Kudankulam Village Panchayat** has passed a resolution against the construction of the '**Away From Reactor (AFR) facility**' at the **Kudankulam Nuclear Power Project (KKNPP)** site for storing **nuclear waste**.
- Earlier, the state government (Tamil Nadu) had **also opposed such construction**.
- The village panchayat is of the view that the AFR site would lead to **radioactive pollution (spread of radioactivity)** and **spoil the groundwater**, which is used for drinking water and irrigation.



### What is an AFR site?

- The scheme for the storage of spent fuel in a nuclear power plant is **two-fold**:
  - One facility is located within the **reactor building/service building**, generally known as the **spent fuel storage pool/bay**.

- Another is located away from the reactor, called the **Away From Reactor (AFR) Spent Fuel Storage Facility, but within the plant's premises.**
- The spent fuel storage pool inside the reactor building has a **limited capacity** and is **used for immediate storage of the spent fuel** removed from the **reactor during refueling.**
- The fuel remains in the pool initially for a few years for it to be **cooled sufficiently before it is shifted to the facility.**
- The AFR Spent Fuel Storage Facility is functionally similar to the 'Spent Fuel Pool' inside the reactor building, **except in terms of capacity.**

## What are the Arguments of the Union Government?

- The proposed AFR facility at KKNPP reactors 1 and 2 is for storage of **spent fuel only and not for storage of nuclear waste, as perceived by a few.**
- The design ensures that there **would not be any adverse impact of the facility** on the personnel, the public and the environment.
- The radiation dose on account of AFR to the **public would be negligible,** even [when] compared to the **exposure from natural radiation** background sources like soil, sun etc.
- This has been established at the **Tarapur and Rawatbhata sites, where AFRs** have been in operation for many years.

## What is Radioactivity?

- Radioactivity is the phenomenon of **spontaneous emission of particles** or waves from the **unstable nuclei of some elements.**
- There are three types of radioactive emissions: **Alpha, Beta and Gamma.**
  - **Alpha particles are positively charged** He (Helium) atoms, **beta particles are negatively charged electrons** and **gamma rays are neutral electromagnetic radiations.**
- Radioactive elements are naturally found in the earth's crust.
  - **Uranium, thorium and actinium** are **three NORM (Naturally Occurring Radioactive Materials)** series that contaminate water resources.
- A small amount of radiation is found in nature **but the extended amount of radiation is harmful to human health.**
- Radioactivity is measured in **Becquerel (SI unit) or in Curie.**
- The unit **Sievert measures the quantity of radiation** absorbed by human tissues.

PYQ

To meet its rapidly growing energy demand, some opine that India should pursue research and development on thorium as the future fuel of nuclear energy. In this on text, what advantage, does thorium hold over uranium? (2012)

1. Thorium is far more abundant in nature than uranium.
2. On the basis of per unit mass of mined mineral, thorium can generate more energy compared to natural uranium.
3. Thorium produces less harmful waste compared to uranium.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (d)

## What are Sources of Radioactivity?

### ▪ Natural:

- **Radiotoxic Elements in Aquatic System:** Radium, a descendant of the NORM series, is **one of the radiotoxic elements** found in aquatic systems and can be penetrated into groundwater via:
  - **aquifer rock dissolution**
  - **decaying of  $^{238}\text{U}$  and  $^{232}\text{Th}$ ,**
  - **desorption processes.**
  - Radium is a radionuclide formed by the decay of uranium (U) and thorium (Th) in the environment.
- **Magma:** Sometimes, magma also releases radioactive gases into the environment.
- **Soil Sediments:** Percolation of NORM from the soil sediments to the aquifer causes groundwater contamination.
- **Atmospheric Deposition of Cosmogenic Radionuclides:**
  - Atmospheric deposition (both dry and wet) of cosmogenic radionuclides add radioactive nuclei in the surface water.
  - Cosmogenic radionuclides are **radioactive isotopes** which are produced by natural processes and distributed within the Earth system.

### ▪ Anthropogenic:

- **Nuclear Reactors and Warheads:**
  - Nuclear reactors and nuclear warhead experiments are the key sources of human-induced radionuclides discharge.
  - Nuclear reactors produce **radioisotopes (Cobalt-60, Iridium-192, etc)** that hand out as sources of gamma radiation in radiotherapy and numerous industrial appliances.
  - Nuclear power plants placed at the coastal regions **add to the radiological contaminants in the marine water by releasing atomic wastes.**
    - Water is also used as coolants in these powerhouses, which also get contaminated.
- **Dumping of Radioactive Waste:**
  - The application of radioactive elements in **nuclear weapons, X-rays, MRI and other medical equipment** causes their exposure to human beings. Dumping of these radioactive wastes in surface water bodies causes water pollution.
- **Mining:**
  - Mining activities of radioactive elements like uranium and thorium also pollute surface and groundwater.
- **Nuclear Accidents:**
  - Radioactive pollution due to nuclear submarine accidents and sinking have been reported.
  - The **Rocky Flats plant in Colorado, Fukushima and the Chernobyl nuclear disaster** are some examples of such nuclear accidents.

## What are the effects of radioactive pollution on Health?

### ▪ Radiation Syndrome:

- Human tissues absorb radiation through polluted water and foodstuff, which can cause serious health risks.
- High doses of radiation can cause acute radiation syndrome or dermal radiation injury.

### ▪ Disorders in Human Physiology:

- Exposure to radiation causes various disorders in human physiology, including cancer, leukemia, genetic mutations, cataracts, etc.

### ▪ Mutation and Structural Alteration:

- Genetic effects ionizing radiation induces mutations in germ cells (male sperm cells and female egg cells), resulting in structural alteration in germ cell DNA that is passed onto offspring.
- **Hereditary disorders** can lead to premature death and severe mental illness.

Which among the following has the world's largest reserves of Uranium? (2009)

- (a) Australia
- (b) Canada
- (c) Russian Federation
- (d) USA

Ans: (a)

**Source: TH**

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