# Topics Covered

- Nuclear Power Plant Safety
- Byproduct of nuclear power generation
- Economics of nuclear power plant
- Nuclear power plant in India
- Future of nuclear power

# Introduction

## Main Sources of Radioactive Contamination

Three main sources of radioactive contamination are:

- **Fission** of nuclei or nuclear **fuels**
- The **effect** of **neutron fluxes** *(number of neutrons travelling through a unit area in unit time)* on the **heat** carried in the primary cooling system and on the ambient air.
- **Damage** of **shell** of fuel elements

All the above can cause health hazards to workers, communing and natural surroundings.

# Nuclear Power: Clean & Green

# What about Nuclear Reactor Accidents??

*Nuclear disaster due to Great Tohoku Earthquake - 2011, Japan*

*Nuclear disaster at* Chernobyl *- 1986, Russia : 16000 People Died*

# Safety Measures for Nuclear Power Plants

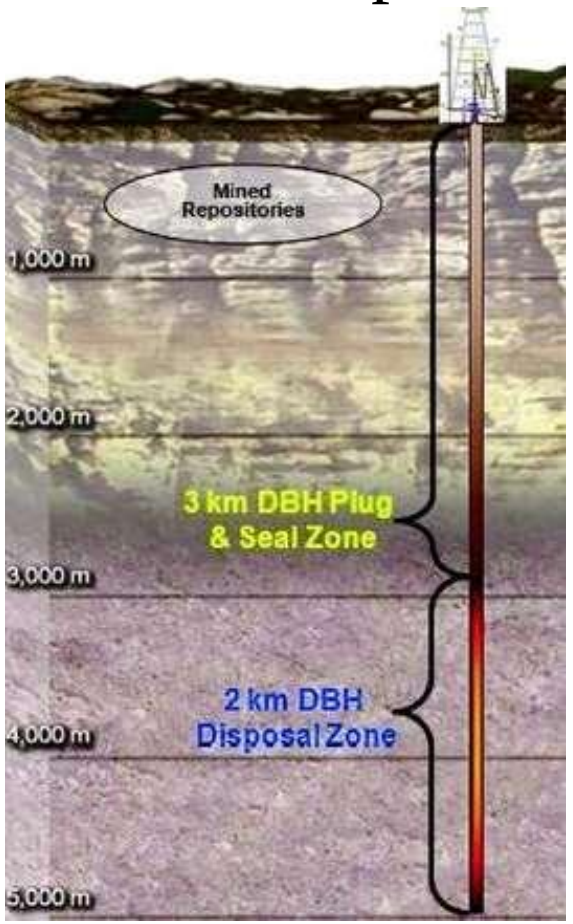
- A nuclear power plant should be constructed **away** from human habitation ( exclusion zone of 160km radius)
- The materials used for construction should be of **required standards.**
- Waste **water** should be **purified**.
- Should have a proper safety system, **plant** could be **shut down** when required.
- Regular **periodic checks** to be performed to evaluate not to exceed the permissible radioactivity value
- While **disposing** off the **wastes** it should be ensured that it doesn't contaminate the **river or sea**.

# Nuclear Waste Disposal

## Geological Disposal

- The process of geological disposal centers on burrowing nuclear waste into the ground to the point where it is out of human reach.

- The waste needs to be properly protected to stop any material from leaking out. Seepage from the waste could contaminate the water table if the burial location is above or below the water level. Furthermore, the waste needs to be properly fastened to the burial site and also structurally supported in the event of a major seismic event, which could result in immediate contamination.



# Reprocessing

- Reprocessing has also emerged as a viable long term method for dealing with waste. As the name implies, the process involves taking waste and **separating** the **useful components** from those that aren't as useful. Specifically, it involves taking the **fissionable material** out from the irradiated nuclear fuel.

## Transmutation

- Transmutation also poses a solution for **long term disposal**. It specifically involves converting a **chemical element** into another **less harmful one**.
- Common conversions include going from **Chlorine to Argon or from Potassium to Argon.**
- The driving force behind transmutation is chemical reactions that are caused from an outside stimulus, such as a proton hitting the reaction materials.

**Natural transmutation :** can also occur **over a long period** of time. Natural transmutation also serves as the principle force behind **geological storage** on the assumption that giving the **waste enough isolated time** will allow it to become a non-fissionable material that poses little or no risk

# Byproduct of Nuclear Generation

- The Nuclear plants supply many by-products like isotopes which have many useful applications in our day-to-day life.
- The radioactive isotopes are widely used in **Biology**, **Medicine,** Agriculture and **Industries**.

| Isotopes | %Yield | Half-life | Type of Radiation | |
|---|---|---|---|---|
| | | | Beta MeV | Gamma MeV |
| Cesium—137 | 6.22 | 33 years | 0.5, 1.2 | None |
| Barium—137 | 6.22 | 2.6 mins. | None | 0.658 |
| Strontium—90 | 5.3 | 28 years | 0.605 | None |
| Cerium—144 | 5.28 | 285 days | 0.351 | None |
| Praseodymium—144 | 5.28 | 17.3 minutes | 3.02 | 0.2 |
| Zirconium—95 | 6.39 | 65 days | 0.391, 1.0 | 0.915 |
| Niobium—95 | 6.39 | 35 days | 0.15 | 0.76 |
| Technetium—99 | 6.19 | $2.1 \times 10$ years | 0.295 | None |
| Promethium—147 | 2.61 | 2.5 years | 0.219 | None |