## Nuclear Energy





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## Nuclear Energy

#### **Nuclear Technology**

Nuclear technology uses the energy released by

splitting the atoms of certain elements.

• It was first developed in the 19405, and during the

Second World War research initially focused on

producing bombs.

• In the 1950s attention turned to the peaceful use of

nuclear fission, controlling it for power generation.



#### Sustainable Energy (Nuclear Energy)

- Nuclear energy is energy in the nucleus (core) of an atom.
- Atoms are tiny particles that make up every object in the universe.
- There is enormous energy in the bonds that hold atoms together.
- Nuclear energy can be used to make electricity. But first the energy must be released.
- It can be released from atoms in two ways:
- 1. nuclear fusion
- 2. nuclear fission

#### **Nuclear fission**

- Certain naturally occurring and man-made heavy elements, for example uranium and plutonium, are relatively unstable.
- When the nucleus of any such element is impacted by a neutron which it absorbs, it can fission, or split into two fragments, releasing at the same time two or three <u>neutrons and energy</u>.
- The total mass of the products of the reaction (fission products and neutrons) is minutely less than the original mass of the atom and impacting neutron, the difference having been converted into energy according to

Einstein's famous formula  $\mathbf{E} = \mathbf{mc}^2$ . [Video 2]



#### A typical fission reaction

#### **Nuclear fusion**

 Nuclear fusion is a process of combining light nuclei to form more massive nuclei with the release of energy. This process takes place continuously in the universe. (Video 2)



**Example:** The nuclei of two isotopes of hydrogen, one (deuterium) having one neutron and one proton, and the other (tritium) having two neutrons and one proton, combine to form helium and a neutron, releasing energy in the process.

### **Nuclear energy applications**

Nuclear energy, which uses radioactive materials, has a variety of important uses in electricity generation, medicine, industry, agriculture, as well as in our homes.

- 1. Electricity Generation. (Video 3)
- 2. Medical applications
- 3. Industrial Applications
- 4. Applications in Consumer Products
- 5. Agricultural Applications
- 6. Environmental Applications
- 7. Archaeological Applications





# Nuclear Accidents

## 1. Chernobyl disaster

• one of the most heinous

nuclear disasters in northern Ukraine - Russia in April1986.

36 died and 2,000 were injured.



## 2. Hiroshima, Japan

• On Honshu Island, in 1945, by bomb,

which contains 36 grams of uranium.

- Its explosive power is 20,000 tons.
- As a result, between 100,000 and

150,000 people died, and about 100,000

others were injured, destroying 60,000

people from Hiroshima.



## 3. The Goiania incident

- In central Brazil in 1987.
- It killed 4 people and injured
   28 others and more than 200
   cases of radiation poisoning.
- It is one of the worst nuclear disasters in the world, as described by Time Magazine.



## 4. Nagasaki – Japan

In 1945, when the United States of America dropped an atomic bomb on the city of Nagasaki, and this was the most important event in the Second World War, which led to huge losses materially and humanly.



5. The Tokimura nuclear accident, the worst in Japan's history, occurred in September 1999 in a uranium processing center in the town of Tokaimura, north of Tokyo, when radiation leaked due to the loss of control over some of the reactors, killing two workers and evacuating thousands of residents from nearby areas.

6. The Fukushima disaster - Japan in 2011 in March occurred as a

result of the 9 Richter earthquake, after which 10 km were evacuated around the station site after the death of 15 thousand people and 1,600 others during the evacuations. Within a year.

### 7. Three-mile island

In March 1979 in the state of Belsaphania, America - Dauphin County, and occurred as a result of a partial nuclear fusion in a nuclear reactor, and its costs amounted to about one billion dollars.



**8. Banbury Test** December 1970, Nevada, USA, results in 86 radiation factors and 80,000 units of radioactive iodine 131 release

9. The Lucence reactor - Switzerland in 1962, and the reactor was destroyed due to an accident as a result of the loss of the coolant, and this led to radioactive contamination with the cave in which it was built.

### 10. The Kiachti - Soviet Union "Russia" catastrophe.

In 1957, the reservoir cooling system containing nuclear waste

was disrupted, the temperature rose, and the explosion

released a lot of nuclear radiation.

## Environmental Impacts of Nuclear Energy

#### **Environmental Impacts of Nuclear Power**

- The rods need to be changed periodically. This has impacts on the environment due to disposal of nuclear waste.
- 2. The reaction releases very hot waste water that damages aquatic ecosystems, even though it is cooled by a water system before it is released.
- 3. Uranium (fuel used in nuclear power stations) mining can cause high levels of pollution in the surrounding environment, as well as posing health risks for mine workers.

- 4. Transport of uranium and nuclear fuels carries potential pollution and environmental contamination risks.
- 5. The radioactive waste produced in nuclear power plants remains highly toxic for centuries.
- 6. Waste (such as cooling water) from nuclear power and fuel reprocessing plants can cause radioactive pollution in the surrounding environment.
- 7. The cost of Nuclear Power generation must include the high cost of disposal of its waste and the decommissioning of old plants.

- Nuclear accident can be devastating and the effects last for long periods of time.
- 9. While it does not pollute air or water routinely like oil or biomass, a single accident can kill thousands of people, make many others seriously ill, and destroy an area for decades by its radioactivity which leads to death, cancer and genetic deformities for generations.
- 10. Land, water, vegetation are destroyed for long periods of time.



## **Nuclear Safety**

Nuclear safety covers the whole life cycle of a nuclear installation. It includes:

- nuclear reactor safety
- nuclear fuel safety
- nuclear waste management and

decommissioning and emergency preparedness.



## References

- 1. <u>http://www.nnr.co.za/what-is-nuclear-energy/</u>
- 2. Nuclear Energy Today Book, 2003. OECD Publications.