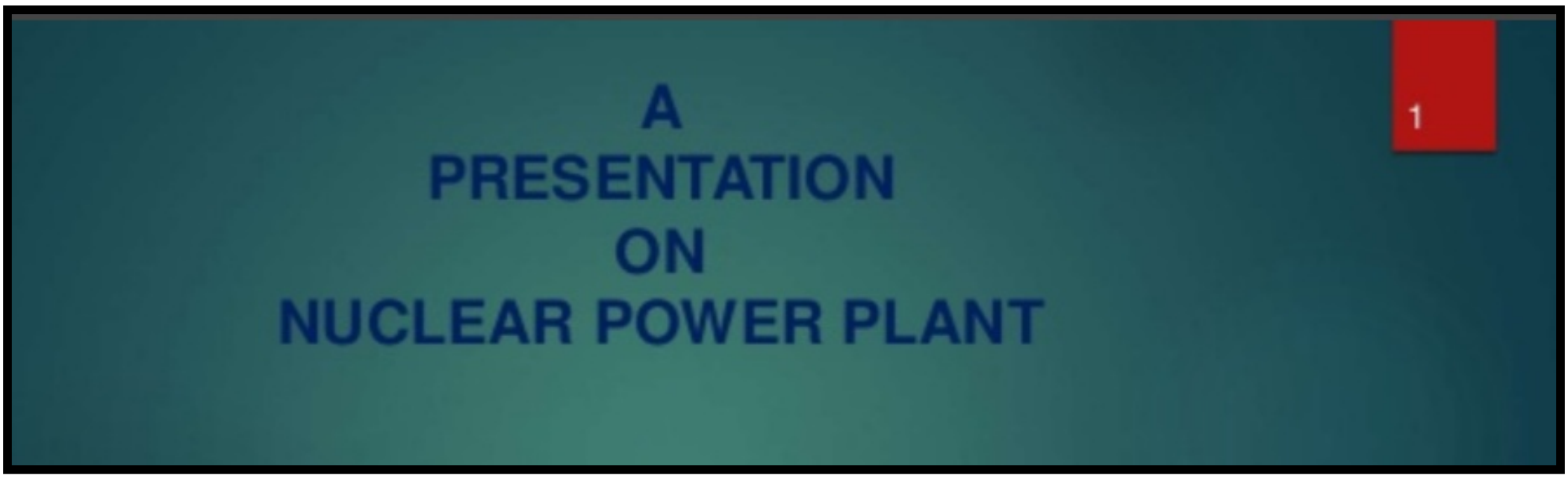
A
PRESENTATION
ON
NUCLEAR POWER PLANT
1

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- NUCLEAR FUEL.
- NUCLEAR FISSION.
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- NUCLEAR REACTOR.
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HISTORY OF NUCLEAR POWER-PLANT:-

FIRST NUCLEAR POWER-PLANT

- Electricity was generated for the first time ever by a nuclear reactor on December 20, 1951 at the EBR-I experimental station near Arco, Idaho in the United States.

- On June 27, 1954, the world's first nuclear power plant to generate electricity for a power grid started operations at Obninsk, USSR.

- The world's first commercial scale power station, Calder Hall in England opened in October 17, 1956.

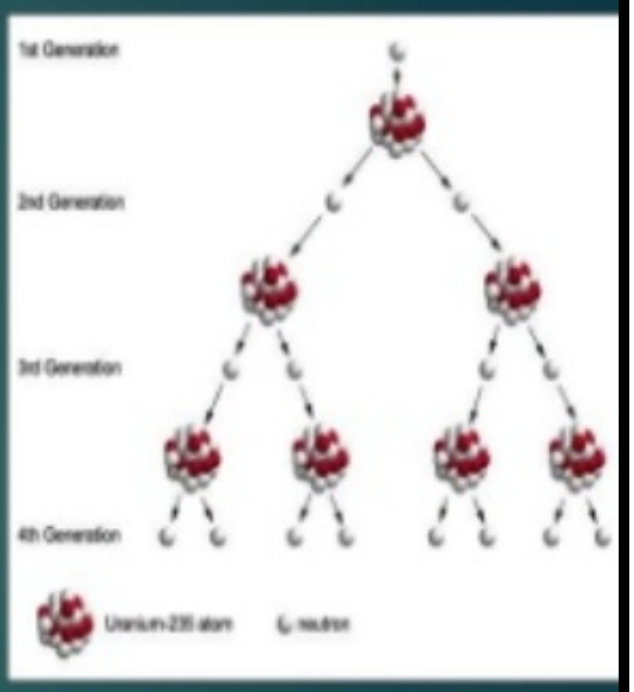
NUCLEAR FUEL

- Nuclear fuel is any material that can be consumed to derive nuclear energy. The most common type of nuclear fuel is fissile elements that can be made to undergo nuclear fission chain reactions in a nuclear reactor.

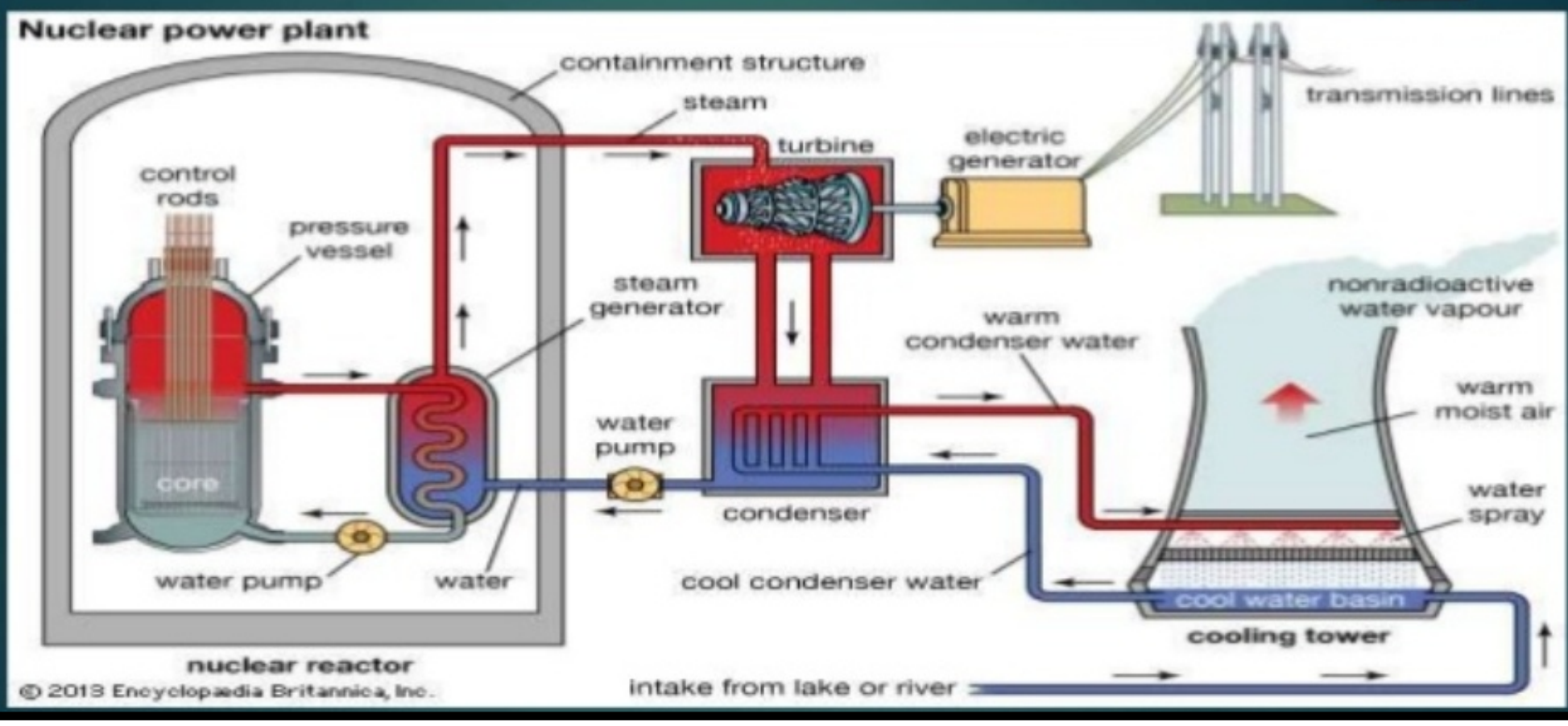
- The most common nuclear fuels are 235U and 239Pu. Not all nuclear fuels are used in fission chain reactions

NUCLEAR CHAIN REACTION

- A chain reaction refers to a process in which neutrons released in fission produce an additional fission in at least one further nucleus. This nucleus in turn produces neutrons, and the process repeats. If the process is controlled it is used for nuclear power or if uncontrolled it is used for nuclear weapons
- **U235 + n → fission + 2 or 3 n + 200 MeV**
- If each neutron releases two more neutrons, then the number of fissions doubles each generation.



REACTOR


Nuclear power plant
containment structure
steam
turbine
electric generator
transmission lines
control rods
pressure vessel
steam generator
warm condenser water
nonradioactive water vapour
warm moist air
water pump
core
condenser
water spray
water pump
water
cool condenser water
cool water basin
cooling tower
nuclear reactor
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intake from lake or river

COMPONENTS OF A REACTOR

1. Control Rods

- Control rods made of a material that absorbs neutrons are inserted into the bundle using a mechanism that can rise or lower the control rods.
- The control rods essentially contain neutron absorbers like, boron, cadmium or indium.

2. Steam Generators

- Steam generators are heat exchangers used to convert water into steam from heat produced in a nuclear reactor core.
- Either ordinary water or heavy water is used as the coolant.

COMPONENTS OF A REACTOR

3. Steam Turbine

- A steam turbine is a mechanical device that extracts thermal energy from pressurized steam, and converts it into useful mechanical.
- Various high-performance alloys and super alloys have been used for steam generator tubing.

4. Coolant Pump

- The coolant pump pressurizes the coolant to pressures of the order of 155bar.
- The pressure of the coolant loop is maintained almost constant with the help of the pump and a pressurize unit.

COMPONENTS OF A REACTOR

5. Feed Pump

- Steam coming out of the turbine, flows through the condenser for condensation and recalculated for the next cycle of operation.
- The feed pump circulates the condensed water in the working fluid loop.

6. Condenser

- Condenser is a device or unit which is used to condense vapor into liquid.
- The objective of the condenser are to reduce the turbine exhaust pressure to increase the efficiency and to recover high quality feed water in the form of condensate & feed back it to the steam generator without any further treatment

COMPONENTS OF A REACTOR

7. Cooling Tower

- Cooling towers are heat removal devices used to transfer process waste heat to the atmosphere.
- Water circulating through the condenser is taken to the cooling tower for cooling and reuse

TYPES OF NUCLEAR REACTOR

- Reactors can be heterogeneous or homogeneous. A heterogeneous reactor has a large number of fuel rods with the coolant circulating around them and carrying away the heat released by nuclear fission. In a homogeneous reactor, the fuel and moderator are mixed, e.g. A fissionable salt of uranium like uranium sulphate or nitrate dissolved in the moderator like H2O Or D2O.

------TYPES:------

a) Boiling water reactor (BWR)
b) Pressurized water reactor (PWR)
c) Pressurized heavy water reactor (PHWR)
d) High-temperature gas-cooled reactor reactor (HTGR)
e) Liquid-metal fast breeder reactor (LMFBR)
f) Show turbine/generator plant common to all types

HOW A NUCLEAR REACTOR WORKS

- 235U fissions by absorbing a neutron and producing 2 to 3 neutrons, which initiate on average one more fission to make a controlled chain reaction
- Normal water is used as a moderator to slow the neutrons since slow neutrons take longer to pass by a U nucleus and have more time to be absorbed
- The protons in the hydrogen in the water have the same mass as the neutron and stop them by a billiard ball effect
- The extra neutrons are taken up by protons to form deuterons
- 235U is enriched from its 0.7% in nature to about 3% to produce the reaction, and is contained in rods in the water
- Boron control rods are inserted to absorb neutrons when it is time to shut down the reactor
- The hot water is boiled or sent through a heat exchanger to produce steam. The steam then powers turbines

FLOWCHART OF ATOMIC ENERGY COMMISION IN INDIA

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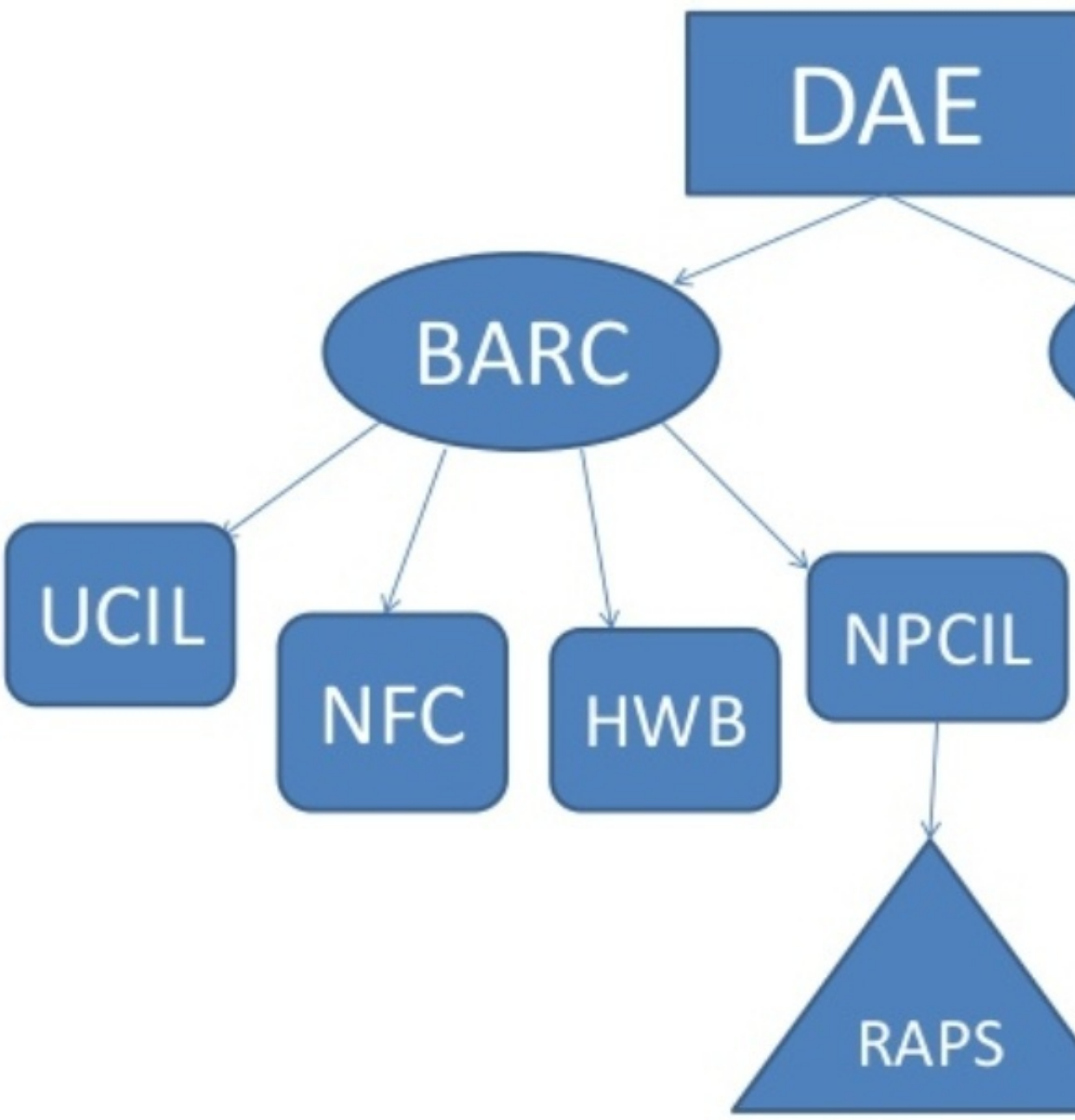

THESE UNITS ARE FURTHER GOVERNED BY ORGANISATION OF "ATOMIC ENERGY REGULATORY BOARD" (AERB)

Nuclear (Atomic) Power Plant… 15

❑ Advantages of Nuclear power plant:

- Space required is less when compared with other power plants.
- Nuclear power plant is the only source which can meet the increasing demand of electricity at a reasonable cost.
- A nuclear power plant uses much less fuel than a fossil-fuel plant.
  1 metric tonne of uranium fuel = 3 million metric tonnes of coal = 12 million barrels of oil.

❑ Disadvantages of Nuclear power plant:

- Radioactive wastes must be disposed carefully, otherwise it will adversely affect the health of workers and the environment as a whole.
- Maintenance cost of the plant is high.

NUCLEAR POWER IN INDIA

- Nuclear power is the **fourth-largest** source of electricity in India after thermal, hydroelectric and renewable sources of electricity.
- As of 2017, India has 25 nuclear reactors in operation in six nuclear power plants, generating 4,780 MW while five other plants are under construction and are expected to generate an additional 3,153 MW.
- India's nuclear power industry is undergoing rapid expansion with plans to increase nuclear power output to 64,000 MW by 2032. The country is involved in the development of nuclear fusion reactors through its participation in the ITER project and is a global leader in the development of thorium-based fast breeder reactors.