CAN NUCLEAR PLANTS FACE THE ENERGY CHALLENGE OF THE XXIST CENTURY?

How does a nuclear reactor work? (video1)

Most nuclear reactors are essentially high-tech kettles that efficiently boil water to produce electricity. They rely on harnessing nuclear fission, which also yields heat and sends neutrons flying. If another atom absorbs one of those neutrons, the atom becomes unstable and undergoes fission itself, releasing more heat and more neutrons. The chain reaction becomes self-sustaining, producing a steady supply of heat to boil water, drive steam turbines and thereby generate electricity in the alternator.

Most nuclear reactors use uranium fuel that has been "enriched" in uranium 235, an isotope of uranium that fissions readily. In uranium ore, Uranium 238 is much more abundant than uranium 235 but does not fission well, so fuel manufacturers boost the uranium 235 content to maintain a continuous fission reaction and generate electricity.

Fission and fusion (see doc.2 on the verso)

Fission occurs when a neutron slams into a larger nucleus, forcing it to excite and split into two smaller nuclei - also known as fission products. Additional neutrons are also released and can initiate a chain reaction. When each atom splits, a tremendous amount of energy is released. Uranium and plutonium are most commonly used for fission reactions in nuclear power reactors because they are easy to initiate and control.
Fusion occurs when two nuclei slam together to form a heavier nucleus. This is the same process that powers the sun and creates huge amounts of energy - several times greater than fission. It also doesn't produce highly radioactive fission products. Fusion reactions are being studied by scientists, but are difficult to sustain for long periods of time because of the tremendous amount of pressure and temperature needed to join the nuclei together.

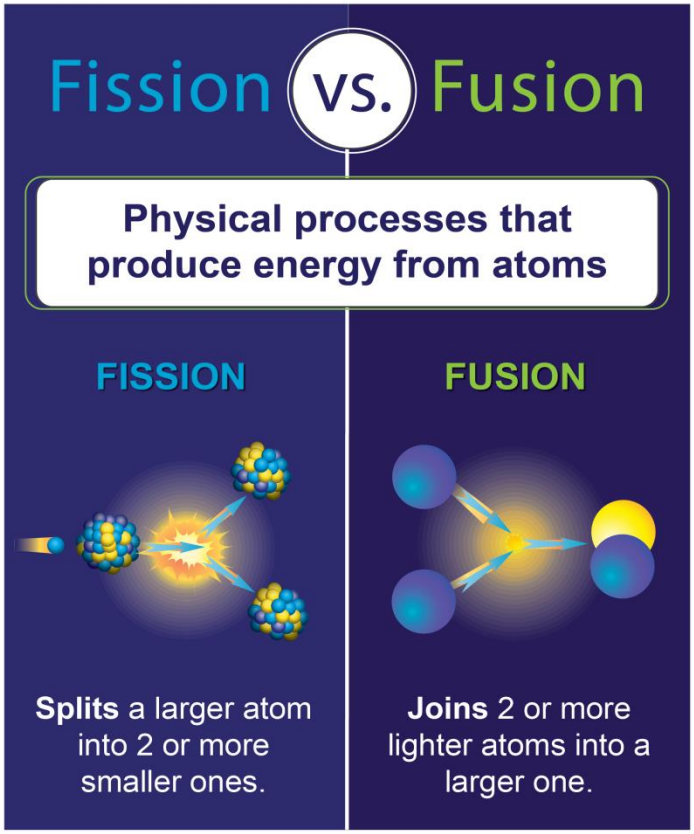
International Thermonuclear Experimental Reactor (video3)

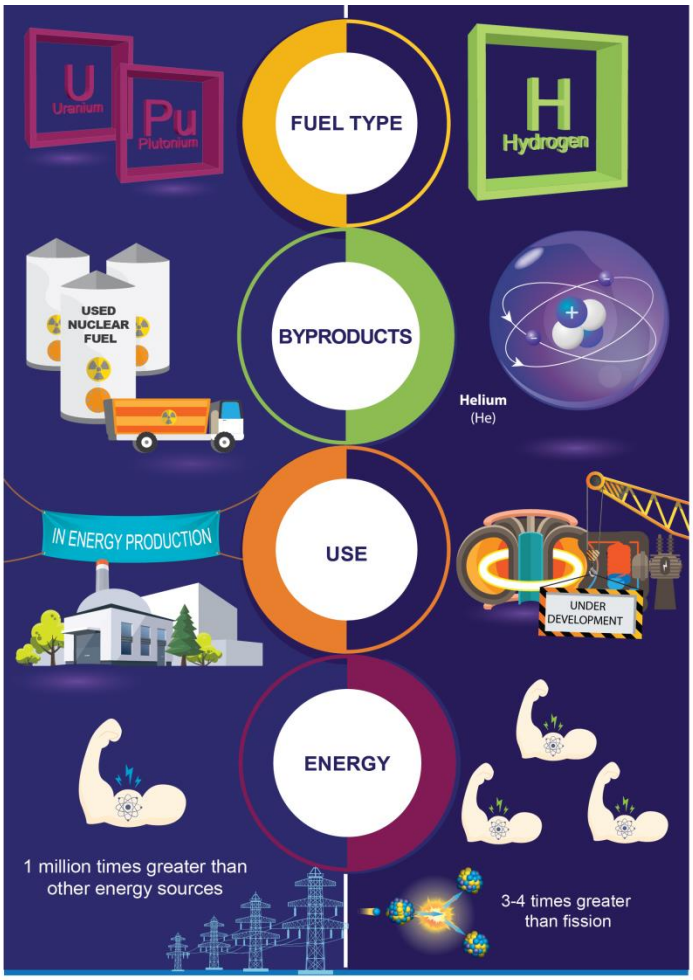
ITER is an international nuclear fusion research and engineering project, which is currently building the world's largest and most advanced experimental nuclear fusion reactor at Cadarache in the south of France. The project is funded and run by seven member entities - the European Union (EU), India, Japan, the People's Republic of China, Russia, South Korea and the United States. The reactor itself has been designed to produce 500 megawatts of output power for 50 megawatts of input power, or ten times the amount of energy put in. The machine is expected to demonstrate the principle of getting more energy out of the fusion process than is used to initiate it, something that has not been achieved with previous fusion reactors. Construction of the facility began in 2007, and the first plasma is expected in 2025.

Questions:

1. Introduce and comment on this documents.
2. How do we produce electricity in nuclear power plants? (a description of all the steps is expected)
3. Describe and compare fission and fusion reactions in terms of process, energy and byproducts.
4. What are the differences between a traditional nuclear plant and ITER?
5. Can nuclear energy face the current energy challenge?

Doc.2





Video 1 : Nuclear Reactor - Understanding how it works

https://www.youtube.com/watch?v=cf4m9ES4dPY

Video 3 : ITER and fusion Energy

https://www.youtube.com/watch?v=mZsaaturR6E