ENVIRONMENTAL ASSEMBLY (UNEA)

Topic 3: improving the efficiency and safety of nuclear energy generation

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1. Definition of Key Terms

Nuclear fission: a nuclear reaction in which the nuclei of heavy chemical elements (such as uranium-235 and plutonium-239) decay into nuclei with lower atomic numbers and therefore less mass, releasing large amounts of energy and radioactivity.

Criticality: Critical does not mean that control is lost, but the exact opposite: "criticality" is the condition in which the chain reaction of nuclear fissions can self-sustain

European Atomic Energy Community (Euratom): set up at the same time as the EEC, it is intended to coordinate the research programmes of the Member States relating to nuclear energy and to ensure its peaceful use. it is unlimited, and Euratom retains a different legal personality from the European Commission

Internacional Atomic Energy Agency (IAEA): an autonomous intergovernmental agency founded on July 29, 1957, to promote the peaceful use of nuclear energy and prevent its use for military purposes, including use for the development of nuclear weapons.

World Association of Nuclear Operators (WANO): established in 1989, it aims to promote a safety culture and professional development for operators working in the nuclear energy sector.

Canada Deuterium Uranium (CANDU): a series of natural uranium-fueled nuclear reactors moderated with heavy water. This type of reactor consists of a tank or vessel containing a cold heavy water moderator at atmospheric pressure. The tank is penetrated by a zirconium alloy pressure tube containing natural uranium fuel, through which heavy water coolant is circulated.

2. Introduction

Nuclear energy is an alternative form of power that is based on nuclear fission and fusion. Recent studies have examined how this energy can be harmful and dangerous for the human population and the environment. Several countries have taken different paths and responded differently to this issue. New technologies and constant research, however, are allowing us to make this energy more sustainable and less harmful to human life, and to exploit a new source of energy.

3. Timeline of Events

1895: Roentgen discovers X-rays

1896: Becquerel discovers spontaneous emission of light from a uranium salt

1898: Curies identify 2 radionuclides, coined the word “radioactive”

1909: Rutherford found that most of the mass is concentrated in small atomic nuclei

1920: Rutherford theorizes the “neutron”

1932: Chadwick identifies neutrons

1938: Hann and Strassman split uranium atoms by neutrons, Meitner and Frisch explain what happens and call it “nuclear fission”

1939: Fermi and Szilard measured neutron multiplication and conclude that a nuclear chain reaction was possible

1942: Fermi succeeds in the first nuclear chain reaction

1951: EBR-1 reactor to produce electricity first in Arco

1954: Soviet Obnisk reactor becomes the first commercial nuclear power plant

1957: Shippingport reactor starts operation, first commercial nuclear power plant

1974: French Prime Minister Messmer launches a large-scale nuclear power program in response to the oil crisis.

1986: EBR-ll reactor shows advanced Sodium cooled reactors can be shut down passively without backup systems

1986: The Chernobyl reactor suffers from a large power excursion that results in the release of large amounts of radiation. More than fifty firefighters die, and up to 4,100 civilians are estimated to die from early cancer

2004: after a long period of deadly power generation in the United States, there was talk of a nuclear renaissance, and talks of building more reactors to offset CO2 emissions

2011: In Fukushima, Japan, four reactors exploded due to an earthquake and tsunami, there were no deaths, and the area was evacuated

4. Background Information

Humans have used nuclear energy to exploit it or as a means of meeting their needs by building nuclear reactors since the mid-1990s, or as a weapon of mass destruction potentially lethal to humans.

Nuclear reactors

Nuclear reactors are classified into several different types depending on the type of coolant that is used, for example, water, gas, liquid metals and molten salts. and also according to the moderator. Moderator materials are substances capable of slowing down neutrons, favouring fissions, the main ones being water and graphite. Some reactors do not use moderator materials, called "fast reactors"; thanks to these main features we can divide nuclear reactors into four different generations:

- **First generation**: they were the prototypes of reactors. The first-generation reactors were inefficient and in most cases had a short operational life, but they were mostly proof of concept: they served, that is, to demonstrate that the design was functional (the 50s and early-60s).
- **Second generation:** born in the late 60s, and ended in the 80s. The most common designs of the second generation were pressurized water and boiling water designs. 3600 MW models were designed (today the most powerful reactors reach 1750 MW, just under half). Unfortunately, these

reactors had safety problems, which will make them dangerous (Chernobyl result).

- **Third generation:** The third-generation reactors are structurally the same as the second generation ones, but are more secure.
- **Fourth generation:** It is the most modern generation and aims at the development of nuclear power plants and innovations, such as the recycling of nuclear waste.

During the 1950s, there was little mistrust of nuclear energy, despite the Second World War ending with a devastating atomic attack that killed thousands of people. Humanity saw nuclear power plants as a gold mine to be mined, regardless of the potential risks they may bring to society in the future. After the 1986 Chernobyl disaster, many countries began to close many nuclear power plants. Some countries, such as Italy and Austria, decided, thanks to the approval of several referendums, to completely remove nuclear power plants from their country, and the first anti-nuclear movements began to emerge. Not all countries decided to phase out nuclear power, and those that continued construction focused on improving the safety of their power plants, such as France. China, Russia, and the United Kingdom are also targeting this field. After the disaster in the following 25 years, work was done on safer reactors (third generation), and countries such as America and India continued to build power plants. but in 2011 due to the Fukushima disaster in Japan, many countries abandoned the development of nuclear energy, such as Germany which pledged to close all its plants by 2022.

Because of these two serious accidents in the history of nuclear power, people have always kept a certain distance from nuclear power and gradually created a movement against the construction of power plants. They are beginning to analyze not only risks such as hazards and radioactivity but also benefits such as CO2 reduction. This will enable, among other things, high energy production without the need for fossil fuels. All this has led to a much-discussed debate all over the world, and even today there is discussion about its potential and its fatalities.

5. Major Countries Involved

- **France:** France currently has the highest share of nuclear-derived electricity in the world, accounting for 68% of its total electricity generation in 2021. Globally, the share of nuclear energy in electricity production was 9.8%, and in all EU member states, except France, this share was 14%. French Prime Minister Mesmer starts a huge nuclear power program responding to oil shocks. 75% of the electricity in 2004 came from nuclear.

- **China:** as of October 2010, the country has four nuclear power plants in operation, for a total of 13 reactors in operation and two under construction. In addition, 10 new nuclear power plants will be built with a total of 22 reactors. China is one of the countries with the most stable growth in electricity generation, with electricity demand nearly tripling over the past decade, demand increasing by 5% to 6% annually and installed capacity expected to add 874 GW annually.

- **The United States:** In 2016, US nuclear power generated 19.5% of all electricity produced in the country. The United States is now the first country in the world to install a nuclear power plant, with 99 reactors with a total capacity of over 101 GW, generating an average of 800 TWh annually, or about 20% of the country's electricity.

- **India:** In 2011, India's nuclear power generated 3.7% of the country's total electricity production. As of September 2010, it has 6 operating nuclear power plants in the country, for a total of 19 reactors in operation and 1 under construction. Power generation in India is primarily coal-based, with nearly 70% of production growing rapidly. India's nuclear power development has been characterized by independence and self-sufficiency, mainly due to the non-ratification of the 1970 Nuclear Non-Proliferation Treaty, which excluded the country from international nuclear development agreements.

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