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Subject We just learned that global climate change is linked to the burning of fossil fuels. One alternative source of energy is nuclear energy. How do nuclear power plants work? What is the chemistry taking place inside a nuclear reactor? What are the dangers of nuclear energy and how can they be lessened?

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**Nuclear energy - the clean but radioactive alternative to burning fossil fuels.**

The burning of fossil fuels is an essential aspect of global climate change. It is therefore necessary to expand the existing alternative energy sources, taking into account their efficiency and safety. Nuclear energy is a particularly controversial alternative because, on the one hand, it can significantly reduce air pollution in the context of direct energy generation, but on the other hand it involves the risk of possible radioactive contamination. In order to be able to assess nuclear energy as an alternative energy source, it is necessary to know how a nuclear power plant works.

How do nuclear power plants work?

A nuclear power plant essentially consists of a nuclear part, in which heat is generated by nuclear fission, and the conventional part, in which the heat is converted into electricity. The conventional part is just like the traditional coal and gas power plants. The big difference, however, is that it produces neither air pollutants nor greenhouse gases when it generates heat.

With the energy that is released when atomic nuclei split, water is heated under high pressure. This creates water vapor that drives a steam turbine that is connected to a generator. This generator generates electricity that is fed to consumers via the power grid. (Swissnuclear 2018).

What is the chemistry like in a nuclear reactor?

In the nuclear section, the reactor core, which consists of long fuel elements, is located in a thick-walled reactor pressure vessel made of steel. These fuel elements in turn consist of bundles of thin fuel rods in which the nuclear fuel is in the form of small tablets containing uranium. Nuclear fission takes place in the fuel rods, which are sealed airtight, producing heat. (Swissnuclear 2018).

“The proton-rich uranium isotope 235 plays a central role. The uranium isotope 235 has the peculiarity that it is in two atomic nuclei when one adds such a neutron to it. The result of this split are two positively charged fissure nuclei that feel abstract because of the Coulomb force. The kinetic energy that controls it belongs to 80 to 90 percent of the energy released by a nuclear fission. In addition to the two fission nuclei in the nuclear fission, another two to three neutrons. These split further uranium isotopes 235, distinguish even more neutrons and energy are released.” (Kernspaltung o. J.).

What are the dangers of nuclear energy and how can they be reduced?

Nuclear fission is an extremely efficient method of generating energy. But it is criticized because of the possible risks. The radioactive radiation released during nuclear fission is dangerous, so appropriate protective measures must be taken. Even small amounts of radiation can change the genetic material in the cells. Radioactive radiation can also cause malformations in newborns. Higher doses of radioactive energy kill cells directly. In order to reduce the dangers, nuclear power plants are equipped with special safety devices.

Thick concrete walls prevent radioactive radiation from entering the vicinity of the nuclear power plant in the event of an accident. (Kernspaltung o. J.).

However, the risks of radioactive contamination are more likely to be viewed as a consequence of a catastrophic cause that is unlikely to occur in normal operation. The greatest risk are natural disasters or terrorist / military attacks. In the past there have been disasters that have had global effects (Chernobyl / Fukushima). In Chernobyl, serious construction defects and deficits in the safety culture were the cause of the disaster. In Fukushima, an earthquake triggered the disaster.

Safety deficiencies and construction errors can be classified as human error and can be reduced by various measures (for example the principle of multiple eyes). Natural disasters, on the other hand, cannot be foreseen, but can be reduced by theoretically running through possible events and developing appropriate security concepts. Risks cannot be completely avoided, but they can be reduced to a minimum!

The transport and storage of nuclear waste also pose a major challenge. Since reactor components and burned-out nuclear fuel continue to emit radiation for several thousand years, particularly safe storage is required. (Kernspaltung o. J.).

Kernspaltung (o. J.): in: *https://www.verivox.de/strom/themen/kernspaltung/*, [online] https://www.verivox.de [01/14/2021].

Swissnuclear (2018): in: https://www.kernenergie.ch/de/so-funktioniert-ein-kernkraftwerk.html, [online] https://www.kernenergie.ch/de/so-funktioniert-ein-kernkraftwerk.html [01/12/2021].