**PAESTA Podcast Series -- You Asked, We Answered!**

**What is the role of water at a nuclear power plant?**

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Hello my name is Duane Belgrave, Jr and I am thankful to be a part of the PAESTA Podcast Series. I am also here to answer a very important question: what is the role of water at a nuclear power plant? When we hear the words ‘nuclear power plant’, our minds tend to automatically think about glowing radioactive elements and dramatic nuclear meltdowns. This is not a wrong thing to think about, as these two things actually do apply--well, hopefully not the nuclear meltdown part. Moving on, many people are unaware of how water plays a large role in the production of nuclear energy--in fact, the process would cease to function apart from the presence of water. Therefore, by the end of this podcast, you will know the role of water in a nuclear power plant.

Before understanding the role of water at a nuclear power plant, you need to have a rudimentary knowledge of how nuclear power works--you must know the basics. Most nuclear reactors use an element called uranium as a main power source. Uranium isotopes are used because they are highly radioactive, or prone to release the energy stored in its nuclear bonds. Because they want to be stable, uranium isotopes constantly give off nuclear energy in a process called radioactive decay. Unfortunately, this radioactive decay occurs too slowly to be used at an energy source, so scientists have learned to quicken the breakdown of nuclear bonds in a process called fission. Therefore, uranium isotopes are spun around at an intense velocity in a centrifuge. Here, neutrons are thrown from one uranium isotope and collide into the neutrons being thrown from other uranium isotopes, thus releasing more energy. This centrifuging process is called enrichment, which has to occur at a certain rate for optimum energy release [3]. This is where water comes in. Water is pumped in and out of the nuclear reactor vessel to regulate the speed of the enrichment process. Furthermore, once the water makes contact with immense amount of heat energy being released, it turns into steam. This steam then exits the reactor through a tube, which takes the steam and pushes it through a turbine. The turbines spin rapidly, thus producing electricity [3]. Here, we see that if water was not present in the nuclear energy process, the enrichment would not occur at the proper rate. If uranium isotopes were not enriched, electricity would not be produced.

It is important to note that there are two main types of nuclear reactors. The first type is called a pressurized water reactor. Pressurized systems rely on water under pressure to produce the heat to make electricity. In a pressurized system, uranium fuel rods are inserted into a steel pressure tank that contains water. The water acts as a coolant, but it also moderates the enrichment process. The control rods are then slowly pulled out. The reaction produces heat, which heats the water in the pressure tank. The water is heated to a temperature of five hundred and eighteen degrees Fahrenheit (which is two hundred and seventy degrees Celsius). The water does not boil, though, because it is under intense pressure. Therefore, the heated water is then channeled to a heat exchanger in a closed circuit. The water in the heat exchanger is then heated up, producing steam [2]. This steam then goes through a turbine, producing electricity.

The next type of nuclear reactor is called a boiling water reactor. This system is far more efficient. Fuel rods are placed into a chamber that contains the reactor core: this chamber is located at the bottom of a tank of water. Once the nuclear reaction begins, the water is boiled until it turns to steam. The steam rises to the top of the chamber where pipelines then take it to the turbines [2].

Water is also used to cool the high-temperature steam that is used to turn the turbines. There are three methods that are used to cool the steam within a nuclear power plant: “once through”, indirect, and dry cooling. “Once through” cooling operates as extremely large volumes of water are run through a condenser to cool the steam; then, the water is released back into a body of water. Indirect cooling uses a water condenser as well as an air tunnel to cool the steam. Lastly, dry cooling utilizes only moving air to cool the steam [4].

Water is a finite source which the masses are competing over. It is used in many industries such as drinking, sanitation, irrigation, and energy. Nuclear energy uses slightly more water than its fossil fuel counterparts per megawatt-hour basis. However, it uses considerably less water than geothermal and concentrating solar sources [1].

Now you know how important water is to the inner workings of the nuclear power plant! I’m Duane Belgrave, Jr from Penn State Brandywine and I would like to thank you for listening to this podcast. Have a great day!

References

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