Controlled Nuclear Fusion
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Review Sheet

We are experiencing an energy crisis due to our worldwide inefficient use of energy. Problems range from burning fossil fuels (increase of CO_2 in atmosphere) to excessive energy consumption and affect us in such areas as the economy and politics. One solution to our current energy crisis is the implementation of controlled nuclear power. This can come in the form of nuclear fusion or fission.

In a nuclear fusion reaction, two light atomic nuclei fuse together in order to form a heavier nucleus, and releasing a large amount of energy in the process. This type of energy is the same that powers the sun as well as hydrogen bombs. The energy essentially is the steam produced by the heat, which powers a turbine in a generator. The advantages of nuclear fusion include the abundance of resources (deuterium, litium) found in earth's water and crust, the relative safety of nuclear fusion reactions, and the environmental advantages. Disadvantages and difficulties include the extremely high amount of energy necessary to engender these reactions (expend more energy than yield), the ability to contain a fusion reaction, as well as the high monetary expense.

Nuclear fission is another possible provider for nuclear power. Nuclear fission occurs when a heavy nucleus is split into smaller parts (of Uranium 235, Plutonium 239, or Uranium 238). Nuclear fission causes a release of neutrons and results in a lighter nucleus. Fission produces large amounts of electromagnetic radiation and kinetic energy. However, it produces much more radioactive waste than fusion and the possibility of a chain reaction could cause a nuclear meltdown. Fusion also yields more energy than the process of fission.

There are nuclear power projects currently underway, the largest being the Joint European Torus (JET). It is a man-made magnetic confinement plasma physics experiment, located in the United Kingdom. The JET facilities include plasma heating systems capable of delivering up to 30 megawatts of power.

It would be ideal to begin now using the powerful, clean energy of nuclear fusion, but a practical fusion plant remains decades away. The cost of building and maintaining sites to house fusion reactions is rocket-high, and potential risks for scientists are prohibitive (plasma becomes radioactive with time and must be replaced). In addition, no one has managed yet to contain the ultra-hot plasma for long enough to sustain a fusion reaction that generates more energy than it expends. It is difficult to find materials suitable for reactors that will withstand temperatures approaching the sun. While fusion could be the solution to our energy crisis and eliminate our dependence on disappearing fuels, we have a long way to go before we can use and manage it.