# Decisions Made and the Consequences of Chernobyl

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## Decisions Made and the Consequences of Chernobyl

On the morning of April 26, 1986, all was quiet in the village of Pripyat, Ukraine until a large blast shook the ground and sent flames high into the air in an event that would shape the continent onward. A major accident had just occurred at the Chernobyl nuclear power station's number-4 reactor during a routine low-power test. The RBMK-1000 was one of the latest feats of engineering lighting up the countryside of the former Soviet Union, and it powered numerous homes and factories for a large area of Northern Ukraine. An RBMK-1000 reactor puts out 3,200MW of thermal energy and 1,000MW of electrical energy (Mikhail V. Malko, 2009), enough to power a small city continuously. Such power stations must be monitored continuously to prevent accidents and malfunctions which could lead to loss of power or a meltdown of the reactor. On April 26, 1986, poor ethical judgements and complacency turned the Chernobyl power station's number-4 reactor into a burning pile of rubble spreading nuclear ash across the continent.

## RBMK-1000 and the Principles of Nuclear Reactors.

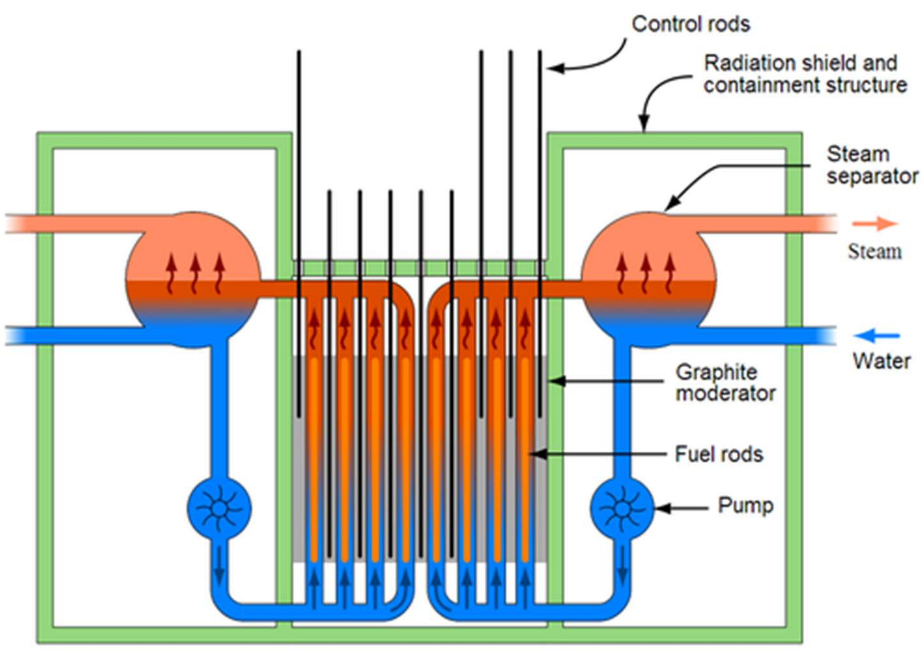
Even the most advanced modern nuclear reactors operate on the principle of harvesting energy. A radioactive material, such as Plutonium (Pu) or Uranium (U), is placed in a cluster. The cluster of radioactive material generates a significant amount of heat energy because of radioactive decay. Radioactive materials emit Alpha, Beta, gamma, and neutrino energy occasionally as a result of their atomic structure being unstable. If a cluster of heat-generating nuclear material were amassed, it would quickly become very hot and begin a nuclear meltdown. A meltdown would irradiate everything in the vicinity and would not be very efficient at producing energy for a reactor. To combat this heat generation, water and neutron-moderating materials must be used in tandem to slow down or speed up the reaction.

**Stabilization of a Nuclear Reaction**

Known as neutron absorbers, rods of graphite surround the rods of nuclear material in an RBMK-1000 reactor and are a critical component in the regulation of the nuclear reaction. Neutron absorbent materials slow neutrons produced by the nuclear fuel and allow the reaction to be accelerated or slowed. If the nuclear material is surrounded by neutron absorbers the reaction speeds up, but as the neutron absorbers are taken away the reaction slows down again. Finally, water is run over the mass of neutron absorbers and nuclear material. The reaction heats the water, and the water may be pumped away to generate steam and electricity. An RBMK-1000 reactor works on this simple principle and this can be seen in Figure 1. The diagram illustrated by Figure 1 shows a side view of the reactor core; showing the directions the various rods and fluids may move.

**Figure 1**

*Diagram of an RBMK-1000 Reactor (Energy Education, 2018)*



The four RBMK-1000 reactors of Chernobyl must have a constant supply of electricity to keep water flowing. This flow reduces the heat generated by the reactors and must be kept constant. In addition to flowing water, the graphite control rods are used to slow down the heat generation of the radioactive rods.

## An Explosion at the Number-4 Reactor, Chernobyl

On the morning of April 26, 1986 a test was being conducted on the number-4 reactor, which would simulate a loss of power to the plant. During an emergency, the plant may receive power from the electrical grid, as well as diesel generators, to help deal with whatever problem the reactor may have. The generators take thirty seconds to spin up and this test was to simulate the power grid going down and the plant having to rely on its generators to restart the reactor. Due to decisions made by the supervisors and complacency, very few control rods were inside of the core.

Due to operator error, the power level of the reactor dropped to only 1% of its normal levels. This was unexpected, and to combat this almost all the control rods were removed with the minimum amount required to be in the reactor being thirty. The operators deemed that the reactor was ready to undergo the test. As power levels rose, they did not stop. The flow of water to the reactor was reduced significantly, and the reactor quickly spiked to 100x its normal power levels. The steam generated by the heat resulted in a steam explosion which blew off the lid of the reactor and started a nuclear fire that would irradiate much of the area.

## What can be Learned

The unfortunate accident that irradiated many people, fauna, and flora in Ukraine could have been prevented if the operators that night had listened to the automated warnings given by the reactor control system. Many reservists of the Soviet military were brought in against their wills with inadequate radiation protection. The region suffered widespread radiation contamination. To meet power quotas ad deadlines standards were lifted with no regard for the potential consequences of a nuclear accident.

## References

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