

## ***Nuclear reactors use uranium to generate electricity under highly controlled conditions***

### **What is a nuclear reactor?**

A nuclear reactor is a facility that harnesses the energy released from uranium to generate electricity. The process involves splitting one atom of uranium ( $U^{235}$ ) into two smaller atoms. The released energy is captured by water, which is heated to make steam, which in turn is diverted to make electricity in a steam turbine.

There are currently no nuclear reactors in Australia. The countries that rely on nuclear reactors for their electricity include France, Belgium, Finland, Hungary, Sweden, Switzerland, Slovenia, Ukraine, South Korea, Bulgaria, USA, UK, Spain, Romania, Russia and Japan.

### **Negative Connotations around Nuclear Energy**

The terms 'nuclear' and 'atomic' have negative connotations for many Australians. This association stems from the historical use of nuclear power for weapons, and accidents that have occurred at nuclear power plants.

Physicists in the early 20<sup>th</sup> century first explored the idea of using radioactive elements like uranium to release energy. In World War II, the field progressed rapidly and concluded with the dropping of two atomic bombs in Japan. Since that time, British nuclear weapons have been tested at Maralinga (South Australia) and Monte Bello Island (Western Australia). In the late 1990s the French tested nuclear weapons in French Polynesia. North Korea is currently advancing its nuclear weapons program.

### **How did accidents happen at nuclear power plants, and what lessons have been learnt?**

The physics and explosive nature of an atomic bomb cannot be recreated at nuclear power plants. The accidents involved accidental leakage of radioactive material.

At **Three Mile Island** (USA), the accident happened as a result of internal structures in the reactor melting. Small quantities of radioactive material were released, but backup safety systems worked. Intense scrutiny of the cause of this accident led to major design changes in the majority of nuclear reactors around the world.

The RBMK nuclear reactor at **Chernobyl** (Russia) had some inherent construction problems requiring close monitoring during operation. It was acknowledged that human error contributed to the accident. There are still eleven similar reactors still operating in Russia, however, many of these are now equipped with a containment building which was missing in the Chernobyl reactors. It is worth noting that even though the accident in Chernobyl reactor 4 was in 1986 the actual site continued to produce electricity through the other reactors until the year 2000.

The nuclear accident at **Fukushima** (Japan) was triggered by a tsunami. Hindsight shows us that the power plant design should have included a higher tsunami wall, and elevated emergency generators and fuel tanks. As a result, widespread release of radioactive material occurred.

### **Nuclear Power Generation in Australia**

A nuclear power plant could be constructed and operated in Australia, and it would provide a source of lower-carbon energy than coal power stations. From a commercial perspective however it is not clear if the economic conditions are right. Advances in the development of Small Modular Reactors (SMRs) – which are essentially miniature versions of nuclear power plants – may alter the economic equation in favour of nuclear plants, but this has yet to be determined.

From a regulatory perspective, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has a strong reputation and some experience in nuclear reactors through activities at Australian Nuclear Science and Technology Organisation (ANSTO).