

# LEARN ABOUT NUCLEAR WEAPONS

## *Nuclear waste*



To be used in nuclear power reactors or in nuclear weapons the natural Uranium has to be enriched to a higher level of radiation. Nuclear weapons were invented in the 1940's and nuclear power plants have been supplying energy since the 1950's. Still, no long term solution for managing nuclear waste has been found. Nuclear waste remains radioactive when removed from a nuclear power plant after energy has been extracted. U-235 has a half-life of 704 million years and U-238 of 4,5 billion years. Thus, it is far from a short term problem

humanity has created and keeps creating for itself through the use of nuclear power and weapons.

*Picture: Nuclear power plants in Sweden (Barsebäck, Oskarshamn, Forsmark and Ringhals)*

Nuclear power provides 16 percent of the world total electricity production. Today (March 2008) there are 438 commercial nuclear power plants in 30 countries in the world. In many western states nuclear power was built up during the 1970's and 1980's, while today other countries such as China and South Korea are developing their nuclear power production. 35 nuclear reactors are being built around the world. A further 91 reactors are discussed, while the decision making process is lengthy due to permissions and financial issues. Suggestions on building yet another 228 reactors have been presented. During 2008 the world's nuclear reactors will use a total of 64 615 tonnes of uranium.<sup>1</sup>

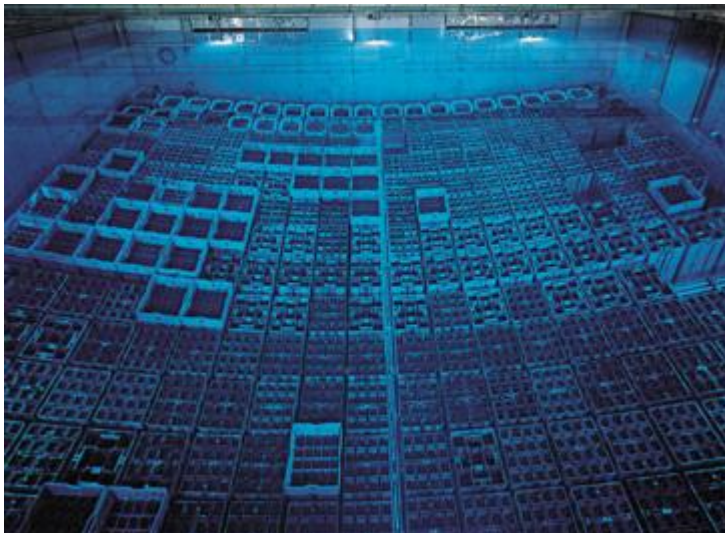
To keep up with a growing population and technological development, the world's energy demands are constantly increasing. Nuclear power has, by many, been presented as an environmentally friendly alternative in the struggle against climate change and the green house effect. Since a large portion of the nuclear reactors around the world today are getting old and need to be closed down, we should still be safe to conclude that the number of operating reactors in the world will not grow in the next ten years. If nuclear power is to contribute significantly to the world's total energy demands, the number of reactors will need to be doubled, which will take decades and demand vast resources. Considering the environmental effects throughout the nuclear fuel chain, from uranium mining to waste management, the critics of nuclear power are many.

With 438 nuclear reactors in 30 countries, in a year demanding almost 65 000 tonnes of uranium to produce energy, it doesn't take a rocket scientist to figure out this will leave behind enormous amounts of nuclear waste. It is frightening that, after so many years of nuclear power use, the issue of long term waste management of material radioactive for millions and millions of years, remains unsolved.

*Types of nuclear waste and management<sup>2 3</sup>*

<b>Level of radioactivity</b>	<b>Explanation</b>	<b>Management</b>
Low level waste	A nuclear power plant uses vast amounts of water. When the water used in the reactors is being purified, radioactive particles are caught in different filters, creating radioactive waste. Maintenance work and reconstructions also produces waste containing radioactive particles, e.g. Metal waste, isolation material, plastic covers, safety clothing etc. This waste will be low- or medium level depending on which radioactive material it includes.	Low level waste can be managed without radiation protection. It includes radioactive particles that can result in significant radiation doses if they enter the human body, e.g. through inhalation. This waste must be kept isolated for 50-100 years.
Medium level waste	Medium level waste consists, just like low level waste, mainly of the filters used to catch radioactive particles from the reactor water, but with a higher level of radiation.	The medium level nuclear waste normally requires radiation protection and is sealed into containers of concrete or steel. Transportation of medium level waste requires

Level of radioactivity	Explanation	Management
		certain transportation containers with 7-20 centimeter thick steel walls.
High level waste	High level waste is produced by the use of uranium in nuclear reactors. The used nuclear fuel is highly radioactive when removed from the reactor. The radioactivity reduces quickly in the beginning, but remains at a dangerous level for a long time. The high level waste should not come in contact with the biosphere for several hundred thousand years.	It is only possible to be close to spent nuclear fuel removed from a reactor if you are behind a radiation cover of at least a few meters of water or one meter thick concrete. The nuclear waste produces heat, which makes it harder to manage. The spent nuclear fuel is stored in water pools for 20-40 years, in highly restricted facilities. Over many years, the heat decreases, making the waste easier to handle. Final management of high level waste remains an unsolved issue.



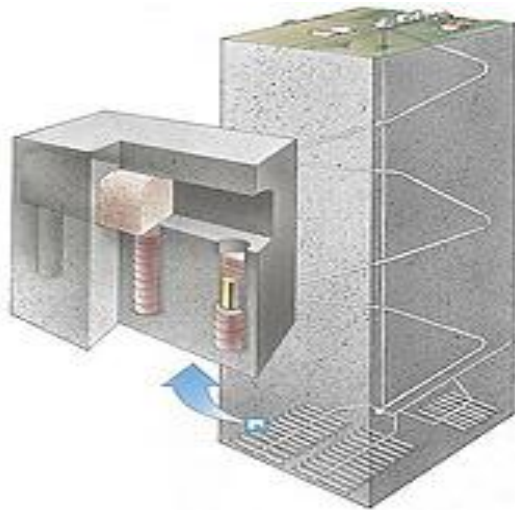
*Picture: Awaiting long term management, nuclear waste is kept in pools to cool off and to let the level of radioactivity reduce.*

### ***Environmental hazards***

Nuclear power is dangerous in several ways. On the one hand, nuclear reactors require uranium for energy production, leading to an environmentally hazardous

and water demanding mining and milling process. You can read more about this in the sections "Uranium mining" and "Uranium milling - Yellow cake". On the other hand, a nuclear power plant accident is an environmental disaster, more elaborated in the section "Nuclear accidents" below. Finally, there is the management of highly radioactive spent fuel.

The largest amount of nuclear waste is found in the former Soviet Union. Nuclear submarines and spent fuel from nuclear icebreakers can be found at the Kola Peninsula. Approximately 100 tonnes of highly radioactive spent nuclear fuel, as well as other radioactive material such as metal waste have been found in this area. At the Leningrad nuclear power plant in Sosnovyi Bor, a store of 3000 tonnes of spent nuclear fuel is kept. There are no reprocessing plans, which means the high level waste will probably remain there for a long time. The Sosnovyi Bor area also houses the Radon Combinat, assigned to manage radioactive waste. The storing facilities are in terrible shape, including 60 000 cubic meters of radioactive waste, easily accessible for e.g. a terrorist group seeking material for a "dirty bomb"<sup>1,4</sup>



Even a "well tended" long term storage of high level nuclear waste poses environment hazards. The encapsulated waste, planned to be buried deep in the mountain, will be surrounded by groundwater. Exposed to the water for thousands of years, the steel capsules will be corroded. The risk of radioactive material leaking is significant. Critics have risen the issue of long term safety. Do we really know how the long term storages will react to a heavy earthquake? No one can guarantee what will happen deep in the mountains a thousand or a million years from now.

*Picture: Long term waste management of high level nuclear waste. Source: SKI*

Yucca Mountain is since some 20 years back the proposed long term storage of nuclear waste in the US. The mountain is situated in an area of high seismic activity. No less than 35 fault lines - that is the areas most sensitive in case of an earthquake - cross the area. And earthquakes in the Nevada area are not exactly unusual.<sup>5</sup> Planning a long term storage of highly radioactive nuclear waste in an earthquake prone area has raised massive criticism in the state.<sup>6</sup>

### ***Old nuclear weapons as fuel***

One of the most central causes for worry regarding nuclear power has long been the use of nuclear power uranium to be used for nuclear weapons production instead.

The problem remains, but today there is also a conversion the other way around taking place: from nuclear weapons to reactor fuel. A number of treaties between the US and Russia demand disarmament of nuclear weapons. Nuclear material that has been declared excess in the US and Russia can be converted to fuel for commercial nuclear power reactors. Already in 1993 a treaty was passed between the US and Russia, under which Russian military highly enriched uranium (HEU) after conversion is being used as fuel in American civilian reactors.<sup>7</sup> In 2005 the first transport of converted American nuclear weapons to an American nuclear power reactor took place.<sup>8</sup>

HEU in American, Russian and other states' nuclear stockpiles amount to approximately 2000 tonnes. This is about twelve times as much uranium as being extracted by uranium mining every year.

The world total stockpiles of weapon grade plutonium is estimated at 260 tonnes, which – if used as mixed oxide (MOX) fuel – would equal a bit more than a year of the world's total uranium production. Military plutonium can be mixed with uranium oxide to MOX fuel. When low enriched uranium or MOX fuel has been used to produce energy in a nuclear power reactor, it is no longer sufficient for nuclear weapons production.<sup>9</sup>

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1 World Nuclear Association <http://www.world-nuclear.org/info/reactors.html>

2 Radiation and Nuclear Safety Authority [http://www.stuk.fi/ydinturvallisuus/ydinjatteet/ydinjate/sv\\_FI/matalat/](http://www.stuk.fi/ydinturvallisuus/ydinjatteet/ydinjate/sv_FI/matalat/)

3 Radiation and Nuclear Safety Authority [http://www.stuk.fi/ydinturvallisuus/ydinjatteet/ydinjate/sv\\_FI/korkea/](http://www.stuk.fi/ydinturvallisuus/ydinjatteet/ydinjate/sv_FI/korkea/)

4 Radiation and Nuclear Safety Authority

[http://www.stuk.fi/ydinturvallisuus/ydinjatteet/ydinjatteet\\_maailmalla/sv\\_FI/lahialueet/](http://www.stuk.fi/ydinturvallisuus/ydinjatteet/ydinjatteet_maailmalla/sv_FI/lahialueet/)

5 State of Nevada, Nuclear Waste Project Office <http://www.state.nv.us/nucwaste/yucca/seismo01.htm>

6 The 2006 State of Nevada Yucca Mountain Survey Summary Report, The Nevada Agency for Nuclear Projects, October 2006.

7 World Nuclear Association <http://world-nuclear.org/info/inf13.html>

8 Webb, Greg. "US to Convert Weapons Plutonium into Nuclear Fuel". Global Security Newswire, 17 September 2007.

9 World Nuclear Association <http://world-nuclear.org/info/inf13.html>