NUCLEAR POWER & WATER CONSUMPTION

Anti-Nuclear & Clean Energy Campaign
Friends of the Earth, Australia
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A number of problems associated with the nuclear industry are much-discussed – the contribution of "peaceful" nuclear programs to the proliferation of nuclear weapons, the nuclear waste legacy, and the small risk of catastrophic accidents or attacks. Less well understood are the various impacts of the nuclear industry on water resources.

Water scarcity is already impacting on the power industry in Australia, largely because of our heavy reliance on water-guzzling coal-fired plants. Introducing nuclear power – the most water-intensive of all electricity sources – could exacerbate those problems.

Current problems and issues in Australia include:

- expensive long-distance water transportation to some power plants because of dwindling local water supplies;
- reduced electrical generating capacity and output at some coal and hydro plants;
- increased prices for water;
- higher and more volatile electricity prices;
- relaxation of laws and regulations concerning usage of river water and groundwater for some power plants;
- increased risks of blackouts; and
- intensified competition for scarce water resources between power plants, agriculture, residences, industries, environmental flows, etc.

The Commonwealth-State Ministerial Council on Energy met in early 2007 to discuss the impact of water shortages on electricity generation, and requested regular updates from the National Electricity Market Management Company.

Current problems have led power utilities to explore alternatives such as the use of wastewater, groundwater or desalination. There is also an expectation that new plants are more likely to be built on the coast and use seawater. The use of dry (air) cooling systems may become more common but air-cooled plants are more expensive, less efficient and emit more greenhouse gases.

The Energy Supply Association of Australia states: "Australia is a water constrained continent and the issue of adequacy of water supplies for generator cooling purposes is already becoming problematic in some areas. There are restrictions on the volume of water that generators may draw and in some States this is beginning to present as a limitation on the amount of electricity that some baseload generators may be able to deliver in hot months".

Nuclear Power Plants

Water for a nuclear power plant can be sourced from a river, lake, dam, or the ocean. The water has two uses - it is converted to steam to drive a turbine, and cooling water converts the steam back to water.

Nuclear power plants consume large amounts of water – typically 13-24 billion litres per year, or 35-65 million litres per day. A December 2006 by the Commonwealth Department of Parliamentary Services states: "Per megawatt existing nuclear power stations use and consume more water than power stations using other fuel sources. Depending on the cooling technology utilised, the water requirements for a nuclear power station can vary between 20 to 83 per cent more than for other power stations."

Reactors in numerous European countries have been periodically taken off-line or operated at reduced output because of water shortages driven by climate change, drought and heat waves. Nuclear utilities have also sought and secured exemptions from operating conditions in order to discharge overheated water.

Water outflows from nuclear plants expel relatively warm water which can have adverse local impacts in bays and gulfs, as can heavy metal and salt pollutants. The US Environmental Protection Agency states: "Nuclear power plants use large quantities of water for steam production and for cooling. When nuclear power plants remove water from a lake or river for steam production and cooling, fish and other aquatic life can be affected. Water pollutants, such as heavy metals and salts, build up in the water used in the nuclear power plant systems. These water pollutants, as well as the higher temperature of the water discharged from the power plant, can negatively affect water quality and aquatic life."

Australian Climate Change Commissioner Prof. Tim Flannery states: "Coal-fired power plants have large water requirements for cooling and steam generation, but these are dwarfed by the water needs of nuclear power. Some nuclear power plants can use seawater for cooling, but problems emerge when they are situated on bays and gulfs, for there the warm discharge water can accumulate and have a large impact on the local marine ecology."

Coastal sites

The consumption of large volumes of water is not nearly so much of a problem for coastal sites using sea-water – but other problems arise. A US report, 'Licensed to Kill: How the Nuclear Power Industry Destroys Endangered Marine Wildlife and Ocean Habitat to Save Money', details the nuclear industry's destruction of delicate marine ecosystems and large numbers of animals, including endangered species. Most of the damage is done by water inflow pipes, while there are further adverse impacts from the expulsion of warm water. (See the report and video at nirs.org/reactorwatch/licensedtokill)

Another problem is 'cold stunning' – fish acclimatise to warm water but die when the reactor is taken off-line and warm water is no longer expelled. In New Jersey, local fishermen estimated that 4,000 fish died from cold stunning when a reactor was shut down.

Another concern is the potential impact of rising sea levels on coastal nuclear power plants.

Comparing Energy Sources

The water consumption of renewable energy sources and energy efficiency and conservation measures is negligible compared to nuclear or coal. Tim Flannery notes that the uptake of renewable energy sources such as wind, solar, and geothermal 'hot rocks' will help ease the water crisis as well as reducing greenhouse emissions.

Water consumption of different energy sources:
(litres per kilowatt-hour of electrical output)

Nuclear	2.5
Coal	1.9
Oil	1.6
Combined Cycle Gas	0.95
Solar PV	0.11
Wind	0.004

Operating a 2,400 Watt fan heater for one hour consumes:

- 0.004 litres of water if wind is the energy source
- 0.26 litres if solar PV is the energy source
- 4.5 litres if coal is the energy source
- 6 litres if nuclear power is the energy source.

A 2009 World Economic Forum paper provides the following figures:

*"A megawatt-hour (MWh) of electricity from coal uses 20 to 270 litres of water at the coal mining stage and an additional 1,200 to 2,000 litres when the energy in the coal is converted to electricity, totalling **1,220 to 2,270 litres** of water consumed per MWh. In comparison, nuclear energy uses 170 to 570 litres of water per MWh during the mining of uranium and production of the reactor fuel and an additional 2,700 litres per MWh as the energy from nuclear fission is converted to electricity, for a total of **2,870 to 3,270 litres** of water consumed per MWh."*

More Information

The following papers are posted at foe.org.au/anti-nuclear/issues/oz/water-nuclear

A detailed, referenced version of this information sheet.

Guy Woods, Department of Parliamentary Services, 2006, 'Water requirements of nuclear power stations.

Dr. Ian Rose (Roam Consulting), 2006, Nuclear Power Station.

Union of Concerned Scientists - 2007 briefing paper on nuclear power & water consumption.

Dr. Benjamin K. Sovacool, January 2009, 'Running On Empty: The Electricity-Water Nexus and the U.S. Electric Utility Sector', Energy Law Journal, Vol.30:11, pp.11-51.

World Economic Forum, 'Energy Vision Update 2009, Thirsty Energy: Water and Energy in the 21st Century'.

US Nuclear Information & Resource Service, 'Licensed to Kill: How the Nuclear Power Industry Destroys Endangered Marine Wildlife and Ocean Habitat to Save Money'.