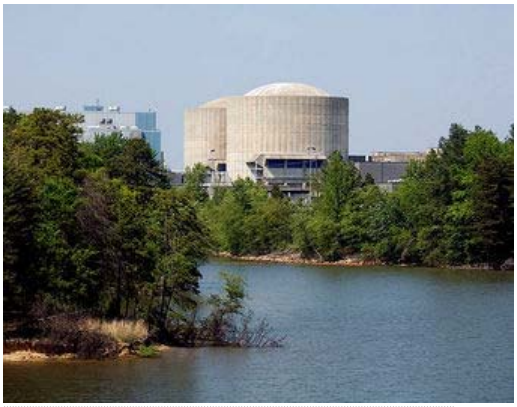
Heat Waves Putting Pressure on Nuclear Power's Outmoded Cooling Technologies

Power generated from coal, natural gas and nuclear withdraws more freshwater per year than the entire agricultural sector; nuclear uses the most

By Lisa Song, SolveClimate News May 4, 2011



Catawba Nuclear Station in York County, South Carolina/Credit: Duke Energy

The scramble to cool the Fukushima Daiichi nuclear complex with seawater in the aftermath of Japan's disastrous accident put a spotlight on just how much cold water an atomic reactor needs to function — and not just in a crisis.

All existing nuclear plants use vast amounts of water as a coolant. But in recent years — often far from the public eye — hot river and lake temperatures have forced power plants worldwide to decrease generating capacity.

Experts say the problem is only getting worse as climate change triggers prolonged heat waves, prompting calls for changes in siting processes.

"As a long-range strategy, [the industry] might change where we site new plants to have better use of water resources," Gary Vine, an independent consultant, told SolveClimate News. Vine has worked in the nuclear industry for decades and is a former employee of Electric Power Research Institute, a utility group.

There is also hope that new technologies will help mitigate the problem.

The U.S. Department of Energy is part of an international team working to design the next generation of nuclear plants — some of which will use less water than traditional plants. But the project faces numerous challenges such as cost and implementation barriers, and the DOE anticipates that the generation IV reactors will not be commercially available for at least two decades.

In the meantime, the scope of the problem is still not precisely known.

Preliminary data from the Union of Concerned Scientists (UCS), an environmental and nuclear watchdog group based in Cambridge, Mass., shows that seven nuclear units at five facilities had to reduce generating capacity due to warm waters on at least 15 occasions between May and September 2010. The plants were in New Jersey, Pennsylvania, Illinois and Georgia. While such incidents didn't affect plant safety, they posed economic risk and decreased power availability.

In one case, which did not appear in the UCS database, the Tennessee Valley Authority's Browns Ferry station near Athens, Ala., lost over $50 million dollars when it was forced to run at half capacity for eight weeks last summer, passing the price surge to customers.

During a blistering heat wave in Europe in 2003, France cut 4,000 megawatts of nuclear power — the equivalent of shutting down four power plants — at a time when demand for air conditioning was at its highest.

Figuring Climate Impacts Into Siting

Of the 104 nuclear plants in the U.S., over 30, or about one-third, are located in the Southeast where they are especially vulnerable to heat waves. In part because the region's wind energy resource lags behind much of the nation, nuclear is seen as an attractive emissions-free alternative.

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Nuclear accounts for about a quarter of the region's electrical generation, compared with 20 percent for the nation as a whole. As of March, the Nuclear Regulatory Commission had received 16 license applications for building new nuclear units in the Southeast. The projects closest to construction are units 3 and 4 of Southern Company's Vogtle plant in Burke County, Georgia.

Sara Barczak, a program director for the Knoxville, Tenn.-based Southern Alliance for Clean Energy, said climate effects must figure into utilities' decisions to build new nuclear facilities, especially since it can cost up to $10 billion per reactor and each is designed to last for 60 years.

Climate change studies published in research journals such as *Science* and the *Journal of Climate* project longer and more intense heat waves over the next century worldwide, adding constraints to water-intensive power systems.

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Increasing the efficency of nuclear cooling/heat exchangers

Submitted by Frank John Holmquist (not verified) on May 15, 2011 - 7:35am.

Most cross flow heat exchangers use normal flow which is normal to the cylinder vs tangent. If you use a slightly tangent imput and axial output you can increase the efficency of heat exchangers by 33% or more with little cost or modification required. also by cooling the cooling waters at night time and early morning by a 10 degrees or more the overall effect will be noticed as all heat engines operate with a temperature differential to drive the system. the greater the hot vs the cool side ther greater power extraction becomes much more efficent. Also by using vortexing nozzle design in the cooling towers for any plant would use less energy with greater misting/dispersal of heat content at lower pressures and pumping requirements. I am a former US Federal nuclear safety inspector/blacklisted whistle-blower for more than 21 years. The powers that be fear the truth and changes, even for the better. madscientistclub.com Frank's World....

reply

The main problem in this type

Submitted by miere (not verified) on May 9, 2011 - 6:25am.

The main problem in this type of energy is safe. In terms of environmental protection is a very clean energy as long as no accidents occur. Unfortunately mankind has managed to control all this energy. Can we achieve this in the future. Until then we should not play with our health.miere poliflora

reply

Calling Bill Gates:

Submitted by catman306 (not verified) on May 7, 2011 - 6:52pm.

Mr. Gates, why don't you put your researchers to work finding ways to scavenge waste heat from electrical plants, both fossil fuel and nuclear, and turn it into electricity. Add on solar panels already can convert heat into useable electrical power. While the efficiency rates are not great, it is 'waste heat', wasted fuel turned to wasted heat, so getting any useable power from it will be a gain for us all: the utility, the rate payers and the environment. Research might increase the efficiency of infrared solar cells.

Any energy converted from waste heat to electricity will cool the waste heat media a corresponding amount, i.e., provide some cooling. A perfect process would convert all the waste heat into electricity and provide perfect cooling, too.

Climate Science Links

U.S. Government

NASA: Eyes on the Earth
National Climatic Data Center
National Snow and Ice Data Center
National Science Foundation
NOAA Climate Service
NOAA Paleoclimatology
EPA's Climate Change Page
Global Change Research Program
Goddard Institute for Space Studies
Navy Task Force on Climate Change
USDA Climate Change Research Ctr
US Forest Service Publications
DOE: Office of Climate Change Policy

International

Intergov'tal Panel on Climate Change
UN Framework Convention (UNFCCC)
UN Environment Programme (UNEP)
Met Office: Hadley Centre (UK)
UK Gov't Climate Change Page

Academic, Non-Governmental

AAAS Climate Change Resources
American Geophysical Union
American Meteorological Society
Oxford University
Columbia University Earth Institute
Scripps Institution of Oceanography

America's survival depends on efficiency.

reply

Cooling Electric Power Plants

Submitted by Anonymous (not verified) on May 5, 2011 - 2:08pm.

Whether the energy source is fossil (oil, coal, gas), solar, or nuclear fuel, the determination of how much cooling water is required is a thermodynamic problem associated with the turbine-generator, NOT the power source (e.g., the nuclear reactor).

Cooling water is used to condense steam back to water in the turbine area (i.e., in the condenser) in order to reuse the water. Otherwise, it would be necessary to vent the steam to atmosphere and continuously feed distilled water into the steam-generator to make more steam. Nobody could afford the electricity produced in such an inefficient and wasteful manner. The amount of cooling water needed is directly proportional to the amount of electric energy produced and the efficiency of the energy conversion process. Assuming perfect efficiency, the amount of cooling water used would be exactly the same regardless of the energy source. Whether the power source was nuclear energy or solar energy the amount of cooling water used would be the same. So, your discussion should focus on turbine-generator efficiency rather than the type of fuel used. The type of fuel used is relevant to atmosphere cleanliness (air quality), in which case nuclear is the clear choice (no pun intended).

Physics 101: Energy and matter can be converted from one to the other but cannot be created or destroyed. Whether the heat (energy) is removed by water or by air is irrelevant in a global sense; it all ends up in the general atmosphere. However, producing electric energy using large plants is more efficient per killowatt hour than by using small plants. A plant that makes 1000 MWe is much more efficient in this respect than a thousand plants that make 1 MWe each. The largest, most efficient power plants are nuclear.

Geo-politics: Oil is a plentiful resource for the substantially indefinite future. However, it is frought with geo-political and environmental challenges; thus, their consequent fiscal problems. If we are ever to reach a place where we can withdraw our military from wars to protect our access to foreign oil sources, we must reach a place where we are no longer using oil to make electric energy and have significantly reduced our use of oil (gasoline/disel) to power transportation and heat our homes. Furthermore, if we are ever to have electric powered cars in numbers large enough to appreciably affect global climate change, the energy cannot be generated by burning fossil fuels, which produce greenhouse gases. It will have to be generated by environmentally clean nuclear reactors because nuclear is the ONLY energy source that can produce such massive amounts of electric energy (either for direct charging of batteries or for production of Hydrogen to use in fuel cells) while producing zero greenhouse gases or heavy metal effluents. Even if we covered every available acre of land with 100% efficient (not practically achievable) windmills and solar panels, we could not generate enough electric energy to replace the existing base-load power plants, let alone provide for future demands. Thus, these are niche technologies with certain beneficial applications but cannot be legitimately seen as replacements for large, fossil or nuclear powered electric generators.

BOTTOM LINE: It is greatly in the interest of world peace and our global climate to maximize use of nuclear energy to the extent possible. Otherwise, we can plan for increasingly larger military forces and global temperatures. Just a wild-n-crazy thought for your consideration.

reply

what a sad joke

Submitted by NOT a nuclear shill (not verified) on May 6, 2011 - 3:08am.

ok bud, no other source of energy available? How many gallons of the coolaid did you drink homes? What was Tesla talking about before Eddison burned his lab down?

What about Stan Meyer with the Hidrogen fuel cell that you pissed in and drove from LA to NY?

You don't know jack about the science of power generation!

Explain to me how a magnet keeps putting out force without using any? and it does that for 400 year or so. Explain that Einstein!

Ever heard of laser fusion? Old news already genius.

The cat is out of the bag already. Go hide in your nuclear power plant sponsored million dollar flat somewhere shillface!

reply

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Submitted by NOT a nuclear shill (not verified) on May 6, 2011 - 3:06am.

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reply

Author in need of Thermodynamics 101

Submitted by Anonymous (not verified) on May 4, 2011 - 1:07pm.

Dear Ms. Song,

While your article does dive into a worthy discussion that is going to recieve more attention as time goes on, your apparent understanding of the topic is deplorable. Please see my comments below:

1. Thermoelectric is not the word you mean. Thermoelectric processes involve two semiconducter materials (N and P type) that produce (direct) current when exposed to a temperature difference. The word 'Thermal' would be more appropriate in this instance since heat is being used to do work.
2. You can't 'evaporate steam', steam IS the gaseous state of water
3. The cooling requirements of a thermal cycle are entirely dependent on the efficiency of that cycle. While the choice of working fluid will affect the efficiency of the cycle, the fluid alone does not dictate the efficiency. A helium cycle running at 33% efficiency will reject the same ammount of heat into the enviornment as a steam cycle running at 33% efficiency.
4. A clearer distinction needs to be made between permanently removing water from a source and using water from a source. i.e. once through systems return all of the water they remove where as cooling towers return less water than they remove.

Water returned to it's source remains available for use by other applications like farming or consumption.

5. The utilities are most certainly taking into account climate when planning these massive expendatures. This is one of the key aspects that drive site slection. Please do your homework! An introductory course in thermodynamics/physics at your local university or community college would be well worth the tuition if you plan to follow this subject in the future.

reply

Use Thoriu

Submitted by Anonymous (not verified) on May 4, 2011 - 8:36am.

The liquid fluoride thorium reactor is a generation 4 technology reactor that has far less cooling needs than our present uranium reactors and has many other advantages as well. We need to quit dithering and build reactors that utilize much better technology.

reply

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