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Climate change puts nuclear energy into hot water

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PARIS: Could climate change be the latest jinx on nuclear power?

Long regarded with suspicion because of radioactivity, nuclear power suddenly has a revived image, thanks to the idea that many more plants could be built without worsening global warming. Unlike power plants fired by coal and natural gas, nuclear fission produces no carbon dioxide, the main greenhouse gas.

But there is a less well-known side of nuclear power: It requires great amounts of cool water to keep reactors operating at safe temperatures. That is worrying if the rivers and reservoirs which many power plants rely on for water are hot or depleted because of steadily rising air temperatures.

If temperatures soar above average this summer - let alone steadily increase in years to come, as many scientists predict - many nuclear plants could face a dilemma: Either cut output or break environmental rules, in either case hurting their reputation with customers and the public.

Governments and the energy industry are just starting to grasp the vulnerabilities of water-hungry power plants. If the complications prove serious in countries where inland sources of water are growing scarce, where seafront nuclear stations are unwelcome or impractical and where alternative cooling technologies are too expensive, it could take the bloom off of nuclear as a source of clean energy and leave it more unclear than ever where sizable new power supplies might come from.

"We're going to have to solve the climate-change problem if we're going to have nuclear power, not the other way around," said David Lochbaum, a nuclear engineer who is with the Union of Concerned Scientists.

"As the climate warms up, nuclear power plants are less able to deliver," he said.

France relies on nuclear power more than any other country and is held up by advocates of nuclear power as a model for how to generate enough cheap and reliable electricity to sell surpluses abroad while reducing carbon dioxide emissions. But global warming is exposing France to new risks.

In countries like Australia, where the government is considering introducing nuclear power, and the United States, which gets about a fifth of its electricity from nuclear power, some officials and operators warn of similar pitfalls if plants are built in areas where there already are water shortages.

Finding enough water for nuclear plants "is front and center of everything we will do in the future," said Craig Nesbit, a spokesman at Exelon, a Chicago-based company operating the largest group of U.S. nuclear plants.

Officials at Électricité de France have been preparing for a possible rerun of a ferocious heat wave that struck during 2003, the hottest summer on record in France, when temperatures of some rivers rose sharply and a number of reactors had to curtail output or shut down altogether.

The French company operates 58 reactors - the majority on ecologically sensitive rivers like the Loire.

During the extreme heat of 2003 in France, 17 nuclear reactors operated at reduced capacity or were turned off. Électricité de France was forced to buy power from neighboring countries on the open market, where demand drove the price of a megawatt hour as high as €1,000, or \$1,350. Average prices in France during summer months ordinarily are about €95 per megawatt hour.

The heat wave cost Électricité de France an extra €300 million. The state-owned company "swallowed it as a one-off cost of doing business in extreme circumstances," Philippe Huet, an executive vice president at Électricité de France, said.

The company was not allowed to pass along price surges to customers.

Huet said the company was preparing for this summer on several fronts. The company is stocking more water in reservoirs, offering lower priced contracts to large users in exchange for the right to cut supplies and using more sophisticated forecasting tools for weather and river temperatures, he said.

"If this year is the same as in 2003 we will handle it better," Huet said. "But we cannot exclude difficulties if the summer is even warmer and drier than 2003."

Patrice Lambert de Diesbach, an energy analyst at CM-CIC Securities in Paris, said hot summers were the problem. "We are up against the maximum amount of hot water that can be released into rivers," Diesbach said. "Unfortunately the situation is only going to get worse."

Anti-nuclear groups have pounced on the difficulties faced by the industry in France.

"Nuclear power actually is worsening the effects of climate change already under way," said Stéphane Lhomme, a spokesman for the French anti-nuclear group Sortir du Nucléaire, or Get Out of Nuclear.

Plant life and fish are damaged by "dumping vast amounts of hot water into rivers and by evaporating larger and larger amounts of water," he said.

Last month, scientists at the Intergovernmental Panel on Climate Change warned Europeans to expect severe water shortages in the decades ahead as glaciers dry up, snowfalls decrease and temperatures rise. Weather services in France and Britain already have warned that the region may face a hot summer this year after months of unseasonably warm weather.

In Germany, the energy giant E.ON also has been forced to reduce operations at its nuclear plants for months at a time because of heat. Just a few years ago, such slowdowns lasted only weeks, said Petra Uhlmann, a spokeswoman for E.ON.

"We reckon there may be more heat waves in coming summers so we may have to reduce operations again," she said.

In Spain, a nuclear power reactor at Santa María de Garoña was shut for a week in July after high temperatures were recorded in the Ebro River.

In Britain, where the government has given the green light for a new generation of reactors, almost all plants are by the sea, virtually eliminating problems in hot conditions.

Countries like China and India that are rolling out new nuclear generators could, in theory, put all plants by their coasts, too. But significant amounts of electricity would be lost in transmitting to faraway inland population centers.

In Australia, where there is fierce debate about whether to build nuclear plants, politicians in Queensland State commissioned a report published last year that concluded there are few seaside sites available. The report also warned that building nuclear plants inland would be a major threat to water supplies in a country already stricken by drought.

In the United States, where at least two-thirds of nuclear plants are on lakes and rivers, the group Public Citizen reported a shutdown last year at a plant in Michigan, and slowdowns at plants in Minnesota, Illinois and Pennsylvania, because of hot conditions.

Public Citizen also has warned that building a new nuclear plant in Illinois at Clinton Lake, which covers about 20 square kilometers, or 8 square miles, would lower water levels and elevate temperatures at a time when drought conditions are expected to worsen in the U.S. Midwest because of climate change.

Public Citizen said the existing reactor at Clinton Lake, operated by Exelon, discharged water at temperatures as much as 25 degrees Fahrenheit (14 Celsius) hotter than when it entered the plant, raising average temperatures of the lake by 14 degrees Fahrenheit.

Nesbit, the Exelon spokesman, said the lake was purpose-built in the 1970s to cool the reactor and had been carefully managed to allow sports like fishing and water skiing. He said U.S. regulators last month gave "an unqualified green light" for a new reactor to be built on the site.

Huge amounts of water are needed to cool power plants.

Each year, Électricité de France draws up to 19 billion cubic meters, or 670 billion cubic feet, of water for its nuclear operations from rivers and lakes - about half of all the freshwater drawn from the environment and far more than used by the agricultural industry.

Électricité de France said almost all of the water was returned to the environment and that losses through cooling towers were just a small fraction of the overall amount.

Ian Hore-Lacy, a spokesman for the World Nuclear Association, said nuclear plants required the same amounts of water as do coal and natural gas plants to produce a unit of electricity.

In practice, said John Large, an independent nuclear consultant and a former research fellow with the United Kingdom Atomic Energy Authority, nuclear plants tend to be big and clustered and put greater strain on local water sources.

The authorities and operators start with powerful reactors and tend to add new capacity at existing plants because nuclear reactors are more costly to build than coal and natural gas burners, and they often face more public opposition, Large said.

Since 2003, Électricité de France has begun relying more heavily on the 14 reactors on French coastlines where water is more abundant and generally cooler than rivers in the summer. But moving all French plants to the seaside is not the answer.

Costs would be too high, and any such project would encounter opposition from coastal dwellers and from inland residents who object to electricity pylons. Another problem is that transmitting power over longer distances is inefficient.

Nuclear now provides about 80 percent of electricity in France, by far the highest share of any industrial country. That "is probably the maximum," Huet said, but he added that water constraints were not holding back nuclear power.

Instead the company is investing in wind power to meet targets for using renewable energy, and is upgrading fossil fuel plants because they are better than nuclear reactors at coping with periodic peak demand.

Strict local rules to protect fish and plant life were imposed when the first reactors went online in France in the 1960s and 1970s, but those rules have softened as the weather has warmed. At the Garonne River in southwest France, for example, the local authorities last year raised the amount of water Électricité de France is permitted to evaporate at the Golfech plant to 45 million cubic meters from 34.6 million cubic meters, a level that was set in 1990, according to Sortir du Nucléaire. Électricité de France first asked the French government to override local temperature rules in 2003, when the heat caught the authorities and electricity operators by surprise. A temporary decree allowed some plants to eject water up to 3 degrees above temperatures upstream from plants, but without specifying maximum temperatures - prompting objections from environmentalists. The government granted a similar request in 2006. But the weather then was cooler than expected and the company did not apply the rules. Huet said that any threat to aquatic life would come from the warmer conditions, not nuclear plants, and that easing environmental rules posed no threat to the ecology of rivers. "The real problem is that river temperatures are increasing on their own upstream from power plants," Huet said.