

insight

MARCH 2000

Nuclear Safety, Efficiency Go Hand in Hand Plant Performance Indicators for 1999 Show Link

By every measure, the nation's nuclear power plants excelled in 1999. Not only were they more efficient than ever, they were safer, too. Across a broad spectrum of performance indicators, U.S. nuclear plants exceeded their 2000 goals—in some cases, significantly.

Take nuclear safety. Since 1989, the nuclear industry has monitored the performance of three important standby safety systems that keep the plant in a stable condition if power generation is interrupted. The latest figures for U.S. nuclear units from the World Association of Nuclear Operators (WANO) show that last year, 96 percent of these systems were available more than 95 percent of the time—an achievement that beat the 2000 goal of system availability by 10 percentage points.

Another safety indicator is the median number of unplanned automatic shutdowns, which tracks the median scram rate for approximately one year. That number was zero for the third year in a row.

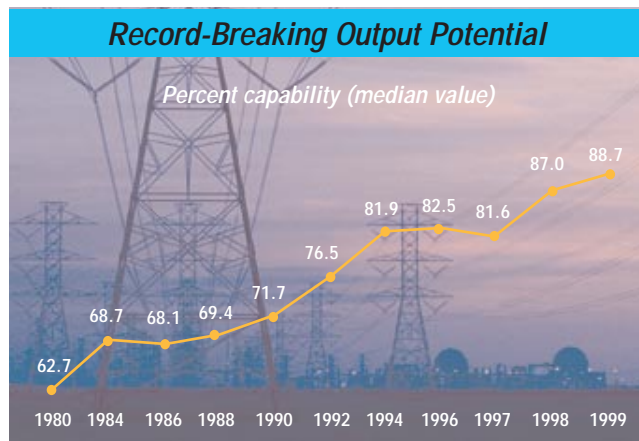
Safety is also measured in terms of the industrial safety accident rate. That rate has plunged from 2.1 lost-time accidents per 200,000 worker-hours in 1980 to 0.34 in 1999. By comparison, the accident rate for U.S. private industry was 2.9 per 200,000

worker-hours in 1998—the last year figures are available from the Bureau of Labor Statistics.

In terms of power production, plants are becoming more efficient in converting thermal energy to electricity output—as a declining heat rate attests. The lower the rate, the greater the efficiency. They're also boosting output by minimizing unplanned energy losses and optimizing planned maintenance and refueling outages. The industry's unit capability factor—which measures the percentage of maximum electricity generation a plant is capable of supplying, limited only by factors within plant management's control—rose to 88.7 percent last year from 62.7 percent in 1980. The goal for 2000 is 87 percent.

"Many utilities are optimistic about the future of nuclear energy—based on the industry's 20 years of continuous progress in safety and reliability," said Gary Leidich,

executive vice president at the Institute of Nuclear Power Operations, which tracks U.S. plant performance for WANO. "The 1999 WANO performance indicators aren't the end



Source: Institute of Nuclear Power Operations

Nuclear plants with high output can be expected to have high margins of safety

of the story, but the beginning of a promising new chapter in the industry's history."

This overall performance is "positive evidence" that the industry remains focused on safety, said Ralph Beedle, NEI senior vice president and chief nuclear officer. "While deregulation and competition are causing change throughout the electric industry, safety is still the nuclear industry's top priority."



Majority of Nuclear Plants May Renew Licenses, Says Gas Foundation Study

Washington Policy and Analysis doesn't think much of current studies that "hype" the use of natural gas in central station electricity generation. The Washington, D.C.-based international consulting firm foresees limitations on the addition of new gas-fired capacity to the nation's generating system. One reason: "assumed life extensions" of nuclear power plants.

Under the "accelerated" scenario, the study assumes that "two-thirds of the nuclear units scheduled to retire [by 2020] will be granted license extensions."

— Washington Policy and Analysis

"As a result of [electric power] industry restructuring, significant consolidation is occurring within the nuclear industry," says Washington Policy and Analysis in a new study for the American Gas Foundation. "This consolidation, combined with environmental pressures to reduce greenhouse gas emissions, will likely result in efforts to renew the licenses of many nuclear plants."

The study—*Fueling the Future: Natural Gas and New Technologies for a Cleaner 21st Century*—develops two scenarios for gas consumption between 2000 and 2020.

One, the "current" scenario, assumes significant increases in the efficiency of equipment that uses natural gas as well as continued technological advances in energy supply and energy use. But it doesn't include the removal of barriers or the adoption of policy measures that would stimulate gas consumption.

The second scenario—"accelerated"—assumes that the barriers would be removed and positive policies would be implemented to increase gas use. Under this projection, the study assumes that "two-thirds of the nuclear units scheduled to retire [by 2020] will be granted license extensions."

The study's authors contrast their projection of gas consumption by electricity generating

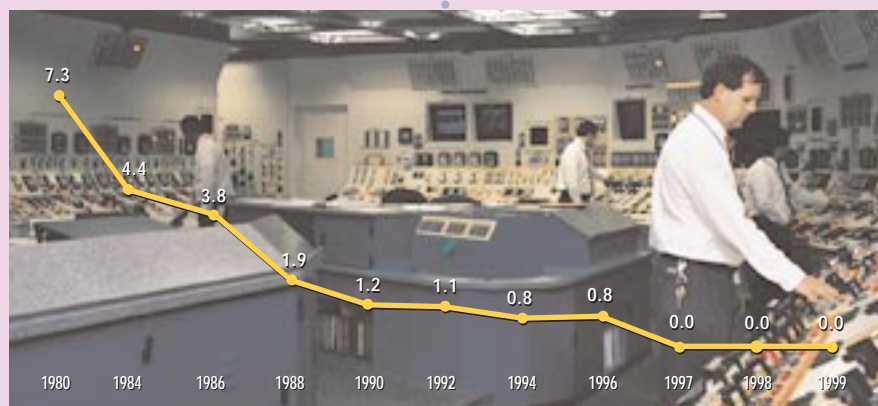
plants with that of the Energy Department's Energy Information Administration. Under the accelerated scenario, Washington Policy and Analysis expects such gas use to rise to 6.7 quadrillion Btu by 2020. This growth is "significantly less than the 9.2 quads forecast" by the EIA in its 1999 *Annual Energy Outlook*, say the study's authors. The 2000 EIA *Outlook* forecasts 9.26 quads by 2020.

"[W]hat makes our study truly unique is where and how we see the growth [in natural gas use] occurring—primarily through the use of new technologies," said William Martin, the study's co-author and former deputy U.S. Secretary of Energy.

Fewer "Scrams," Safer Plants

The number of unplanned, automatic scrams—the sudden shutdown of a reactor that can cause a change in the temperature or pressure of the cooling system—

has plunged over the past 19 years. The rate, which stood at 7.3 in 1980, has had a median value of zero for the past three years, according to the Institute of Nuclear Power Operations.



Source: Institute of Nuclear Power Operations

New Frontiers in Cancer Treatment

Targeting Malignant Cells With Radioisotopes

For years, cancer researchers have sought a “silver bullet”—a treatment that locates and kills malignant cells without harming normal ones. At last, they may be closing in on such a cure. In simplest terms, they’ve developed antibodies that can deliver a dose of radiation to a particular kind of cancer cell—while sparing all other types of cells.

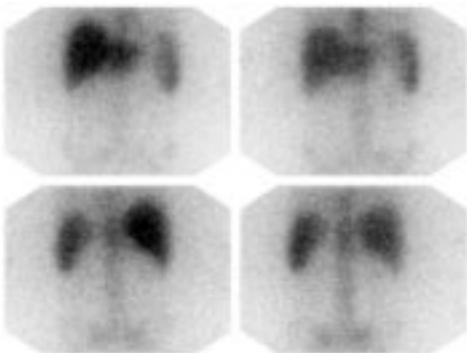


PHOTO COURTESY OF MEMORIAL SLOAN KETTERING CANCER CENTER

With successive injections, a growing number of the patient’s leukemia cells absorb radioisotope-bearing antibodies.

The approach is being tested in New York, where 18 patients with a common form of leukemia are being treated with radionuclide-bearing antibodies at the Memorial Sloan Kettering Cancer Center. So far, it’s working.

“The agent does kill tumors,” says Dr. Steve Larson, who heads the clinical nuclear medicine department. “All of this was just speculation before we started the clinical trial.” That was 18 months ago. The procedure has proven safe for the patients, for whom conventional therapy has failed. But Larson and his team have yet to reach the maximum permissible dose, when large amounts of tumor are killed.

The antibodies used in the clinical trial were developed by a team that included Dr. David Scheiberg, a pioneer in this kind of therapy.

The radioactive isotope—bismuth-213—was produced by the team using another radioisotope—actinium-225—supplied by Oak Ridge National Laboratory in Tennessee.

Meanwhile, researchers at Oak Ridge are studying the effect on laboratory animals of other antibodies “labeled” with bismuth-213. These antibodies are able to recognize tumor cells and actively seek them out. It’s a bit like fitting together the pieces of a jigsaw puzzle, says Russ Knapp, an Oak Ridge researcher.

Monoclonal antibodies—so named because they are produced from a single cell—bonded with bismuth-213 are ideal for treating a liquid tumor like leukemia, says Knapp. “Because of the type of radioactive particles emitted by the radioisotope, these antibodies are very effective against small clumps of cells like leukemia tumors.”

Researchers at Oak Ridge are constantly refining, optimizing and improving the production of useful radioisotopes for medical applications, he says. “We straddle basic and applied research. Once we develop an efficient system to provide a useful radioisotope, and the initial animal studies look promising, our efforts transcend into applied research.”

Larson and Knapp would be the first to admit that none of this would be possible without support from the Department of Energy and the National Institutes of Health. “DOE has been an essential player in radioisotopes for therapy,” says Larson, “especially the more novel or exotic ones.”

Last year, the agency launched its Advanced Nuclear Medicine Initiative, which supports research in therapeutic applications of radioisotopes. Under this program, DOE is providing research grants and affordable isotopes. “Trials like the one we’re conducting are very expensive,” says Larson. DOE’s program will accelerate the process by providing more of the radioisotopes and early technical support for developing radiolabeled antibodies, he adds.

Until recently, most of the successes in the medical use of radioisotopes have been in the diagnosis of cancer and other diseases. Now, advances in molecular biology are paving the way for the use of radioisotopes in treating disease.

“I foresee the day when we can kill individual cells,” Larson says. “That’s the great potential, and that’s why we’re so excited about targeted therapy.”

PHOTO COURTESY OF OAK RIDGE NATIONAL LABORATORY



Oak Ridge researchers use chemical synthesis in targeting radioisotopes for therapy and diagnosis

Nuclear Energy R&D—Up, Up and Abroad

Encouraged by congressional support for nuclear energy research and development, the Energy Department is looking ahead—and abroad. With \$27.4 million in fiscal 2000 funding for two R&D programs—the Nuclear Energy Research Initiative (NERI) and the Nuclear Energy



Bill Magwood,
head of DOE's Office of
Nuclear Energy, Science
and Technology

"There is sufficient motivation to use nuclear energy, but advanced R&D is needed."

Plant Optimization (NEPO) program—DOE has requested \$40 million for the coming fiscal year. Of that amount, \$7 million would be used for international collaboration under the NERI program.

Current funding is a far cry from that in fiscal

1998, when no money was appropriated for nuclear energy R&D. "That gave us time to think about the Energy Department's role in this area," DOE's Bill Magwood told those attending the second Nuclear Energy R&D Summit earlier this month.

Out of that deliberation—with input from the academic world, national laboratories and the nuclear industry—came NERI and NEPO. Both embraced many of the recommendations made by a presidential advisory committee in a 1997 report.

Electricity demand is growing rapidly, especially in developing countries, said Magwood, head of the agency's Office of Nuclear Energy, Science and Technology. There is sufficient motivation to use nuclear energy, he said, but advanced R&D is needed to eliminate some of the barriers to the expansion of this energy source around the globe. That's where officials from nuclear utilities, equipment and service vendors, national laboratories and universities come in.

There's been a great change in the way the nuclear energy industry is viewed in Congress and

the business community, thanks in part to improved nuclear plant performance and safety, NEI President and CEO Joe Colvin told summit participants. Growing recognition of nuclear energy's value as a reliable and emission-free source of electricity has boosted support for nuclear R&D.

But the fiscal 2001 request for nuclear R&D funding was built on past appropriations, when nuclear energy's ability to compete was uncertain, Colvin said. Now, when the industry's performance is breaking records, "we need to aim higher. Without [greater] funding we cannot face what lies before us—the challenges of meeting increased energy demand both in the United States and around the world."

Colvin then posed a question: "How do we move forward as a group?"

More than 80 summit participants spent a couple of hours brainstorming answers to that question. They came up with about two dozen suggestions, which should ensure that nuclear energy continues to play a vital role in the world's energy supply.

NYPA Mulls Competing Nuclear Plant Bids

A few years ago, a bidding war over two nuclear power plants would have been inconceivable. But in today's marketplace, it's taken in stride—a sign of the growing recognition of nuclear plants' market value.

After months of negotiations, New Orleans-based Entergy Nuclear agreed in mid-February to buy the New York Power Authority's Indian Point 3 and FitzPatrick nuclear plants. Less than two weeks later, in stepped another suitor: Dominion Resources. The Virginia-based company topped Entergy's price of \$638 million for the two plants,

plus \$171 million for the nuclear fuel, by offering to pay \$686 million for the plants and matching the offer for the fuel.

"The big secret is out," said Barry Abramson, managing director and utility analyst with PaineWebber. "Buyers can make a lot of money operating a nuclear plant well in a deregulated market."

Entergy owns and operates the two-unit Arkansas Nuclear One, Waterford 3 and the River Bend plants in Louisiana and the Grand Gulf nuclear plant in Mississippi, as well as the Pilgrim

plant in Massachusetts—which it bought from Boston Edison last July.

Virginia-based Dominion owns and operates the two-unit North Anna plant and the two-unit Surry plant.

The New York Power Authority staff is holding discussions with Entergy and Dominion Resources on their competing offers to buy Indian Point 3, a 980-megawatt unit on the Hudson River outside New York City, and FitzPatrick, an 800-megawatt unit near Oswego.

International Consensus on Need for Nuclear

Nine nations have gone on record to say that nuclear energy will continue to be an important source of reliable, emission-free electricity in the years to come. They intend to do what they can to ensure that a new generation of nuclear power plants is available by 2020.

Their motivation: rapidly rising global demand for electricity, especially in developing nations, and growing concern about the “consequences of air pollution and greenhouse gas emissions.”

The nine countries—Argentina, Brazil, Canada, France, Japan, the Republic of Korea, South Africa, the United Kingdom and the United States—issued a joint statement in late January. In it, they agreed that the next generation—Generation IV—of nuclear power plants should be studied as an option for the future. Today’s advanced light water

reactors—Generation III—will remain a viable option in some countries for the next two decades, said government officials of the nine countries. But they recommended an improvement in the cost-competitiveness of the designs, which include General Electric’s Advanced Boiling Water Reactor, ABB Combustion Engineering’s System 80+ and Westinghouse’s AP600.

“I am encouraged by the consensus reached by these diverse nations to collectively consider and pursue next generation [nuclear] technologies that are more proliferation-resistant, safe and economical,” said Ernest Moniz, Under Secretary of Energy. “Hopefully, an international R&D effort will evolve from further discussion.”

The Generation IV plants won’t represent a new start, however. Rather, they will be part of the

continuum of nuclear plant designs. Generation II plants are today’s workhorses, which continue to set new production and safety records without emitting greenhouse gases. Many of these plants will renew their operating licenses, thus maximizing their design life.

They owe some of their efficiency improvements to the Generation III plants now approved by the Nuclear Regulatory Commission for construction. The lessons learned from Generation III designs have been fed back into the current operating plants. By the same token, the cost reductions identified through work on Generation IV plants could be applied to Generation III designs.

The next step: An expert group will develop specific recommendations on the future direction of multilateral cooperation.

New Jersey Plants Generate More Than Power

A couple of nuclear power plants have had quite an impact on southern New Jersey. An economic impact, that is. The plants—Salem and Hope Creek—are responsible for:

- 1,164 jobs created
- \$71.3 million in sales
- \$35.4 million in wages
- \$4.7 million in indirect state and local taxes.

And—oh yes—they also produced almost 24 billion kilowatt-hours of emission-free electricity in 1998. Data from that year have been analyzed by William Latham of the University of Delaware’s Department of Economics. He found that Public Service Electric and Gas (PSE&G), which operates the two nuclear plants, spent \$122.6 million—more than half its total nuclear-related expenditures—in five counties in southern New Jersey. The direct and indirect, or ripple, effect of that money helped a number of businesses, from restaurants to insur-



PHOTO COURTESY OF PSE&G

The Boy Scouts benefit from plant workers’ contributions of money—and time

ance companies to retail shops.

Charitable and nonprofit organizations benefited, too. Employees at the company’s nuclear plants contributed almost \$170,000 to such groups as the American Heart Association and the Boy Scouts of America.

The economic ripple extended beyond the five counties of southern New Jersey. In Pennsylvania, PSE&G spent more than \$55 million, and it spent \$29.2 million in Delaware. PSE&G’s expenditures

in all three states were more than \$200 million. The total impact—6,231 jobs, \$286 million in sales and \$267 million in wages—puts PSE&G’s nuclear operations among the state’s top employers.

But it’s the benefit to small employers that has really made a difference, Latham points out. Some of those companies would otherwise find it hard to stay in business, he says. The managers of two small restaurants in New Jersey’s Salem County told Latham that they depended on business generated by the nuclear plants to keep them going.

“The facts and figures contained in the report are impressive,” said Harry Keiser, president of PSEG Nuclear. “But it’s also important to keep in mind that the lives and livelihoods of real people are reflected in these numbers.”

Updating the Atomic Energy Act



Sen. Pete Domenici

At the time of its passage in 1954, the Atomic Energy Act was pioneering legislation. It permitted private ownership of nuclear power plants, opening the way for the development of commercial

nuclear energy. Not surprisingly, the act is showing its age—in large measure because of the restructuring of the electric power industry.

In the current business environment, nuclear power plants are being sold—and bought. Operating licenses are being transferred. New corporate entities are being formed.

To address these changes, Sen. Pete Domenici (R-N.M.) has introduced a bill that would, among other things, bring the Atomic Energy Act up to date. The bill—S. 2016—includes provisions to:

- eliminate prohibitions on foreign ownership of a U.S. nuclear power plant while preserving provisions that protect U.S. security interests
- eliminate antitrust reviews by the Nuclear Regulatory Commission during license transfer proceedings, since other federal agencies already have comprehensive responsibility for enforcing antitrust laws affecting electric utilities
- allow the NRC to hold legislative-style hearings instead of trial-style hearings in license transfer cases
- authorize the NRC to require companies not licensed by the agency to comply with their nuclear decommissioning funding obligations.

“These changes are necessary to ensure that nuclear energy remains part of our nation’s energy portfolio,” said Domenici.

“Sen. Domenici deserves great credit for identifying important changes to the Atomic Energy Act that are needed to reflect new business realities,” said Marvin Fertel, NEI senior vice president. “Left unchanged, the Atomic Energy Act could delay or frustrate the industry’s ability to reposition its nuclear generating assets in response to restructuring.”

A Good Practice Shared Is a Good Practice Gained

Exchanges Are Secret of Industry’s Success

There’s a secret behind the nuclear energy industry’s soaring performance. Give up? It’s sharing—of information, experience, ideas.

The idea of sharing good practices isn’t new. Nuclear power plants have been doing it for a couple of decades. What’s significant is that—at a time of developing competition—the exchanges continue. Nuclear power plant employees are talking with each other through the industrywide benchmarking program. As a result, plants are becoming ever more efficient, and production costs continue to fall.

These successes are measurable, and they reinforce the value of benchmarking. This is how it works.

Using an economic model that describes key plant processes, a team screens all plants for the most efficient and effective selected process—radiological work during refueling outages, for example, or cost-effective business practices. The team then surveys all plant sites and selects several for a visit, during which team members interview plant staff to learn what lies behind their good practices.

Benchmarking is at the root of the industry’s dramatic rise in electricity production and plant efficiency. In just five years, output has risen from 640 billion kilowatt-hours in 1994 to an estimated

720 billion kilowatt-hours last year, even though there were six fewer operating units. Capacity factor—which measures a plant’s actual electrical output against its potential output—has jumped from 75.1 percent in 1994 to 86.8 percent last year.

Benchmarking also has helped prepare the industry for competition. The nuclear operating company that acquires new plants may have one way of doing business. The acquired plant’s way may be different. How to reconcile? The benchmarking model can help. It allows an operating company to build a kind of regional standardization for all major work processes.

There is little doubt that companies will continue to cooperate—competition notwithstanding.

“Regardless of the size of the nuclear operation, I think we all understand the importance of sharing appropriate information,” says George Hairston, president and CEO of Southern Nuclear. “You are your brother’s keeper.”

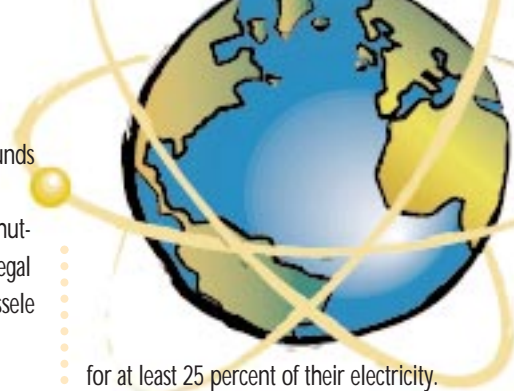
That’s a view shared by Allen Franklin, Southern Company president and chief operating officer. He believes that the industry must not lose sight of its mutual interest as it moves into the competitive arena. “We should err on the side of sharing too much information,” says Franklin.

Watch This Space

Hollywood has its Oscar. The nuclear industry has its TIP Award. Each year, the award goes to the company—or companies—with the best new practice that others in the industry can adopt.

Established in 1994, the Top Industry Practice Awards recognize innovative projects that meet several criteria, including improving safety, reducing costs, increasing productivity and efficiency.

This year’s winner or winners will be announced in early May, at the annual Nuclear Energy Assembly in Chicago. Stay tuned.



POLITICS CAN'T CLOSE DOWN DUTCH PLANT

The Netherlands' only operating nuclear power plant—Borssele—is no longer facing imminent shutdown. Last month, the Dutch High Administrative Court annulled a change to the plant's license that would have forced Borssele to close by the end of 2003.



In 1994, the Dutch parliament narrowly voted in favor of shutting down the 449-megawatt plant. Following the vote, the Ministry of Economic Affairs amended Borssele's operating license to expire Dec. 31, 2003. Last December, employees of EPZ—the Dutch utility that operates Borssele—challenged the amendment before the Dutch high court. EPZ staff argued that the economic affairs ministry did not produce an environmental justification for the forced closure of the plant, and because replacement power would be supplied by a fossil-fired plant, the license change was invalid.

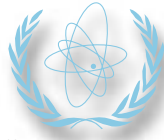
Borssele provides more than 4 percent of the country's electricity and would account for 2-3 percent of the Netherlands' carbon dioxide reductions under the Kyoto accord.

In its decision, the Dutch high court said

the country's atomic law specifies the grounds on which a nuclear license can be denied. Because the decision to force the plant's shutdown was politically motivated, it has no legal basis. As a result of the court's ruling, Borssele now has no limit on its operating license.

GLOBAL PLANT DATA FOR 1999

The global nuclear industry is alive and well, judging by data from an International Atomic Energy Agency survey. Last year, four new nuclear power plants were connected to the electrical grid. In addition, construction was begun on seven new plants—bringing the total number of plants under construction to 38.



New plants came on line in France, India, South Korea and the Slovak Republic, and construction was begun on plants in China, Taiwan, Japan and South Korea.

The 10 countries with the highest reliance on nuclear energy in 1999 were: France (75%), Lithuania (73.1%), Belgium (57.7%), Bulgaria (47.1%), Slovak Republic (47%), Sweden (46.8%), Ukraine (43.8%), South Korea (42.8%), Hungary (38.3%) and Armenia (36.4%).

Eighteen countries rely on nuclear energy

for at least 25 percent of their electricity.

A total of 436 nuclear power plants generated almost 2.4 trillion kilowatt-hours of electricity in 1999, a 3 percent increase over 1998 output.

FRESH SUPPLY OF NEW NUCLEAR PLANTS

What do Brazil, France and South Korea have in common? New nuclear plants.

Angra 2, a 1,309-megawatt pressurized water reactor, will begin operating this month in Brazil. In France, the country's 58th nuclear unit was connected to the electrical grid earlier this month. The 1,450-megawatt Civaux 2 is the fourth and last unit in France's N4 "family," which is serving as a benchmark for the next-generation European Pressurized Water Reactor being developed jointly by France and Germany. And the completion of Unit 4 at the Ulchin plant brings the number of nuclear units in South Korea to 16. The country's nuclear plants account for 29 percent of South Korea's generating capacity and supply more than 40 percent of its electricity.

People Are Talking About Yucca Mountain

For five months, members of the public have been speaking out at nationwide meetings held by the Energy Department to elicit comments on its draft environmental review of Yucca Mountain—site of a proposed repository for used nuclear fuel. Here's what a couple of the participants said:

"The topography is as good as it gets. ...Yucca combines the best of Mother Nature with the best of engineering."

—Jack Barraclough, Idaho state representative

"Go to any major city in the United States and you'll find that the air there contains mercury, sulfur dioxide, carbon monoxide. Nuclear energy produces none of these things. It does produce a small amount of spent fuel, and the question we face today is where should we put that fuel."

—Fletcher Newton, president, Power Resources Inc.

A Safer Burger

Eating a big juicy burger might make you feel guilty. But if it's been irradiated, it's unlikely to make you sick.

Irradiation—the use of gamma rays to reduce and eliminate bacteria in food—is widely accepted as safe and efficient. Last month, the U.S. Department of Agriculture approved the use of radiation in meat, including ground beef—the stuff of burgers. The World Health Organization, the Food and Agriculture Organization, the American Medical Association and the American Dietetic Association had previously endorsed it. Irradiation of poultry, fruits and vegetables is already approved.



Most spices sold in this country are irradiated. And NASA has included irradiated foods on the menus of its space flights since the 1960s.

More than 6.5 million serious cases of food-related illnesses occur in the United States each year, causing more than 10,000 deaths, according to the national Centers for Disease Control and Prevention. Without irradiation, hundreds of people in 1993 became ill, and three children in Washington state died, after eating fast-food hamburgers contaminated with a virulent strain of E. coli.

Irradiation doesn't "compromise the nutritional quality of treated products," says the Food and Drug Administration. But irradiation can't do anything about the guilt!

NUCLEAR ENERGY insight

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