NUCLEAR ENERGY
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Getting Their Just Rewards

Young Engineers Savor Challenges of Working at a Nuclear Plant

The new economy needs juice—and lots of it. Electricity demand is growing faster than expected, fueled in part by the Internet.

The nation's nuclear power plants are doing their part to meet the rising demand. And they'll continue producing reliable power well into the 21st century. But will there be enough engineers to support the plants?

Some of the young professionals working at nuclear plants today are likely to answer that question by divulging a little-known fact: engineering jobs at a nuclear plant are challenging, varied and satisfying.

Ask Matthew Norris if he's bored with his job at Southern Co.'s Vogtle nuclear plant in Georgia, and he'll just laugh. "There's no reason to be bored—there's a new challenge every day," says the chemical engineer.

"You're given ownership," Norris says of the systems he's responsible for maintaining. "Management says: 'This is where we are, and this is where we want to be. We'll provide the tools and the training resources. You take us from A to B.' There's a lot of training and review, but no micro-management."

When he was a graduate student in chemical engineering, Norris thought only nuclear engineers work at nuclear plants. But after interviewing at Vogtle, he discovered that the plant employs all kinds of engineers—mechanical, electrical, chemical, civil and industrial.

Nicole Faulk—a mechanical engineer at Southern Co.'s Farley plant in Alabama—relishes the variety. "For me, there's no such thing as a typical day," she says. But that suits Faulk. "Most engineers don't want to be in a rut.

"One of the most exciting things for me is to put on a hard hat and look at a challenging maintenance problem in the plant," says Faulk. When she and the maintenance team resolve a problem that's keeping the plant from operating exactly as it should, "you feel rewarded."

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A Couple of WISE Guys Get Wiser

Jason Wilds and Justin Hendrix are a couple of WISE guys—and proud of it. That's WISE as in Washington Internships for Students of Engineering, the program that brought the two university students to Washington, D.C., this summer.

Wilds and Hendrix were among 14 third-year engineering students selected from across the country to spend 10 weeks learning how government officials make decisions on complex technological issues and how engineers can contribute to legislative and regulatory public policy decisions.

"The program put public policy in perspective," says Hendrix, who's studying for a degree in mechanical/nuclear engineering at Kansas State University. "I realized that there's more to a policy decision than a technical solution." The program also helped sharpen his career focus. "I feel a lot more confident about the opportunities in the nuclear industry," says Hendrix.

Justin Hendrix (left) and Jason Wilds (right).

Wilds, a chemical engineering student at Tennessee Technological University, says there's no nuclear engineering department at his university. "But a lot of engineers with a degree in one discipline end up working in a different engineering area." He adds that—thanks to the WISE program and his internship at the Nuclear Energy Institute—"I'm an advocate of nuclear energy."

Young engineers from page 1

Most engineers are more interested in "how you do things—the process—than what you do," Vogtle's Norris believes. He credits the industry's root cause and corrective action program—used by all U.S. nuclear plants—with fostering problem solving. Through the program, "you learn how to solve a problem, not just treat the symptoms," says Norris.

Nicole Faulk
Plant Farley
Southern Co.

"One of the most exciting things for me is to put on a hard hat and look at a challenging maintenance problem in the plant."

Mike Gillin loves his job. After 14 months on the job at PECO Energy's Limerick nuclear plant, the mechanical engineer says he's "honored and humbled by the amount of responsibility" he's been given. Gillin's job is to monitor the performance, plan the work and manage all projects for seven plant systems. "I'm entrusted with million-dollar projects and given the opportunity to prove myself," he says.

While Vogtle's Norris feels gratified by solving both day-to-day and longer-term maintenance issues, the greatest satisfaction comes from generating electricity, he says. "It's the ultimate raw material—used by almost all other industries."

These young engineers don't feel they are pigeon-holed. "I do a lot of mechanical and electrical work," says chemical engineer Norris. "It's a very rounding experience." Anne Silber, a nuclear engineer at Tennessee Valley Authority's Sequoyah plant, agrees. "I've been given a lot of opportunities and have seen many different parts of the job," she says. "The company is interested in making us as well-rounded as possible."

After acquiring such broad experience, isn't there a risk that many young engineers will seek jobs elsewhere? It's not likely, says Vogtle's Norris. Many nuclear operating companies emphasize training and professional development. Limerick's Gillin says PECO makes clear the opportunities—including "the ability to climb to the supervisory ranks"—available to its employees.

Farley's Faulk and the others actively recruit new engineers. "Who better to tell someone what the job involves than the person who does it," she says. At TVA's Sequoyah plant, Silber and a fellow engineer, Autumn Terbrueggen, promote co-op programs for engineering students. "I was a co-op student at Sequoyah," says Terbrueggen, who has degrees in electrical and civil engineering. "Thanks to the program, I learned how nuclear plants work."

Getting inside a nuclear power plant makes all the difference. "Even if co-op students don't take a job in the nuclear industry, their perceptions about nuclear energy will change," says Silber.

Despite employees' recruiting efforts, young engineers are still in a minority at most nuclear power plants. But that is about to change, says Chuck Goodnight, a consultant with Tim D. Martin & Associates. The average age of a nuclear plant employee now is 47, and some 12 percent of engineers will be eligible to retire within the next three years. Goodnight expects the demand for engineers to increase as attrition begins to take effect. In response, nuclear operating company executives are building tomorrow's workforce, recruiting young professionals on college and university campuses, at career fairs and through student co-op programs.

To those who wonder if tomorrow's engineers will have a plant to go to, Sequoyah's Silber says simply: "The industry does have a future. As reliable suppliers of needed electricity, nuclear plants won't be going away."

Hands-On Experience

Few people would buy a car without test driving it. But many of today's nuclear engineering students don't see the inside of a nuclear power plant—or a nuclear operating company—before they start working at one. There's a way to change that, says Deborah Laughton. "Open the company's doors to interns."

Laughton, who began working at Commonwealth Edison after graduation from college, participated in the Washington Internships for Students of Engineering in 1994. She believes that students benefit by seeing what it's like to work in a nuclear plant and discovering "the broad range of engineers who work in the industry." The company gets "young engineers with fresh ideas"—and perhaps future employees.

Emily Deckard jumped at the chance to be a co-op student at ComEd. After spending a "semester" at the company, she's back at Purdue University, where she's a sophomore pursuing a nuclear engineering degree. "By alternating between school and the company, it will take five years to get my degree instead of four," says Deckard. But she'll end up with two years of work experience. Already, it's paying off, she says. "ComEd keeps increasing my responsibilities and I see myself growing as a result."

Deckard wants a career in nuclear medicine, which means she won't end up working for ComEd. No matter. "People at the company who know of my interest have encouraged me to go into nuclear medicine," she says. There's likely to be no shortage of career opportunities in the field. A report by consulting firm Frost & Sullivan notes that—because of the large number of retiring nuclear scientists—"the number of professionals entering the [nuclear medicine] field must continue to grow."

Industry Consolidation Pace Quickens

Consolidation is "great for the [nuclear energy] industry and will make plants stronger both financially and in terms of operations," says utility analyst Barry Abramson, a managing director with PaineWebber Inc.

Wall Street sees the value of this consolidation trend and is increasingly bullish on nuclear plant license renewals, according to Abramson. "To get another 20 years of operation from an already inexpensive operator makes good financial sense," he says.

In the search for increased operating efficiencies and higher levels of cost competitiveness, nuclear energy companies are turning to mergers, strategic acquisitions, even productivity tools such as benchmarking to find their place in the emerging utility landscape. They also recognize the value of nuclear energy in their electricity generation mix.

PLANT SALE PRICES CONTINUE TO SOAR

Dominion Resources has agreed to buy Northeast Utilities' Millstone nuclear power plant. Under the agreement, Dominion will pay approximately $1.3 billion in cash for the three-unit plant on the Long Island Sound near New London, Conn. The figure reflects ever-higher nuclear plant sale prices, topping the previous record of $976 million paid by Entergy Nuclear earlier this year for two nuclear power plants in New York State. According to Robert McWhinney, president and CEO of S&W Consultants, the rising prices paid for nuclear plants reflect a decrease in perceived financial risks. "Now that a number of sales are complete, buyers are more confident."

Dominion, which already owns and operates two nuclear plants in Virginia—the two-unit North Anna plant and the two-unit Surry plant—will add Millstone units 2 and 3 to its nuclear fleet. The company is also buying Millstone Unit 1, which was closed in 1998 and is being prepared for decommissioning.

"This acquisition supports our broader corporate strategy to become a major energy provider of choice in the Northeast, Midwest and Mid-Atlantic regions," said Thomas Capps, chairman, president and CEO of Dominion. By adding Millstone to its portfolio of generating assets, Dominion will be positioned to significantly increase its market share in New England.

Merger of Equals Forms Largest U.S. Power Company

Juno Beach, Fla., and New Orleans. A new industry powerhouse has been created with the announcement that Entergy Corp. and FPL Group Ltd. have agreed to merge. With a combined customer base of 6.3 million and a generation capacity of more than 48,000 megawatts, the new company, to be named at a later date, will be the largest U.S. electric utility and the largest power producer. It will be number two in nuclear generation, with more than 10,000 megawatts of capacity at nine nuclear generating units.

"From a business standpoint, this merger appears to make a lot of sense," says James Asselstine, a Lehman Brothers managing director and bond analyst. "It will integrate two companies that are relatively near each other in the Southeast, with an attractive mix of unregulated and regulated businesses."

PaineWebber's Abramson says that "Wall Street looks very favorably on the merger because it is a logical combination." The financial community likes the combination of "two of the top-performing nuclear companies, because they can only get better," he says.

NRC APPROVES TRANSFER OF 20 OPERATING LICENSES TO EXELON

The Nuclear Regulatory Commission has approved the transfer of the operating licenses for 20 nuclear generating units from Commonwealth Edison Co. and PECO Energy Co. to Exelon Generation Co. Exelon Generation is being formed in connection with the proposed merger of Unicom Corp., the parent of Commonwealth Edison, and PECO.

The transfer affects 13 Commonwealth Edison nuclear generating units—three of which are closed—and seven PECO units, one of which is closed. The key issues considered by the NRC's technical staff included decommissioning funding, insurance and Exelon's technical and financial qualifications.

SALE OF OYSTER CREEK IS FINAL

The sale of GPU Inc.'s Oyster Creek nuclear power plant to AmerGen Energy for $10 million has been finalized. The sale of the 619-megawatt plant marks GPU's exit from the generation business. Last year, GPU sold its Three Mile Island Unit 1 to AmerGen for $100 million.

With the sale, AmerGen—a joint venture between PECO Energy Co. and British Energy—has purchased three nuclear plants and has a purchase agreement pending for a fourth. In contrast to GPU, AmerGen's corporate strategy emphasizes the acquisition of additional nuclear electricity generation.

"We are pleased to be acquiring another quality nuclear plant," said Jerry Rainey, AmerGen's CEO. "Oyster Creek is a good fit for our growing generation portfolio."

Separately, GPU announced last month that it is merging with FirstEnergy Corp. in a $4.5 billion cash-and-stock deal. The deal provides a significant market for FirstEnergy's 12,000 megawatts of generating capacity, which includes 3,663 megawatts of nuclear generation.

Careers in the Nuclear Industry

How Engineering Students See the Profession

Hoping to motivate talented engineering students to consider careers in the nuclear industry, NEI thought that listening would be a good start. This spring, NEI asked Bisconti Research Inc. to conduct a series of focus groups with students at several university campuses. Ann Bisconti, the company's president, reflects on the findings.

We spent several weeks on four college campuses talking with 151 students in a variety of engineering majors. The students met with us in 15 focus groups, and they also filled in a questionnaire. The result? We got an earful.

To supplement this information, we analyzed a large database on the backgrounds, interests, and life goals of men and women who entered college in 1999 and previous years and planned to major in engineering. This analysis had not been done before.

Most engineering students never think about majoring or working in the nuclear field. Students say that nuclear majors and careers are invisible to the majority. But those who are made aware of the field most often see nuclear engineering study as too narrow. They also see nuclear industry careers—for any engineering majors—as too narrow.

Today's students are looking for a wide variety of opportunities to do cool new things. They want new problem-solving challenges and stimulating multidirectional career path options.

If nonnuclear engineering majors see the field as narrow, they might be surprised to hear the main reasons why nuclear engineering majors say they chose the field:

- Fascinating, "cool" things to study in nuclear engineering—"It's on the cutting edge of everything…the key to unlocking the door to what we want to do." "It's exciting. You can't see it, feel it, or touch it, but you can measure it." "You design stuff you can't see—like a mystery." "Awesome."
- Variety of applications and many career possibilities in nuclear engineering—"I found there was so much you can do that I didn't know—food, nuclear power plant safety, possibilities for space exploration." "I didn't know how many things you can do—propulsion, petroleum, electricity, food irradiation, medicine, sterilization, MRIs, all kinds of applications—how involved nuclear energy is in our daily lives. It's all around us and people don't know it."
- Multidisciplinary nature of nuclear engineering study—increases the value and marketability of graduates: "You have to know mechanical, electrical, math, thermodynamics."

In the focus groups, nuclear engineering majors also talked about good career opportunities, the supportive family-like atmosphere of their relatively small department, the special programs and scholarship opportunities, the unique opportunities to work with faculty on research, and pride because people think nuclear engineering majors must be very smart.

But most nuclear and nonnuclear engineering majors can't envision what work would be like in a nuclear power plant or other nuclear industry environment—unless they happened to grow up next to a nuclear energy plant. And most have never spoken to a representative of the industry.

Now that the industry is starting once again to give serious attention to campus recruiting, a few students are noticing the presence of recruiters. But they say that company brand and industry image must be established before the students will listen to the message recruiters may bring.

Diversity in Nuclear Engineering

To encourage minorities to pursue degrees in nuclear engineering, the University of Wisconsin-Madison and South Carolina State University have created a dual degree program.

Under the program, funded by the Energy Department, students at South Carolina State University—one of the country's historically black colleges and universities—will be able to earn a nuclear engineering degree from Wisconsin.

South Carolina State students who participate in the program will receive $25,000 in scholarships or fellowships to pursue their degrees. They will spend three years studying general engineering courses. The summer between their junior and senior years, they will begin nuclear engineering classes at Madison. After returning to South Carolina State for the fall semester, the students will spend their final semester and summer at Madison.

Those who complete the program will receive dual degrees from the two universities. Students who complete the requirements for a bachelor's degree at South Carolina State may enroll at Madison for a master's degree in nuclear engineering.

"We are pleased to have the opportunity to forge this relationship, which will introduce more diversity into the academic arena," said James Anderson, dean of South Carolina State's School of Engineering, Technology and Sciences. "We have many students who will benefit from this relationship and make tremendous contributions to the field."

Yucca Mountain 'Time Machine'

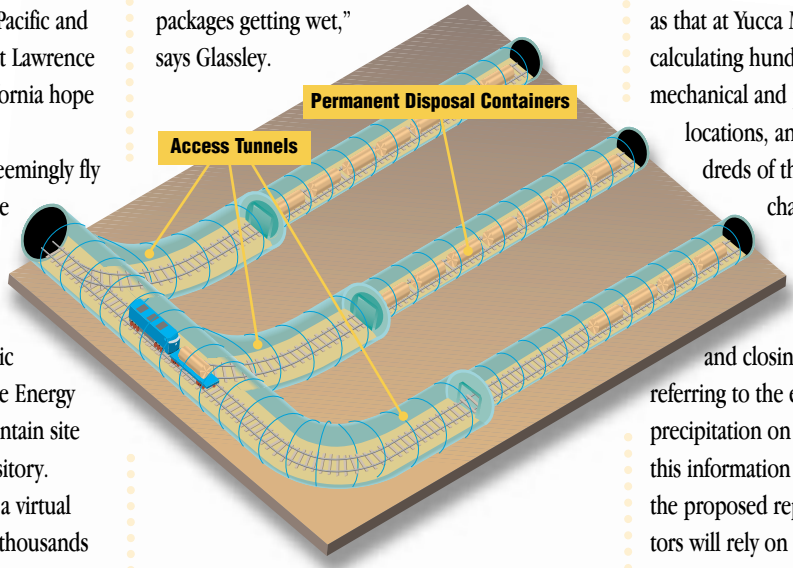
Supercomputer, Powerful Code Offer Glimpse of Future Repository

Imagine being able to take a virtual tour of a used fuel repository at Yucca Mountain in Nevada—thousands of years into the future. That's not as far-fetched as it sounds.

With a supercomputer called Blue Pacific and a powerful computer code, scientists at Lawrence Livermore National Laboratory in California hope to take such a tour soon.

"With 3D glasses, we'll be able to seemingly fly into the tunnels and look around at the waste packages," says Bill Glassley, who—with John Nitao—heads a team that has built a code that models in unprecedented detail the likely geologic evolution of a used fuel repository. The Energy Department is studying the Yucca Mountain site to determine if it is suitable for a repository.

In essence, the team has produced a virtual time machine that can simulate—over thousands of years—the complex interaction of the heat from used fuel with water in the repository's fractured rock. "One of the biggest challenges of the Yucca Mountain project is determining how the mountain will respond to the tremendous amount of heat generated by the buried waste and if any of those geologic responses will result in the waste packages getting wet," says Glassley.



To tackle that challenge, the team started with a DOE supercomputer capable of reducing processing time from months or even years to several hours or less. Next, it built a sophisticated code that tracks the interplay of water, heat, carbon dioxide and chemical reactions in any subsurface environment, including unsaturated sites such as that at Yucca Mountain. By simultaneously calculating hundreds of independent chemical, mechanical and physical variables at millions of locations, and repeating the calculations hundreds of thousands of times, the code tracks changes in the rock that are likely to occur over thousands of years.

"The code is really giving us snapshots in time of the openings and closings of rock fractures," says Glassley, referring to the effects of mineral dissolution and precipitation on fracture surfaces. DOE will use this information in evaluating the performance of the proposed repository site. In addition, regulators will rely on this information to determine whether or not the proposed repository will be able to meet rigorous standards for public health and safety protection far into the future.

DOE, PECO Energy Sign Used Fuel Agreement

To deal with its delay in moving used fuel from nuclear power plant sites, the Energy Department has agreed with PECO Energy Co. on the cost of storing the used fuel at its Peach Bottom plant site in Pennsylvania.

Under a 1982 law, DOE is statutorily and contractually obligated to begin accepting used fuel from plant sites by 1998—when a permanent repository was scheduled to open. The same law established the Nuclear Waste Fund to pay for permanent storage of used fuel. Electricity customers pay a fee of one-tenth of a cent for every kilowatt-hour of nuclear-generated electricity they use. Customer commitments plus interest exceed $17 billion. The new agreement is an amendment to the Peach Bottom contractual obligation. According to one estimate, DOE will not be able to open a repository until at least 2010.

Because of DOE's failure to meet its obligation, nuclear plant operating companies are compelled to build additional on-site storage facilities.

Under the July agreement, PECO can reduce its projected payments to the Nuclear Waste Fund by an amount equal to the costs it incurs in providing additional storage for used fuel at its Peach Bottom plant site. PECO's initial costs are in the range of $30 million. DOE estimates the costs could reach $80 million over the next 10 years. PECO must be able to demonstrate that the costs are the direct result of DOE's failure to move used fuel from the plant site.

Energy Secretary Bill Richardson said he hoped the agreement would be a precedent for additional settlement negotiations with other operating companies.

Corbin McNeill, PECO Energy's chairman, president and CEO, called the contract amendment "a positive step forward" that would provide for the appropriate reimbursement of costs resulting from DOE's delay in building a repository without impairing the Nuclear Waste Fund.

Nuclear Energy Key to Energy Security, Clean Air

Recognize Value of Major Nonemitting Electricity Source, Experts Tell House Panel

If the United States is to achieve energy independence while it meets tougher air quality standards, it must continue to use nuclear energy.

That was the conclusion of a four-member panel of energy experts who appeared before a House subcommittee in July.

"Issues related to reliability of supply and the need for emission controls are once again converging as they did in the 1960s and '70s," NEI's Maureen Koetz told the House Science Subcommittee on Energy and Environment. "Federal policymaking, especially national energy policy, must re-examine nuclear power's unique and irreplaceable value as an expandable, emission-free energy source, and craft policies and programs so electricity markets recognize and reward that value," said NEI's environmental policy director.

Koetz said that nuclear energy is one of the most successful energy security programs in the United States. "Today, our 103 nuclear power reactors continue to provide a reliable hedge against volatile fuel prices and other energy supply disruptions, protecting American businesses and homes from fluctuating cost and providing a reliable supply of electricity."

"A ton of pollution avoided is as valuable as a ton reduced."

On continuing the use of nuclear energy to meet air quality standards, Koetz called on lawmakers to recognize that "a ton of pollution avoided is as valuable as a ton reduced." In 1999 alone, U.S. nuclear plants avoided 168 million metric tons of carbon. That number grows each year as electricity production at nuclear plants increases.

"Nuclear energy belongs in the portfolio of strategies that we use to address this array of challenges," said John Holdren, a Harvard University professor and member of the President's Committee of Advisors on Science and Technology. Holdren decried "the complacency" that persists in the world's view of energy issues. Continuing on the current energy course, he said, risks climatic disruptions that "will become the dominant environmental problem of the 21st century."

James Duderstadt, chairman of the Department of Energy's Nuclear Energy Research Advisory Committee, said "there is an urgent sense that the nation must rapidly restore an adequate investment in basic and applied research in nuclear energy if it is to sustain a viable U.S. capability in the 21st century." A recent study by the DOE advisory committee recommends that nuclear energy R&D funding increase to $240 million annually by 2005. That represents a sixfold increase over current funding levels.

Citing nuclear energy's clean-air attributes, Pulitzer Prize-winning author and historian Richard Rhodes told the panel: "Shocking as the statement may sound after all the years of misrepresentation, nuclear power is demonstrably the greenest form of large-scale energy generation at hand. ...The fundamental advantage of nuclear power is its ability to wrest enormous energy from a small volume of fuel." Nuclear energy accounts for two-thirds of all nonemitting electricity sources in the United States.

Subcommittee Chairman Ken Calvert (R-Calif.) said that every energy source has risks, costs and benefits. "The challenge we face in formulating a comprehensive energy policy is how to balance the costs and benefits in a way that minimizes environmental impacts yet provides the energy we need to prosper."

Now Hear This

"About 20 percent of our electricity comes from nuclear power plants. [But] keeping the same percentage of nuclear won't solve all our [environmental] problems. We need to increase nuclear generation by 10 percent to deal with clean air needs in nonattainment areas [those areas of the country where air pollution levels exceed national standards]."

— Sen. Larry Craig (R-Idaho), speaking at The Heritage Foundation, Washington, D.C., July 18, 2000.

Clean Electricity at a Glance

Midwest Region

- 28 nuclear generating units produced 169.0 billion kilowatt-hours of electricity in 1999
- Emissions avoided by nuclear plants in 1999:
  - SO_2 - 923,164 short tons
  - NO_x - 454,118 short tons
  - CO_2 - 39,027.187 metric tons

Northeast Region

- 26 nuclear generating units produced 166.8 billion kilowatt-hours of electricity in 1999
- Emissions avoided by nuclear plants in 1999:
  - SO_2 - 906,700 short tons
  - NO_x - 454,251 short tons
  - CO_2 - 38,322,163 metric tons

West Region

- 8 nuclear generating units produced 69.9 billion kilowatt-hours of electricity in 1999
- Emissions avoided by nuclear plants in 1999:
  - SO_2 - 381,209 short tons
  - NO_x - 158,837 short tons
  - CO_2 - 16,138.983 metric tons

South Region

- 41 nuclear generating units produced 322.2 billion kilowatt-hours of electricity in 1999
- Emissions avoided by nuclear plants in 1999:
  - SO_2 - 1,757,377 short tons
  - NO_x - 855,113 short tons
  - CO_2 - 74,282,707 metric tons

Don't Renounce Nuclear Energy

In a bid to encourage "wide debate" about energy in Europe, the European Commission plans to issue a paper providing information on a range of energy options—including nuclear energy. It would be "absolutely imprudent to renounce nuclear" when considering the continent's long-term energy needs, said commission vice president Loyola de Palacio.

Speaking at a Sept. 6 press conference in Brussels, de Palacio said: "We must reevaluate nuclear as part of Europe's energy mix."

Republican, Democratic Platforms Cite Nuclear Energy, Used Fuel

Meeting in Philadelphia in July, the Republican National Convention approved a national platform that recognizes nuclear energy as America's primary source of emission-free electricity.

"The current administration has turned its back on the two sources that produce virtually all the nation's emission-free power: nuclear and hydro, the sources for nearly 30 percent of the country's electricity. Because of cumbersome federal relicensing of hydro and nuclear operations, we face the prospect of increasing emissions and dirtier air."

On the other side of the country, the Democratic National Convention—which met in Los Angeles in August—approved a platform that includes a position on used nuclear fuel.

"America is blessed with abundant low-cost sources of coal, petroleum, and natural gas, but we must use them wisely and ensure that changes in the energy sector promote a workforce whose skills are expanded, utilized, and rewarded. Democrats believe that with the right incentives to encourage the development and deployment of clean energy technologies, we can make all our energy sources cleaner, safer, and healthier for our children. This responsibility includes disposing of nuclear waste in a scientifically sound manner in accordance with standards designed to protect human health and the environment."

Where Is Cassini Now?

The Cassini spacecraft is zooming toward Saturn at more than 31,000 miles an hour. Launched in 1997, the craft will reach its destination in 2004, when it will begin exploring the dynamics of Saturn's rings and moons. The power for Cassini's computers and other equipment comes from three radioisotope thermoelectric generators, or RTGs. The RTGs—which are reliable, long-lived and safe—use the heat from plutonium-238 to generate electricity.

To find out where Cassini is today, go to <http://www.jpl.nasa.gov/cassini/today/>

In November 2004, Cassini will release the Huygens probe to study the clouds, atmosphere and surface of Saturn's moon Titan.

PHOTO COURTESY OF NASA'S JET PROPULSION LABORATORY

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