United States General Accounting Office

GAO

Testimony

Before the Subcommittee on Technology, Committee on Science, and the Subcommittee on Government Management, Information and Technology, Committee on Government Reform, House of Representatives

For Release on Delivery
Expected at
10 a.m.
Tuesday,
October 26, 1999

Y2K COMPUTING CHALLENGE

Nuclear Power Industry Reported Nearly Ready; More Risk Reduction Measures Can Be Taken

Statement of Joel C. Willemssen and Keith A. Rhodes
Directors, Accounting and Information Management Division

GAO
Accountability * Integrity * Reliability

GAO/T-AIMD-00-27

Ms. Chairwoman, Mr. Chairman, and Members of the Subcommittees:

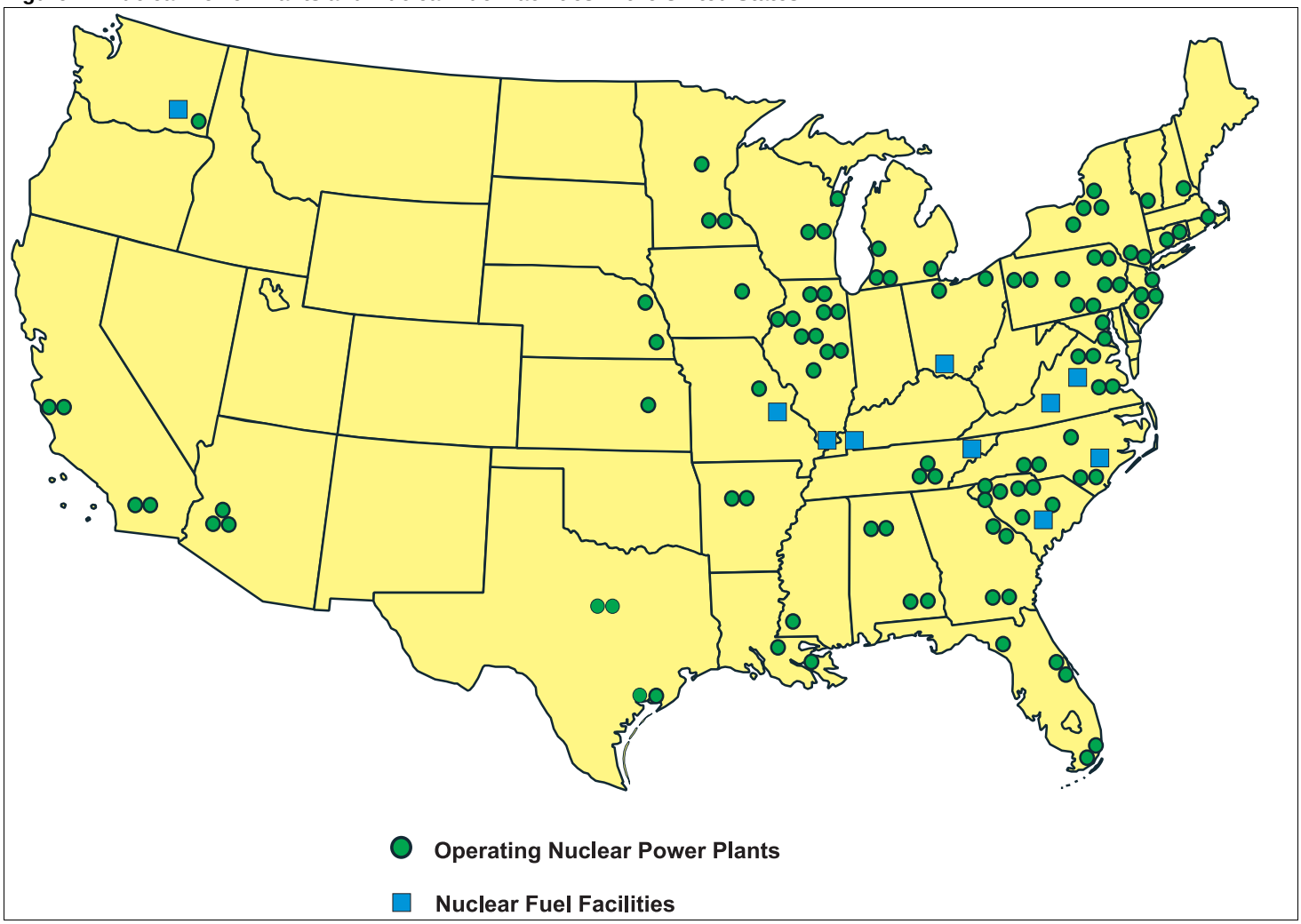
Thank you for inviting us to participate in today's hearing on the Year 2000 (Y2K) readiness of our nation's nuclear power industry. As with any industry, nuclear power plants must ensure that their systems are Y2K ready so that they can continue to operate and maintain an uninterrupted supply of electrical power. Given the nature of the nuclear power industry, a failure in systems could endanger safety and have potentially serious short- and long-term consequences.

As requested, after a brief background discussion, today we will (1) highlight the Y2K status of the nation's nuclear power industry, (2) discuss the Nuclear Regulatory Commission's (NRC) oversight of the industry's Y2K readiness, (3) provide an overview of the industry's contingency planning, and (4) comment on the international readiness of nuclear power plants.

Background

Our nation's nuclear power industry currently consists of 103 operating nuclear power plants. These are run by 41 licensees at 66 sites. According to NRC officials, an additional 19 nuclear power plants have been decommissioned and are no longer operating, although 14 of them continue to store highly radioactive spent nuclear fuel. Ten additional facilities fabricate nuclear fuel. As figure 1 shows, most of the 103 currently operating nuclear power plants and the 10 nuclear fuel facilities are located in the eastern part of the country.

Figure 1: Nuclear Power Plants and Nuclear Fuel Facilities in the United States



Source: NRC and the Nuclear Energy Institute.

Similar to other industrial facilities, nuclear power plants face a wide range of internal and external Y2K risks. Internal risks include the potential loss of reactor monitoring and control and the loss of emergency equipment and services, while external risks may include the loss of off-site electric power, water supply, critical consumables, and the loss of emergency equipment and services.

Probably the most serious external risks faced by a nuclear power plant are the potential instability of the electric power grid and the loss of off-site

electric power. Such events may cause reactor shutdowns, and result in a loss of power or "station blackout." NRC studies show that a major contributor to reactor core damage occurrences is a station blackout event.

Figure 2: A Typical Nuclear Power Plant

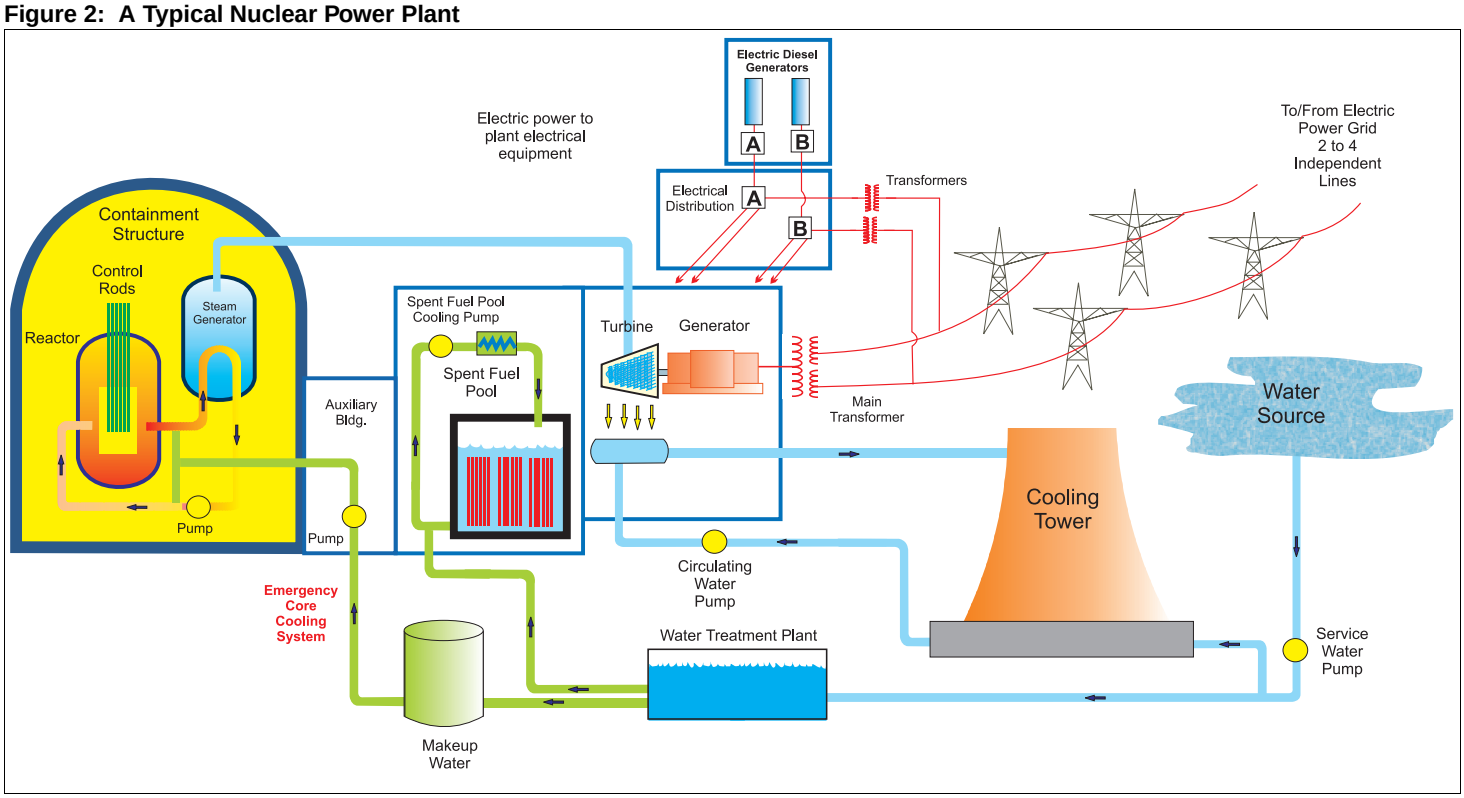


Figure 2 shows the key components of a typical nuclear power plant, and highlights the location of critical safety equipment such as the emergency core cooling pumps. Typically, nuclear power plants have emergency safety systems, including auxiliary feed water (water pumping) systems and standby emergency diesel generators, for cooling the reactors. Normally idle, these systems are designed to be activated during any emergency—such as loss of off-site power—that disrupts the reactor's primary cooling systems.

Currently, all 103 operating nuclear power plants have active reactor cores and, along with 14 of the decommissioned plants, maintain on-site spent nuclear fuel pools. Both the reactor core and the spent fuel must be cooled

to ensure that they are not exposed and do not release lethal radioactive material.

NRC licenses, regulates, and inspects the design, construction, and operation of domestic power plants and nuclear fuel facilities. It has established regulations for the safe operation of the 103 operational reactors, and requires nuclear reactors to have multiple safety systems to control and contain the radioactive materials used in each plant's operation. NRC also requires licensees to test and maintain safety equipment to ensure that this equipment, such as a reactor's emergency cooling system, will operate when needed.

The Nuclear Energy Institute[1] (NEI) has agreed to take the lead in developing industrywide guidance for addressing the Y2K issue at nuclear power plants. NEI was also tasked by the North American Electric Reliability Council (NERC) with monitoring and reporting on the nuclear power industry's Y2K readiness. The Department of Energy has asked NERC to assess and report on the Y2K readiness of the electric power industry.

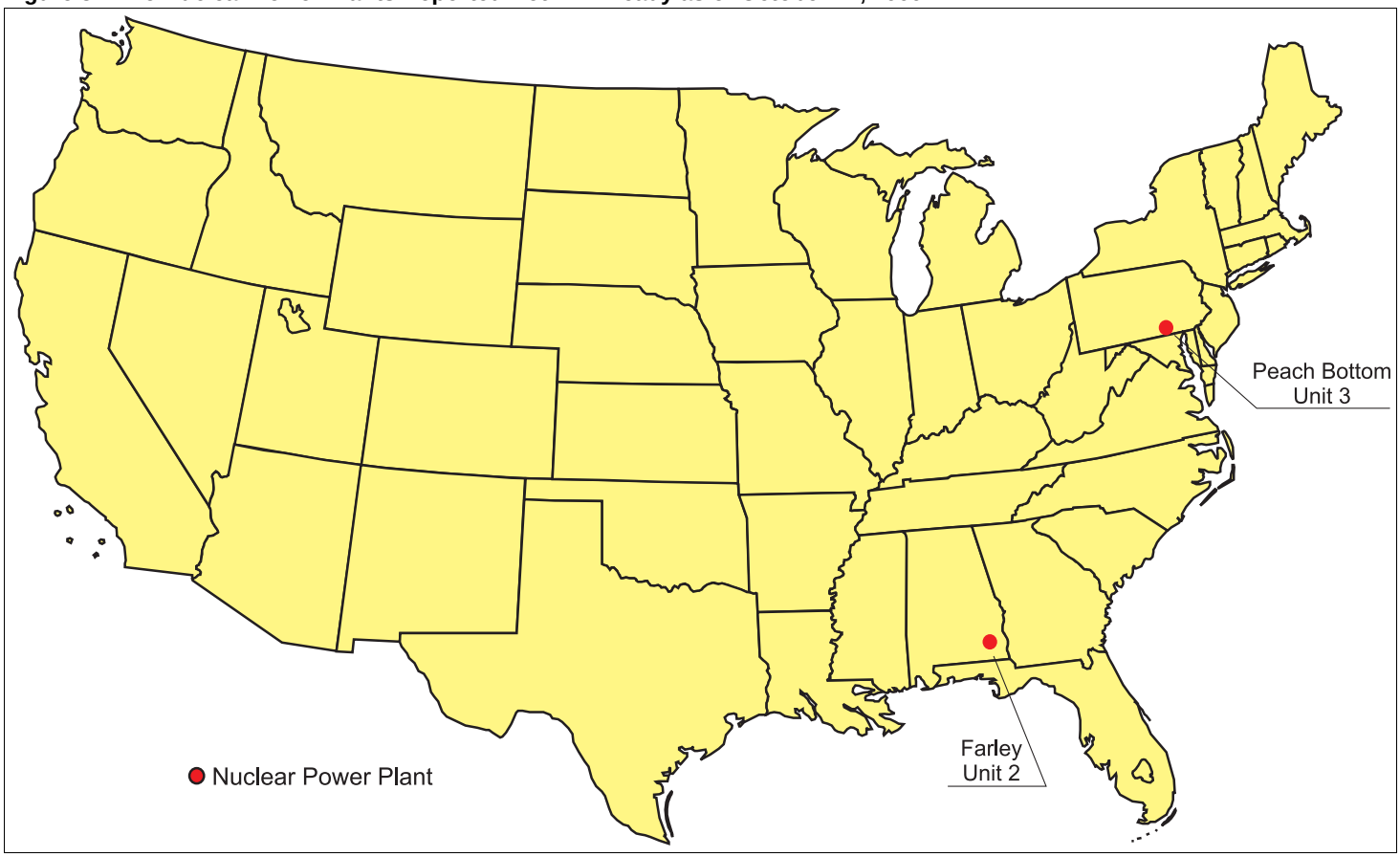
Most U.S. Nuclear Facilities Reported to Be Year 2000 Ready

Last month, NRC reported that 75 of the 103 nuclear power plants were Y2K ready, and that all of the 103 operational nuclear power plants had resolved Y2K-related problems that could affect the performance of systems needed to safely shut down the plants. NRC tracks a plant'sY2K status based on the readiness of systems in three categories: (1) safety systems, which can affect plant protection and emergency shutdown, (2) plant operating and plant support systems, and (3) site support systems, such as administrative systems.

On October 22, 1999, NEI updated the industry's Y2K readiness status and reported that 101 of the 103 nuclear power plants were Y2K ready. According to NEI, for the remaining two nuclear power plants—shown in figure 3—the safety and site support systems are considered to be Y2K ready. NEI reported that the two plants—Peach Bottom 3 and Farley 2—still have remediation work to complete on their plant operating and support systems.

[1]NEI is a policy organization of the nuclear industry that seeks to foster and encourage the safe utilization of nuclear energy.

Figure 3: Two Nuclear Power Plants Reported Not Y2K Ready as of October 22, 1999



Source: NEI.

Table 1 summarizes information provided by NEI on the scope of remediation work remaining at the two plants classified by NRC as not yet Y2K ready. The table shows that one of the plants—Peach Bottom Unit 3—will complete all remediation by the end of October 1999, while the second plant—Farley Unit 2—will not be ready until mid-December 1999.

Table 1: Scheduled Completion Dates for Non-Y2K-Ready Nuclear Power Plants as of October 22, 1999

Licensee	Plant(s)	Open items	Scheduled completion date (1999)
Plant operating and plant support systems			
Philadelphia Electric Company	Peach Bottom 3	Digital Feedwater System	October 31
		Turbine Vibration Monitor	October 31
Southern Nuclear Operating Company	Farley 2	Turbine Digital Electro Hydraulic System	December 16

Source: NEI.

NRC is also responsible for nuclear safety at the decommissioned nuclear power plants operating spent fuel storage facilities. NRC said that it contacted these plants in early 1999, and at that time the plants reported either that their systems were Y2K ready or would be in the near term.

Six of the 10 nuclear fuel facilities reported to NRC that they were Y2K ready by September 1, 1999. The remaining four facilities have all provided NRC with status reports and schedules for remaining work, indicating that they will become Y2K ready by November 1, 1999. All of the nuclear fuel facilities, with the exception of two gaseous diffusion plants, have informed NRC that they plan to be shut down during the Year 2000 rollover period.

NRC Is Providing Oversight of Y2K Activities

Since 1996, NRC has been working with the nuclear power industry—and NEI—to address Y2K in the nuclear power industry. In December 1996, NRC notified all nuclear power plants and fuel facilities about the potential problems that nuclear facility computer systems and software might encounter during the transition from 1999 to 2000. This notification was followed in May 1998 by a letter to all operating nuclear power plant licensees requiring that they submit a written response by July 1999 stating how they planned to address the Y2K problem.

In 1997, NRC asked NEI to take the lead in developing industrywide guidance for addressing the Y2K problems faced by the nation's nuclear power plants. Responding to NRC's request, in October 1997 NEI published its Y2K guide.[2] In our comments[3] on the NRC Y2K approach and on NEI's guide, we noted that they did not adequately address risk management, business continuity and contingency planning, remediation of embedded systems, and independent verification and validation (IV&V) of systems. While NEI did not revise its guide in response to our comments, NRC informed nuclear power plants that the NEI approach and our own Year 2000 assessment guide[4] were approaches that plants might want to follow. NEI later addressed some of the issues we raised regarding its Y2K guide by issuing another guide[5] in August 1998 that focused on contingency planning and risk management.

Regarding reporting of Y2K readiness, in 1998 NRC required all plants to report by July 1, 1999, to confirm if their facilities were Y2K ready or would be by January 1, 2000. This request covered only the safety-related systems required by the plant license and NRC regulations. In January 1999, NRC expanded this reporting requirement to include plant operating and plant support and site support systems that, while not addressed by NRC regulations for safe operation and shutdown, are necessary for continuity of plant operations.

In January 1999, NRC completed audits of 12 Y2K programs involving 42 of the 103 operating nuclear power plants. Areas assessed included software applications and embedded systems and components. Information obtained during these assessments indicated that no significant Y2K problems existed in the plants' systems that would affect their ability to safely operate and shut down.

In March 1999, NRC expanded the scope of its assessments efforts to include all 103 operating nuclear power plant sites. NRC administered to

[2]*Nuclear Utility Year 2000 Readiness* (NEI/NUSMG 97-07, October 1997).

[3]*Year 2000 Readiness: NRC's Proposed Approach Regarding Nuclear Powerplants* (GAO/AIMD-98-90R, March 6, 1998).

[4]*Year 2000 Computing Crisis: An Assessment Guide* (GAO/AIMD-10.1.14, September 1997; initially published as an exposure draft in February 1997).

[5]*Nuclear Utility Year 2000 Readiness Contingency Planning* (NEI/NUSMG 98-07, August 1998).

the 103 operational nuclear power plants a 452-question checklist covering items such as assignment of qualified personnel, testing for critical dates, and testing and validation of remediated software applications or embedded components. These assessments, completed by June 30, 1999, found that 14 of the 103 plants required additional follow-up reviews to more fully evaluate their Y2K programs. In the follow-up reviews, completed by August 13, 1999, NRC staff concluded that 13 of the 14 plants' Y2K programs were consistent with industry guidance. The last plant reported to NRC that it made its Y2K program consistent with the guidance in September 1999.

Regarding the decommissioned nuclear power plants, NRC has not issued specific Y2K guidance. However, it has notified the 14 plants with spent fuel on-site that they should follow the NEI Y2K guidance, and report on their Y2K readiness status. In early 1999, NRC also reviewed readiness activities at these 14 decommissioned plants that still have nuclear fuel. Through these reviews, NRC concluded that the licensees are implementing Y2K changes that address equipment and systems important to safety. At that time, the licensees reported that their computer systems were Y2K ready or would be in the near term. However, NRC does not know the current status for those decommissioned plants that previously reported they were not ready. Because of the risk posed by the spent fuel facilities at these sites, we believe that NRC should evaluate and report on the current Y2K status of these plants.

In June 1998 NRC required nuclear fuel facilities to report by December 31, 1998, whether they were Y2K ready. For facilities expecting to be ready at some point during 1999, NRC asked for a status report of remaining work, and another report by July 1, 1999. In addition, between September 1997 and October 1998, the major fuel facilities were asked Y2K-related questions during routine inspections. Based on these inspections, NRC concluded that the facilities were aware of the Y2K problem and were taking appropriate steps to address it.

NRC has not required that licensees perform an IV&V of their Y2K programs. Use of IV&V would provide NRC—and nuclear power plants' and nuclear fuel facilities' managers—with additional assurance that all critical applications and systems are Y2K ready. In March 1998, when commenting on NRC's proposed Y2K approach, we suggested that NRC require licensees to (1) describe their Y2K plans for IV&V of systems related to safety and (2) provide the results of IV&V with their written certification of Y2K readiness. NRC has not included such a requirement in

its Y2K instructions to licensees. In discussing this with NRC officials, they emphasized that a rigorous quality assurance program exists at each nuclear facility to review and validate modifications to safety systems. While we recognize this, such programs do not deal with the broader issue of Y2K testing of safety systems, or systems supporting plant and site operations.

Although we were told by NRC that some licensees obtained independent technical reviews of each nuclear facility's Y2K system test plans and results, NRC did not have specific, current information identifying the types of Y2K IV&V reviews performed at nuclear power facilities. NRC noted that the industry had reported in April 1999 that multiple audits were completed at 65 of the 66 sites—56 audits by utility quality assurance departments, 36 by cross-utility audits, and 46 by third parties. However, neither NRC nor the industry issued guidelines establishing criteria to ensure consistency of reviews.

In the few months remaining, an opportunity exists for conducting targeted independent reviews of the licensees' Y2K programs. Since neither NRC nor NEI's guidance defined the criteria for what constituted an independent review, it would be of value for NRC to survey the plants to gain an understanding of what independent Y2K IV&V reviews were completed. Based on this information, NRC could then identify plants that may need reviews.

Year 2000 Contingency Plans Developed by All Facilities, But Completion of Plan Testing Uncertain

For many years, nuclear power plants have had contingency plans to deal with a wide range of threats, including earthquakes, tornadoes, and blackouts. Licensees have now had to modify these plans to address the Y2K threat and its accompanying risks, both internal and external.

NRC officials told us that nuclear power plants are following the contingency planning process guidance developed by NEI. This NRC-approved guidance recommended management controls, preparation of individual system contingency plans, and development of an integrated contingency plan that allows the utility to manage Y2K-induced risks.

Between May and June 1999, NRC reviewed the contingency planning activities of 12 operating nuclear power plants, looking at the implementation of NEI's guidance. All 12 plants' planning activities were found to be consistent with the guidance, and appropriate management and oversight was being provided. In light of these results and follow-up visits,

NRC concluded that plants were acceptably implementing industry guidance, and therefore determined that such detailed reviews focusing specifically on contingency planning were not necessary at additional plants.

Concurrently, NRC had underway its assessment of Y2K readiness at all 103 plants, as previously discussed. The 452-question checklist NRC was using for this assessment included 52 questions covering areas of contingency planning. Such areas included internal and external facility risks and whether an integrated Y2K contingency plan—a compilation of individual contingency plans that included the remediation actions planned for key rollover dates—was developed. Based on these assessments, NRC reported that all 103 nuclear power plants were using the NRC-approved industry guidance—guidance that included contingency planning—and that only one plant (Cooper Nuclear Station) had not yet completed its integrated contingency plan. NRC verified that this plant has since completed its plan.

While the nuclear power plants have reportedly completed Y2K contingency plans, it is unclear as to whether these facilities have validated their plans. NEI included validation as a step in its contingency planning process guidance to provide confidence that plans can be executed as intended. While NRC's assessment at the 103 plants included questions on whether the nuclear facility validated contingency plans, NRC has not summarized the results of each question from all plants and therefore does not know how many plants responded affirmatively that they had indeed tested their plans. Further, NRC did not assess how the plans were being validated.

The need for additional contingency preparation was also raised by public interest groups, most notably by the Nuclear Information and Resource Service. In December 1998, this group, concerned about the potential impact of Y2K problems on nuclear power plants, submitted three related petitions to NRC.

The first petition requested that all licensed nuclear facilities be shut down by December 1, 1999, if their safety systems were not Y2K compliant, and remain shut down until all repairs were completed. The second petition requested that NRC require nuclear power plant licensees to conduct a successful, full-scale emergency planning exercise involving the failure of computers or digital systems as a result of the Y2K problem, again asking that plants not doing so be shut down. The third petition asked that nuclear

facilities have operational emergency diesel generators to provide backup power, that a 60-day supply of fuel for these generators be available, and that the licensees provide alternate means of backup power such as solar panels or wind turbines.

NRC denied all three petitions. While acknowledging the importance of the Y2K-related matters raised by the petitioners, it concluded that actions taken by nuclear plant licensees to address Y2K issues, coupled with NRC oversight, provided reasonable assurance of adequate protection of public health and safety. In responding on August 23, 1999, to the petition that NRC require nuclear power plants to conduct emergency planning exercises that cope with Y2K computer-related failures, NRC stated that this was not necessary because while the cause of computer and equipment failure may be different after December 31, 1999, the result and expected response would be the same as many situations encountered during emergency exercises and drills in the past. For example, NRC said in this response, it is typical in the development of scenarios for exercises and drills to assume that communications links, plant computers, and display and monitoring equipment will be out of service.

Because of the very nature of nuclear facilities, it is true that plants are already required by law to follow and maintain tested emergency plans.[6] These plans are to provide emergency response capabilities that take into account a variety of circumstances and challenges, and the facilities are required to exercise their plans periodically, develop and maintain key skills of involved personnel, identify deficiencies in their emergency plans and personnel, and take appropriate action to correct identified deficiencies. However, it is unknown whether or not each plant has recently tested, through normal emergency exercises, scenarios addressing potential Y2K-induced failures. Therefore, given the known Y2K threat to nuclear facilities, we believe that NRC should obtain information on the scope and extent of nuclear power plants' emergency exercises, and whether these exercises have incorporated Y2K scenarios.

Regarding the nuclear fuel facilities, NRC has not required these facilities to develop specific Y2K contingency plans. However, 8 of the 10 fuel facilities have informed NRC that they plan to be in safe shutdown during the transition to Y2K, and NRC inspections at the other two facilities found their contingency plans to be acceptable. For decommissioned plants, NRC

[6]10 CFR 50.47, 10 CFR 50.54 paragraphs (q), (s), and (t); and Appendix E to 10 CFR Part 50.

applied the same requirements for the 14 plants with spent fuel as it did for the 103 operating plants. NRC could not say how many of the decommissioned plants completed contingency plans, as the agency had not reviewed them because NRC staff concluded that Y2K issues were highly unlikely to cause a potential threat to public health and safety at such plants. NRC also noted that decommissioned plants have an extended amount of time to take relatively simple corrective actions should Y2K failures occur.

Another important area that needs to be addressed is Day One planning. Each nuclear facility needs to develop a Day One strategy—a comprehensive set of actions to be executed by nuclear facilities during the last days of 1999 and the first days of 2000. We have recently issued Day One planning guidance that the Office of Management and Budget has encouraged federal agencies to use.[7]

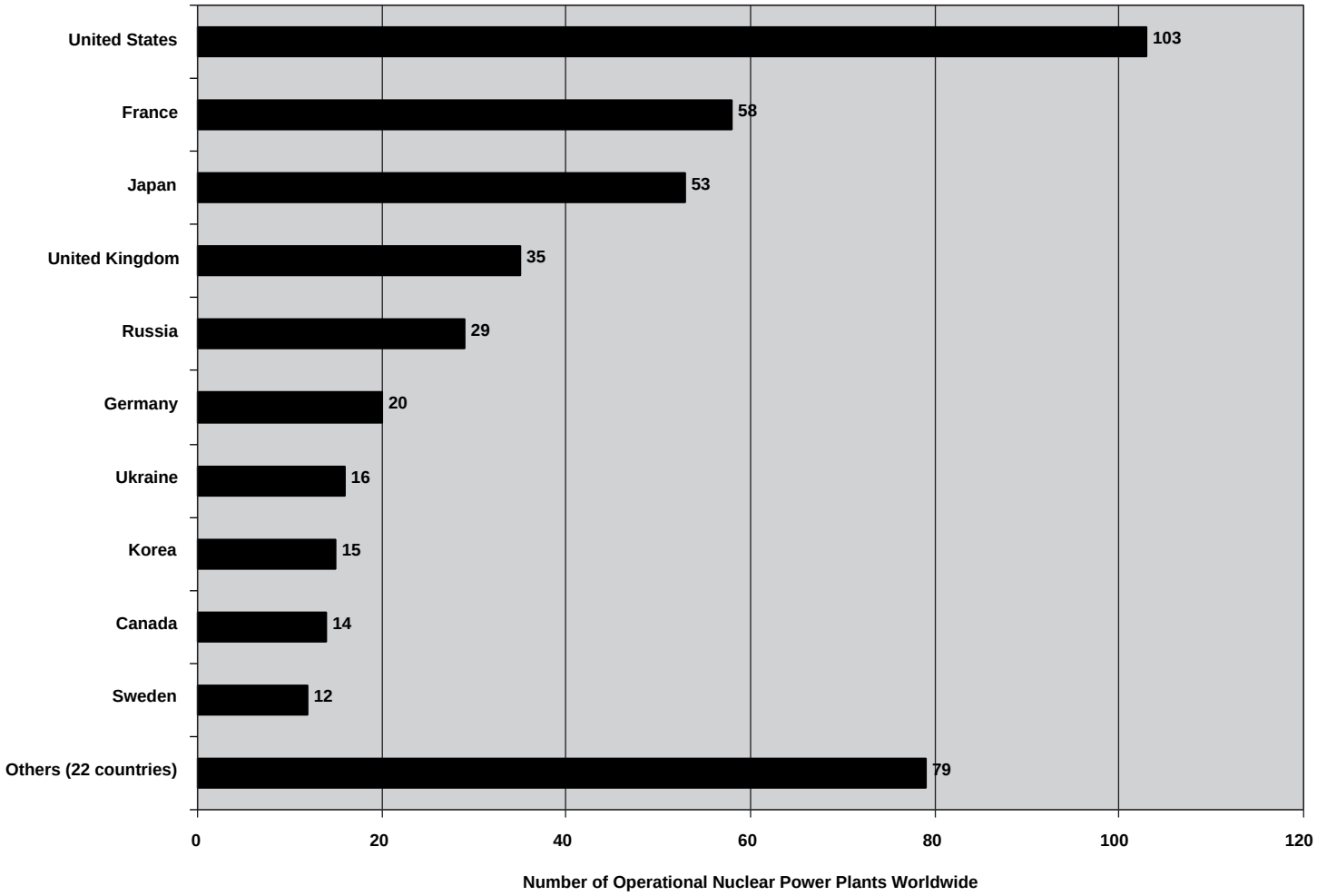
No Day One guidance has currently been issued by the industry on what plants should be doing during the end of December and beginning of January 2000. NRC officials told us that nuclear power plants have taken certain actions to be ready for the Y2K rollover, such as requiring additional staffing and stockpiling consumables (i.e., diesel fuel for emergency diesel generators). However, these do not entail a comprehensive set of actions to be carried out systematically by every operational nuclear power plant. The actions that the nuclear power plants and fuel facilities take during this time will be just as critical as actions already taken to become Y2K ready. Accordingly, we believe that NRC should ensure that all nuclear facilities have developed appropriate Day One plans.

Little Is Known About Worldwide Year 2000 Readiness of Nuclear Power Plants

Little current data are available on the Y2K readiness of the 331 nuclear power plants operating outside the United States. Figure 4 shows that 31 other countries besides the United States are operating nuclear power plants. Nine of these countries have more than 10 nuclear plants each, for a total of 252 plants. The remaining 22 countries each have 10 or fewer, for a total of 79 plants. Figure 5 shows the location of operational nuclear power plants worldwide.

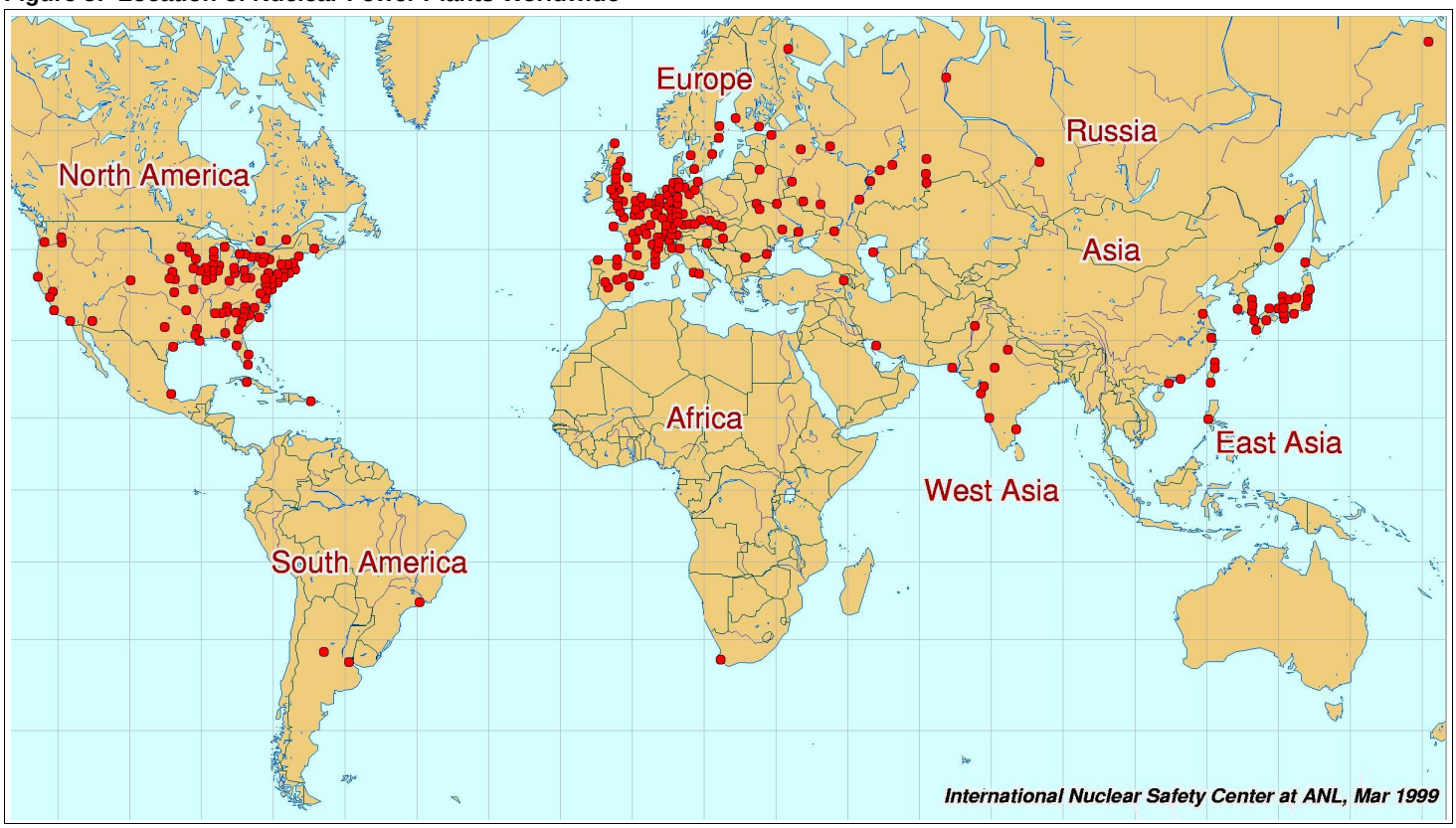
[7] *Y2K Computing Challenge: Day One Planning and Operations Guide* (GAO/AIMD-10.1.22, October 1999).

Figure 4: Ten Largest Nuclear Power Producers Worldwide



Source: International Atomic Energy Agency.

Figure 5: Location of Nuclear Power Plants Worldwide



Source: International Nuclear Safety Center, Argonne National Laboratory.

What information is available suggests that several other countries are taking steps to ready their nuclear power plants for the change of century. For example, the International Atomic Energy Agency (IAEA) has been working with its 128 member states to ensure that they are informed of the Y2K problem. The agency has published guidelines for its members' use in addressing safety and operability concerns, and has sponsored international workshops in January and July of this year to provide assistance to members on the challenge of the Y2K issue. Based on information exchanged at these workshops, several countries reported that they were on their way to readying their nuclear power plants for 2000.

Similarly, the Nuclear Energy Agency (NEA) has been working with its 27 member countries[8]—representing 85 percent of the world's nuclear power capacity—to ensure awareness of nuclear safety during the transition to 2000. In February 1999, during NEA's workshop on the impact of Y2K on the nuclear industry, some participants—including those from Canada, France, Japan, Spain, and Sweden—reported that most of their plants would be Y2K ready by July 1999.

However, other countries appear to be behind the United States. For example, the Russian representatives at the NEA workshop noted that their State Regulatory Authorities of Nuclear Energy and the Federal Nuclear and Radiation Authority of Russia were still studying the impact of Y2K on the nuclear power industry. They also noted that some facilities and organizations do not probably fully appreciate the impact of Y2K on the nuclear power industry for their nuclear facilities.

Similar concerns were raised by the National Intelligence Officer for Science and Technology during a hearing earlier this month.[9] Testifying on the intelligence community's assessment of foreign Y2K efforts, he noted that both Russia and the Ukraine are particularly vulnerable to Y2K failures. He further noted that they got a late start in remediation and lack sufficient resources to identify and correct problems, and that the areas of greatest risk include the electric power grid and nuclear power plants.

It should be noted that NRC—with cooperation from NEA and IAEA—is developing a prototype of an international Y2K early warning system. This Internet-based system would be used by NRC and other regulators to share information concerning Y2K problems that affect plant operation, telecommunications, or grid reliability. To date, this effort includes mainly Canada, Europe, Mexico, and Far Eastern countries.

[8]Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

[9]Statement of Lawrence K. Gershwin, National Intelligence Officer for Science and Technology, National Intelligence Council, before the Senate Special Committee on the Year 2000 Technology Problem, October 13, 1999.

In summary, while progress has been made in making the nation's nuclear power plants and fuel processing facilities Y2K ready, some risk remains. At particular risk are the two plants that do not yet have their nonsafety systems ready, especially the one with a completion date scheduled for more than 30 days from now, ever closer to the turn of the century. Similarly, the four nuclear fuel facilities that were not Y2K ready by September 1, 1999, raise concern. Likewise, not knowing the current Y2K status of all 14 decommissioned plants with spent fuel also raises concern. Finally, the lack of information on two key issues—independent reviews of Y2K testing and emergency Y2K exercises—and the lack of requirements for Day One planning increases the Y2K risk to the nuclear power industry.

To further reduce risks, NRC and the nuclear power industry can still take specific actions to ensure Y2K-related plant safety. First, NRC should evaluate and report on the Y2K status of all decommissioned plants with spent fuel status that previously reported they were not Y2K ready. Second, NRC should survey the 103 operational nuclear power plants to gain an understanding of what independent reviews were completed. Based on this information, NRC could then identify plants that may need additional reviews. Third, it should obtain information on the scope and extent of nuclear power plants' emergency exercises, and whether these exercises have incorporated Y2K scenarios. Finally, NRC should ensure that all nuclear facilities have developed Day One plans.

Ms. Chairwoman, Mr. Chairman, this concludes our statement. We would be happy to respond to any questions that you or other members of the Subcommittees may have at this time.

Contact and Acknowledgments

For information about this testimony, please contact Joel Willemssen at (202) 512-6253 or Keith A. Rhodes at (202) 512-6412, or by e-mail at *willemssenj.aimd@gao.gov* or *rhodesk.aimd@gao.gov*. Individuals making key contributions to this testimony included Mirko Dolak, Troy Hottovy, William Isrin, Janet Jamison, and Michael Tovares.

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary, VISA and MasterCard credit cards are accepted, also.

Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 37050
Washington, DC 20013

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000
or by using fax number (202) 512-6061, or TDD (202) 512-2537.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

PRINTED ON RECYCLED PAPER

United States
General Accounting Office
Washington, D.C. 20548-0001

Official Business
Penalty for Private Use $300

Address Correction Requested

Bulk Mail
Postage & Fees Paid
GAO
Permit No. GI00