CERTAIN CHALLENGES

NUCLEAR SAFETY DIMENSIONS OF Y2K ISSUES

BY MORGAN D. LIBBY

Electrical energy is the bedrock of modern societies — an infrastructure component that is crucial to transportation. communication, public health and safety, and national and global economies.

One certain challenge as the world approaches the Year 2000 is to ensure the stability of electricity supplies in the face of the far-reaching Y2K computer problem. Another certain challenge is to maintain the margin of safety at nuclear generating facilities, which worldwide provide about 16% of total electricity and sizeably higher shares in a number of countries. The challenge exists whether the facility is producing power and thus must rely upon the functioning of its digital safety systems, or even if it is shut down, when it becomes necessary to rely upon secure sources of off-site power to maintain safe shutdown conditions.

For the world's electric utility industries, Y2K's certain challenges boil down to the simple phrase: "Keep the plants safe and on-line." They can be seen as a three-tiered set:

Electricity Generation. Generating facilities may use a variety of fuels: nuclear, coal, oil, gas, and hydro are examples. These generating facilities rely upon digital equipment to varying degrees. Some systems, such as hydro facilities, are rather simple systems but are often highly automated and use remote processor control systems. Other systems, such as nuclear facilities are highly complex in terms of the variety of processes they rely upon and may employ analogue and/or digital control systems.

Generating facilities sometimes use digital technology for safety systems, normal operation, and support functions. They often rely upon services that are supplied by outside organizations who also use digital technology. To varying degrees it is none-the-less true that most generating facilities cannot function for long without digital technology. Nuclear facilities that rely upon digital equipment cannot confidently maintain their margin of safety without addressing the Y2K problem directly.

Transmission/Distribution. Transmission and distribution facilities are relied upon to maintain the integrity of the interconnected grid by ensuring that frequency and voltage are kept within limits as the balance between capacity and load is maintained. Furthermore, subsequent to loss of off-site-power incidents at nuclear stations, they expedite the restoration of off-site power for reasons of safety.

Some transmission and distribution facilities employ sophisticated digital control and monitoring systems.

Electric Power Loads. A fully remediated delivery system will still be challenged by Y2K if the electric power load that is typically present on the rollover date rapidly reduces due to failures in consumer or commercial systems. Although such widespread "common-mode failures" are unlikely, the operators of the electrical delivery system must be mindful of the possibility and pre-position their facilities in anticipation of such an event.

ASSESSING Y2K READINESS

In some countries, the Y2K problem has been actively and publicly pursued for more than two years as it relates to nuclear generating facilities. The Y2K problems are being resolved and the management of the

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Mr. Libby, an expert from the United States, is the Y2K Coordinator in the IAEA Department of Nuclear Safety. His services have been provided to the Agency by the United States as part of its support to the Y2K Action Plan of activities.

effort leads knowledgeable observers to conclude that Y2K readiness is an achievable goal. In these countries the regulatory authorities at many levels have recognized the importance of resolving the Y2K problem and have made it part of their mandate for both nuclear and non-nuclear facilities.

However, in some other countries, Y2K has not yet gained the support that is necessary. Awareness at the sponsor level (typically senior government officials and facility managers) is incomplete and statements about Y2K readiness that are sometimes made are offered without evidence of an organized evaluation to support them. Unless more concerted efforts are undertaken immediately the Y2K readiness of many countries that are highly dependent on electrical service cannot be assured in time. Furthermore, those that employ nuclear facilities to generate their electricity cannot confidently assure safe operation absent a comprehensive Y2K programme.

The key obstacle to progress has been the lack of timely national commitment to the goal of Y2K readiness. Leaders need to embrace this goal and instruct the appropriate ministries and infrastructure agencies to pursue a course of action consistent with attaining it. The methods employed should ensure safety at nuclear facilities in the complete sense of the word, and the safe operation of other related facilities and supporting infrastructures.

IAEA SUPPORT & ACTIONS

Within the framework of its Y2K Action Plan, the IAEA has assigned safety-related programmatic responsibility for Y2K issues to its Department of Nuclear Safety, which has the responsibility for issues related to nuclear power plants and research reactors.

Important steps have been taken since late 1998. Given the Y2K deadline and the importance of coordinating actions, an important feature of the Agency's efforts has been to form a coalition with like-

Photos this page: At top, staff at the Zaporozhe nuclear power plant in Ukraine review the Y2K inventory during an IAEA assistance mission. Below, inside the Chernobyl plant control room, showing the new Safety Parameter Display System, personal computers, digital recorders, and other plant systems. *(Credit: Libby/IAEA)*

minded external organizations. The objective is to address the Y2K problem globally with special attention to Eastern Europe. Discussions have been held with representatives of several organizations in the interests of collaborating on Y2K activities to maximize their effectiveness and to minimize duplication.

Sharing Guidance and Experience. In line with its Action Plan, the Agency sent letters to its Member States in September 1998 on the potential impact of the Y2K problem on nuclear power plants and research reactors worldwide. National regulatory authorities were requested to complete a questionnaire on actions being taken in their country on this issue.

Later in 1998, drawing upon the views of experts from Member States, the guidance document, *Achieving Year 2000 Readiness: Basic Processes* was prepared and later issued as an IAEA technical document (TECDOC-1072) in print and electronic forms for dissemination over the Agency's *WorldAtom* Y2K Internet site *(www.iaea.org)*. Compiled by a team of international experts, the document is intended to help operators of nuclear power plants and research reactors and managers of other types of nuclear facilities who have embarked on Y2K programmes to discover, understand and solve Y2K problems. The document is based mainly on existing international experience in this field and covers such topics as:

- initial assessment, including inventory, of all potentially affected software and embedded systems;
- detailed assessment of each item to evaluate failure modes and how they will perform following each of the several Y2K critical dates;
- remediation;
- Y2K final testing and validation of inventory items;
- contingency plans. This mainly covers elements that cannot be fixed becasue they are really relationships. For example, a facility may rely on fresh water from an external supplier. The choice is either to rely on the supplier or to have a contingency plan to be

Photos this page: At top, the Agency's Y2K coordinator, Morgan Libby, explains the assistance programme to staff at the Chernobyl nuclear plant in Ukraine. Below, Chernobyl staff and an observer from the Kursk nuclear plant in Russia, review items for the Y2K inventory during an IAEA assistance mission earlier this year. *(Credit: Libby/IAEA)*

assured of water supplies from some other source. This applies equally to diesel fuel, bottled gas, communications services, and other supplies or services.

At the end of January 1999, the Secretariat held a five-day workshop on the use of this guidance document within the framework of a technical co-operation project in the European region on nuclear safety regulatory and legislative infrastructure. It was attended by 40 participants from 27 countries. Assistance in its organization and the services of lecturers were provided by the United States Department of Energy. Eighteen training modules and supporting information from the workshop are available in English and Russian. The information also is accessible in electronic form on the Agency's *WorldAtom* Y2K Internet site.

By June 1999, fifteen Member States with nuclear power plants and/or research reactors had responded to a questionnaire sent out by the Agency in September 1998. They were Canada, Czech Republic, Finland, Germany, Hungary, Indonesia, Japan, Mexico, Netherlands, Pakistan, Slovak Republic, Spain, Ukraine, the United Kingdom and the United States. Information was provided by these States on measures taken or planned, guidance documents, information received from nuclear power plants, problems identified in nuclear power plants, and contingency plans.

All of these States have taken measures and have Y2K readiness programmes in place, with a schedule to complete all actions needed to demonstrate Y2K readiness by the third quarter of 1999. One Member State had already begun implementing its Y2K readiness programme in 1996, four States began in 1997, and the other ten States began last year.

With regard to Y2K guidance documents, five Member States have prepared documents of their own. Four States do not have their own guidance documents, but have recommended those from the United Kingdom and the United States to the operators of their nuclear installations. Three Member States do not have specific Y2K guidance documents, but have detailed plans whose implementation is controlled by their respective nuclear regulatory authorities, while three other States have recommended the Agency's Y2K guidance document to the operators of their nuclear installations.

According to the information received from the fifteen Member States, two of them did not identify any Y2K related problems in their nuclear installations, four are currently conducting investigations in that regard, and nine have identified Y2K related problems which are not safety related but which could affect the continuous operation of the nuclear installations in question. The complete information provided by each of these States has been made available on the Department of Nuclear Safety's Web pages and is accessible through the Agency's Y2K Web site. Active contacts are being pursued with those countries which have Y2K readiness programmes in place but have not as yet provided any information to the Agency.

Additionally, a group of international experts assembled by the Agency's Department of Nuclear Energy developed a document that addresses the potential for grid instabilities and their influence on nuclear power plant operations in selected countries of Eastern Europe, namely Bulgaria, Russia, and Slovakia. *(See article, page 29.)* The Y2K issue at nuclear power plants also was addressed at two meetings convened in late 1998 by the Agency in Germany and in Vienna. Additionally, the IAEA participated at meetings in Bulgaria earlier this year.

Y2K Missions. The Agency has designed an assistance programme consisting of missions to specific nuclear power plants and research reactor sites to assist the operators in setting up and implementing an organized Y2K readiness programme in accordance with the basic guidance document. The objective is to help in developing a facility inventory and databases that can be shared by participants in the programme. Together with plant managers and staff, teams of experts assess and review plant equipment, process computers and information technology systems for Y2K readiness. Internationally recognized Y2K experts and observers from countries with similar facilities take part in the missions. *(See box, next page.)*

A mission to the Chernobyl nuclear power plant in Ukraine operating RBMK-type reactors took place from 12 to 23 April 1999. The team of three experts was provided by British

Y2K ASSISTANCE MISSIONS: FOCUS ON PARTNERSHIPS

In cooperation with its Member States and international partners, the IAEA initiated an assistance programme earlier this year to help national nuclear authorities in their Y2K-readiness efforts. More than ten missions have been completed and planned, mainly to nuclear plants in countries of Eastern Europe and China. Visiting teams typically include three experts from the IAEA and partner organizations, as well as a number of observers from the Agency's Member States.

Mission activities are co-ordinated with the efforts of the United States Department of Energy and certain utilities that have co-operation agreements with the utilities requesting the missions. The IAEA also has reached agreement with the World Association of Nuclear Operators (WANO), the International Union of Producers and Distributors of Electrical Energy (UNIPEDE), and the Commission of the European Communities (CEC) on all matters relating to the conduct of the missions, particularly the reference guidance documents, the team structure and composition, task description, report format, and financial support. These organizations have agreed to cooperate with and support the Agency's missions.

Mission aims. Mission teams perform a range of tasks. Central objectives are to help plant managers inventory and assess systems of Y2K significance. Systems include those related to plant operation, management, and safety. They also help in identifying items that may require remedial measures and provide guidance in areas of contingency planning.

Specific team tasks include conducting an interview with plant management; reviewing the plant's schedule of operations; meeting staff to determine the type of assistance needed; conducting an initial assessment to inventory and categorize items; assisting plant staff in reporting relevant information to a facility database related to Y2K activities; advising on preparations for a more detailed assessment; conducting exit interviews with plant and Y2K programme managers; and completing an exit report of conclusions and recommendations.

In their work, teams follow the strategy detailed in the IAEA's guidance document, *Achieving Year 2000 Readiness: Basic Processes.* The document is not a substitute for national requirements but is designed to assist them to discover, understand, and correct Y2K-related problems, and to set up contingency plans as an integral component of their programmes.

Nuclear Fuels Limited Magnox Generation. In addition to the staff of the plant, two observers from the Ignalina nuclear power plant in Lithuania and the Kursk nuclear power plant in Russia took part in the mission.

Other missions to nuclear plants have been organized and completed to Qinshan and Daya Bay in China, Bohunice in Slovakia, and Zaporozhe in Ukraine. For July and August 1999, further missions are being prepared to the Kozloduy plant in Bulgaria, South Ukraine in Ukraine, Krsko in Slovenia, and Dukovany in the Czech Republic.

As part of its follow-up activities, the Agency organized an international workshop in July 1999 in Vienna. The purpose was to encourage information exchange among Member States on Y2K problems detected in equipment according to reactor type, and to share solutions to these problems. Working groups were formed from among the participants operating similar types of reactors (WWERs, RBMKs, PHWRs, PWRs and BWRs). Also discussed was the status of the development and implementation of contingency plans.

Emergency Management. In general the ability of the Member States to respond to emergency conditions that might arise from Y2K varies widely according to the robustness of their electrical system, the existing state of contingency plans to deal with electrical system malfunctions, their current state of Y2K readiness, and the resources available between now and January 2000.

Furthermore, from a nuclear perspective, the state of emergency preparedness varies significantly as does the level of procedural controls, training, and operating margin of safety.

Within the framework of its activities, the Agency has urged Y2K National Coordinators to review the state of their Y2K readiness programmes for the management of emergencies. They were advised to set an

Y2K & NUCLEAR SAFETY ON LINE

As part of its programme, the IAEA Department of Nuclear Safety maintains a series of topical Web pages on the Agency's *WorldAtom* Internet site. *(www.iaea.org/ns/nusafe)*. The Y2K pages include links to the Agency's guidance documents, reports on the assistance programme, and training materials, with access to both English and Russian versions. The pages also feature Y2K-related links to a number of national nuclear bodies. They include:

- **Canada,** Atomic Energy Control Board
  -- through www.info2000.gc.ca
- **France,** Electricite de France
  -- www.edf.fr
- **Germany,** German Society for Nuclear Installation Safety
  -- www.grs.de
- **Russian Federation,** Ministry of Atomic Energy
  -- www.entek.ru/~y2k
  -- and Russian X-Atom Network -- *www.x-atom.ru*
- **Sweden,** Swedish Nuclear Power Inspectorate
  -- www.ski.se
- **Switzerland,** Year 2000 site -- *www.millennium.ch*
- **United Kingdom,** Health & Safety Executive
  -- www.open.gov.uk/hse
- **United States,** Nuclear Utilities Software Management Group
  -- www.nusmg.org
  – and Nuclear Regulatory Commission -- *www.nrc.gov*
- The IAEA pages also link to a range of other sites compiled by the Nuclear Energy Agency of the Organization for Cooperation and Development -- *www.nea.fr*

organized course of action using industry best practice or guidance documents and to seek required staff and funds. In the absence of such steps, the prioritization of Y2K efforts is essential. This prioritization should reflect the importance of coordinating national efforts, and for those with nuclear facilities, the agreements underlying the operation of those facilities. Such considerations should influence the expedited allocation of talent, resources, and oversight.

IAEA Responsibilities for Emergency Response. Under two international safety conventions — the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency -- the IAEA has responsibilities to assist its Member States in areas of emergency response and planning.

In carrying out its work, the IAEA Emergency Preparedness and Response Unit maintains the Emergency Response Plan and associated procedures and checklists, and conducts appropriate training and exercises. The Plan defines the objectives, assigns responsibilities and authorities for decision making, and defines the concept of operations of the response system, including the public information aspects. It has been thoroughly reviewed and overhauled this year, and forms the basis of the Agency's anticipated response to the Y2K problem.

Because of the particular threats posed by the Y2K problem, the Unit has been carrying out a risk analysis, identifying potential threats to its capabilities and developing contingency plans. The existing system relies primarily on conventional and dedicated communications lines (telephone and facsimile). Computer-related aspects such as contact point databases and assessment codes have been guaranteed to be Y2K compliant, and paper backups already exist. The most serious problems would occur if the conventional communications lines (telephone and facsimile) were to fail. Backup fax carriers have already been engaged and will be extended. Moreover, the use of other means of communication (through computer networks or satellite links) as a backup system is being actively explored.

Contingency protocols for exchanging information are being drawn up for official contact points under the two Conventions. Through a newsletter, contact points will be further informed about the contingency plans in place and the expectations of States Party to the Conventions.

Looking beyond Y2K issues, the Unit is testing and planning for implementation in 2001 of a more extensive use of Internet and Web technology for the exchange of information relative to its responsibilities under the two Conventions. ❑