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REACTIONS

FROM THE AMERICAN NUCLEAR SOCIETY TO TEACHERS INTERESTED IN THE NUCLEAR SCIENCES

Has the Electricity Industry Beaten the 'Millennium Bug'?

By E. Michael Blake

As autumn began, the public's edgy uncertainty over the so-called 'Y2K problem' or 'Millennium bug' was giving way to what seemed to be a calmer sort of uncertainty. In a September speech, Alan Greenspan, chair of the Federal Reserve Board, declared his belief that the problem has essentially been solved already, to the extent that there should be no widespread disruptions in the workings of the United States government or private sector starting on January 1, 2000.

ReActions is not in the business of making predictions like Greenspan's but has reviewed the status of the electricity supply industry and found that officials are confident the transition to the year 2000 will be smooth. In short, there should be neither massive blackouts nor mishaps at nuclear power reactors.

What the Bug Is, Or Was

Most people 30 years old or younger, when hearing the word 'computer', probably think of the sort of personal information appliance they encounter routinely at work or in their homes. It's easy to take for granted how swift and powerful these modern computers are and to lose sight of how limited the technology was in the 1960s.

Punch Cards

In those early days of automated information-handling, the common means of data entry was through punched cards that could hold 80 columns of information, with the information in each being the placement of punches in the column. The cards would be fed into a card reader connected to a computer – which was a massive complex of machines maintained in a carefully-controlled environment – and the computer would then process the data from the punches on the cards. It would either perform an operation or sort the cards themselves by common data characteristics (say, if each card contained data for one person his address, phone number, birth date, etc. a program could call for the cards to be sorted by state, age, alphabetically by last name, etc.).

Saving Space Creates Future Problem

As crude as this punch card system sounds, it was a big improvement over what had been used before (i.e., large reels of punched paper tape, which tore easily). But the limitation of 80 columns to a card forced programmers to cut corners in order to maximize the amount of data each card could hold. One common shortcut was to use only the last two numbers in references to a year for instance, 67 for 1967. This attempt to save two columns may have made things more efficient at the time, but thirty years later gave rise to the main preoccupation of the high-tech world. Even if it has been caught in time, it has required the spending of billions of dollars for the problem to be studied and addressed.

Software — Standardized vs. Specialized

On the surface, it may seem trivial that 00 in the year columns (or 'year field') doesn't tell you if the year involved is 1900, 2000, or 5800. What made the problem so vexing at the outset grew from another difference between computers then and computers now.

These days, the software with which most people are familiar is standardized to a great extent, and new versions generally are written to be compatible with earlier ones ('legacy' software). In the 1960s, however, a programmer's job was to write software for a specific task on a specific type of computer. Although computer hardware has changed greatly over the years and in many applications the old centralized mainframe computers have given way to smaller, faster devices, many organizations maintained the continuity of their systems by having programs written to carry over the core functions of the old software into the new computing environment.

Source Code

As a result, over time many programs had become so complex that it was difficult to isolate the original software the 'source code'. Worse, in many cases, no records had been kept of what that source code was, and the original punched cards had been misplaced or damaged so nobody could be sure whether the source code's interpretation of 00 in the year field would lead an entire system to malfunction or shut down. Also, blocking the manual input of data that might include the 00 year field wouldn't solve the problem, because computers have internal clocks that record both the time and the date – so the passage of time would eventually put 00 in the year field, with

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'Millennium Bug'? – Continued

unknown consequences.

None of this resulted from short-sightedness by programmers at the time. As noted previously, their work was to write new programs for new tasks on new systems. At no time did it seem that the programs they had written six months earlier would still be in use as much as two years later, so there was no reason to mull the consequences of their programs in thirty-some years. If anything, the fact that the problem arose at all is a tribute to the quality of the programmers' work. What they wrote worked so well that it was carried over and amended as years passed, rather than junked outright.

Getting Over It

The hunt for the 'millennium bug' (also known as the 'Y2K problem' – Y for year, 2K for 2000) began earliest within the federal government, which envisioned potential problems in everything from missile launch codes to air traffic control to the delivery of Social Security checks. Much study focused on the COBOL programming language, still in widespread use today. Many COBOL programmers who worked on the original source code packages were called in to assess the situation (though nobody expected them to remember the old code itself), but as the pursuit of the bug moved into the private sector and other organizations, more and more computer professionals – with or without 20 or more years of COBOL experience – were put on the case. In some cases, whole systems were simply taken offline, given 00 as year field input, and allowed to run without performing actual tasks, just so the consequences could be determined.

Contingency Plans Made

Even with growing confidence that there won't be a catastrophe, organizations are preparing nonetheless. Employees of utilities are already being notified of whether they are assigned to damage-control tasks and required to be on duty on New Year's Eve.

A "Trial Run"

Electric utilities have already overcome an early hurdle. In some programs written in the UNIX operating system, the date September 9, 1999, was potentially important. The four-digit sequence '9999' can be read to indicate the end of a file, perhaps interrupting operations – and in programs that grouped the month, date, and year, the onset of September 9 (9th month, 9th day, 99th year = 9999) might tell systems to stop whatever they were doing.

The North American Electric Reliability Council (NERC) took the approach of September 9 as an opportunity to conduct a test of its contingency plans for Y2K as well as 9999. NERC, the network of electricity grids that was formed in the wake of the massive power blackouts in the eastern United States and Canada in 1965, reported that the drill went as planned. There were no adverse consequences as a result of 9999. Indeed, there have been no reports that any significant automated systems, in any industry or field of endeavor, failed to perform vital tasks as a result of 9999.

Because of the kind of automated clock-and-calendar systems mentioned previously, the NERC drill simulated the first sign of trouble from the first part of the world to begin September 9: Pacific Islands just west of the International Date Line. As more and more of the world passed midnight, the drill continued. It showed that the grid should be able to recover from a loss of energy management systems, supervisory control and data acquisition, and data communications; should be able to support restart from blackout; and should be able to link up portions of the grid if they become isolated. According to NERC, all of the drill's objectives were met.

Are the Reactors Ready?

One part of the electricity supply – the nation's nuclear power reactors – is already under close centralized regulation, from the Nuclear Regulatory Commission. The NRC has been coordinating for some time the efforts by its power reactor licensees to prepare for Y2K. On September 7, the NRC announced that 75 of the 103 operable power reactors are completely Y2K ready. The remaining 28 reactors were, at that time, still completing work on systems that either impact the generation of electricity or involve monitoring or administration. In every case, the work was expected to be finished by December 16. According to the NRC, the safety systems of every power reactor have already been checked out as Y2K-ready.

Updates Scheduled During Planned Outages

Only three of the reactors have completion dates later than October 31, and some of the work is being scheduled so as to coincide with reactors' planned outages (power reactors in the United States have designs that require shutdowns for refueling – which, at most reactors, occurs once every 18 to 24 months – and for certain maintenance and repair tasks). In other cases, the licensees are waiting for component deliveries or analysis results. When the year ends, every power reactor that would otherwise have been scheduled to be in service should indeed be up and running – so at least the power grid should have from the reactors a stable source of electricity.

Earlier Computer Upgrades

In part, the nuclear industry has been able to come to grips with Y2K because it has already changed out a great deal of the computer equipment with which the power plants were originally built. Computers have always been important to the generation of nuclear electricity, and many plants were built with just the sort of old-style mainframes and special-purpose software that are usually thought of as vulnerable to Y2K problems.

After the Three Mile Island-2 accident in 1979, it was agreed that power reactors needed faster computers that could assess and evaluate more data and give operators a clearer view of plant conditions. Part of the remedy was an industry-wide switch from analog to digital computers. This by itself didn't guarantee immunity from Y2K, but the combination of revamped equipment and more clearly traceable software has made Y2K less traumatic for reactor licensees than it has been in other industries – and less traumatic for reactor licensees than other challenges within the nuclear industry, such as long-term storage of spent fuel and high-level radioactive waste.

On the whole, the electricity industry appears confident that there will be no unpleasant surprises this coming January 1, and the nuclear power community expects no significant difficulty with the reactors that feed power to the grid. This does not mean, of course, that nothing will happen – only that everything that has been anticipated is being addressed.

E. Michael Blake is a freelance writer, and former Senior Editor of *Nuclear News*

Updated Food Irradiation Fact Sheets Available

The latest information on food irradiation, as prepared by a respected international group, is available to teachers with web access.

The International Consultive Group on Food Irradiation (ICGFI) has published an updated set of fact sheets on the use and benefits of food irradiation technology. This revision reflects developments in technology since 1991, when the series was first published.

The revised fact sheets cover: status and trends in food irradiation, scientific and technical terms, benefits of food irradiation, food irradiation facilities, safety of irradiated food, nutritional quality, packaging, food irradiation costs, trade in irradiated foods, detection methods for irradiated food, and irradiated foods and the consumer. There are also suggestions for further reading.

The ICGFI is an international organization established under the aegis of the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), and the International Atomic Energy Agency (IAEA). The ICGFI has a membership of 46 governments and provides information to Member States of the FAO, WHO, and the IAEA.

The fact sheets are available on the web (in pdf format) through the IAEA web site (www.iaea.org), a useful information source. The full address for the fact sheets is (www.iaea.org/worldatom/Press/Booklets/

Project 60

Research & Group Activity

Constructing a Time Line of Developments in Nuclear Science

Objective: Learn about the early development of atomic and nuclear science
Develop Teamwork by sharing information

Tools: Use standard library resources such as an encyclopedia, specialized science encyclopedia, or other reference materials. A computer and internet access can also be helpful.

Directions: The people, places and things in the list below have played a role in the development of our understanding of the structure of matter or in the growth and application of nuclear science and technology.

Research the names listed, looking for:

- the time (range of years) during which the person lived or the event occurred
- the major contribution to nuclear science and technology (theory or application) made by the person or event
- the year in which the contribution or discovery was made (if available)
- what this discovery or contribution has done to improve health, quality of life, etc.

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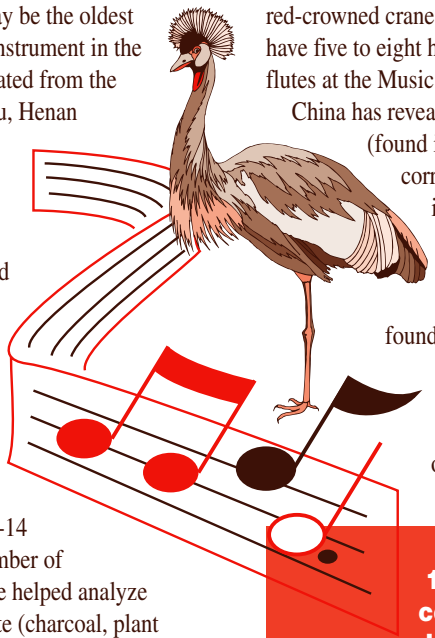
Nuclear Science is Crucial in Establishing Age of Oldest Playable Musical Instrument

Carbon-14 dating has helped establish the age of what may be the oldest playable musical instrument in the world – a bone flute excavated from the early Neolithic site of Jiahu, Henan province, China. The flute is one of six complete instruments, 7,000-9,000 years old, uncovered at the site. Researchers also found fragments of about 30 other flutes.

Garman Harbottle, senior chemist emeritus in the Chemistry Department of Brookhaven National Laboratory and a long-time expert in carbon-14 dating techniques, is a member of the Jiahu research team. He helped analyze carbon-14 data from the site (charcoal, plant ash, human bone, a fruit pit and a grain of carbonized rice were examined). Harbottle has said that carbon dating was crucial in establishing the age of the site and the relics found there.



The flutes, made from the wing bones of the red-crowned crane, *Grus japonensis Millen*, have five to eight holes. Tonal analysis of the flutes at the Music School of the Art Institute of China has revealed that the seven holes (found in several of the flutes) correspond to a tone scale that is similar to the Western eight-note scale which begins "do, re, mi." The known age of the relics found at the site, the flutes, and other materials are providing information about the early foundations of Chinese society.

The September 23, 1999, issue of *nature* contained information detailing the dating of the site and testing of the bone flutes. This material is also available by visiting www.nature.com (search for "bone flute").

Nuclear Sciences

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After everyone has completed the research, the class should share the information and arrange people and events on a time line.

Atoms For Peace Speech
Antoine Henri Becquerel
Herman Blumgart
Niels Bohr
James Chadwick
Marie & Pierre Curie
John Dalton
Democritus
Dresden-1
Albert Einstein
Enrico Fermi
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Visit the American Nuclear Society exhibit booth at either convention.

CD V-700

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Detecting Radiation in Our Radioactive World

Long Beach Area
Orange County Dept. of Education,
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Saturday, November 13, 1999
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(For registration information, phone ANS at 708-352-6611or 800-323-3044.)

Tulsa, NSTA Convention
November 18-20, 1999
Tulsa Convention Center
Workshop: Thursday, November 18
8:00 am - 9:15 am

Reno, NSTA Convention
December 2-4, 1999
Reno-Sparks Convention Center
Workshop: Friday, December 3
10:00 am - 11:15 am

Workshops presented by the American Nuclear Society. All participants receive a *FREE* **CD-V 700** Geiger counter for classroom use, along with helpful information and directions for experiments/ demonstrations using the Geiger counter to teach about our radioactive world.

 ANS was founded in 1954 as a nonprofit, international scientific and educational organization. Its members are scientists, engineers, and educators working in government, academic and industry. Teacher names are welcome for addition to the *REACTIONS* mailing list. Any communication dealing with this publication should be addressed to *REACTIONS* Editorial staff, American Nuclear Society, 555 N. Kensington Ave., La Grange Park, IL 60526-5592; telephone 708/352-6611; e-mail outreach@ans.org; http://www.ans.org **November 1999**

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Details In This Issue!

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