Vince Madden

Beating the Millennium Bug

As 1999 progressed we all became conscious from media reports of the year 2000 problem (or Y2K bug). The problem occurs in some software because two-digit fields were used to represent the year and the algorithms used may not be able to recognize the change to the new millennium and may misread "00" for the year 1900 instead of the year 2000. Others do not correctly identify 2000 as a leap year and risk failure on 29 February 2000, or 31 December 2000 (the 366th day).

Date-related problems can affect software in mainframes, desktop computers, local area networks, digital control systems and are sometimes embedded in facility equipment. Such problems can also affect information residing in data files, databases and libraries. The failure modes range from inconvenient display of dates to complete failure of processing systems and the functions they perform.

For a nuclear power plant the first challenge is to acquire an inventory of all potentially affected systems. With this inventory one can then assess whether or not there is any impact on plant safety and secondly whether the plant will be able to continue generating, affecting the utility's ability to supply electricity into the transmission system. A significant loss of generating capacity could impact on a transmission and distribution company's ability to maintain a supply of electricity to all its customers.

Responsibility for assessing Y2K rests with the operating organization. In many countries the regulator has imposed requirements on a nuclear operator against the potential challenge that, unless satisfied, will require plant shutdown for the date roll-over.

At the International Atomic Energy Authority general conference in September 1998 a resolution was adopted defining a number of measures to address the year 2000 issue. In January 1999 the IAEA published *Achieving Year 2000 Readiness: Basic Processes* (available via website www.iaea.org/ns/nusafe/y2000/y2k.htm). This document presents an approach that may be used for discovering, understanding and correcting Y2K-related problems.

The IAEA is establishing teams to support those member states that request assistance for their own national initiatives.

The World Association of Nuclear Operators is cooperating on this initiative by seeking experts for these teams from our member utilities. To date missions have taken place to plants in Ukraine (Chernobyl, Zaporozhe) and China (Qinshan) and plans are being put in place to carry out further missions to Kozloduy in Bulgaria, and Qinshan and Daya Bay in China. In Slovakia, which has had an active Y2K program for some time, the team peer reviewed the work done at Bohunice nuclear power plant.

Until relatively recently the safety systems on reactors were based on analogue systems and a number of utilities have reported that as a consequence their ability to shut down their reactors is unaffected by Y2K. In January 1999, reporting on the United States electricity industry's efforts to prepare the power supply system for the year 2000, the North American Electricity Reliability Council stated: "No [nuclear] facility has found a Y2K problem that would have prevented safety systems from shutting down a plant, if conditions required after the turn of the century."

Some of the more recent designs have made extensive use of digital equipment and hence Y2K assessments are compelling. Having completed an assessment and conducted any remediation or replacement, many utilities are conducting an integrated simulation test.

Tokyo Electric Power Company carried out a simulation in April 1999 to verify that there will be no problems at Kashiwazaki-Kariwa on 1 January 2000. This is the first reactor in Japan to use only digital systems for control, instrumentation and safety and so relies more heavily on computers than earlier plants. During a scheduled annual break in operation the simulation was done by setting the computer clocks to shortly before midnight on 31 December 1999, and letting the systems run to 1 January 2000.

An analogous test was carried out at Electricité de France's Civaux-2 unit in March of this year—this unit, which has not yet gone critical, also features fully digital instrumentation and control. The EDF test also covered two other key dates that have the potential to be problematic: 8-9 September 1999, and 28-29 February 2000. After the test the date was reset correctly and no anomaly in any of the three tests was reported.

All the above is not to say that nothing requiring attention has been found. It is quite common for plants to report assessment as revealing shortcomings in non-reactor safety critical systems such as on-site access computers, radiation monitoring equipment and similar systems that need a date function. Problems have also been reported in computer-based systems for feedwater control, turbine control and control rod position indication—though the latter does not affect the ability to control a rod during insertion.

The most common problems encountered have been in-core monitoring systems which are required to ensure that local power limits are not exceeded, and area radiation monitoring systems.

The solutions adopted have varied from modification and testing of the software through to replacement of the software or associated hardware.

It can be more practical and cheaper to bring forward a planned replacement program than tackle an extensive investigative and remediation project, particularly if, in a few years, a replacement system will need to be installed to maintain equipment reliability.

In some systems it has been possible simply to work around the problem by winding back the computer clock. This approach has been adopted on the feedwater control system at a Swedish plant where they are reported as having wound back the clock by eight years thereby delaying the problem. In the intervening period they anticipate replacing the relevant computer system.

A full picture of the situation in all 33 of the countries operating nuclear power plants is not readily available. An absence of information does not mean that there is no work being undertaken, rather that it is being addressed locally.

With less than a few months to go the question arises as to what can be done in the remaining period. A particular focus is contingency planning. All nuclear power plants have already established contingency plans to cope with the likes of a hurricane, fire or a nuclear emergency.

In many of the countries operating nuclear power plants work began as long ago as 1996. In such instances the assessment and any remediation or replacement program has now largely been carried out. This work has been done at quite significant cost to the industry, *eg* the two nuclear operating utilities in the United Kingdom have spent in excess of € 50 million at their nuclear power plants plus further sums on "essential" and "business critical" work.

The author is the director of the World Association of Nuclear Operators

The above article is a shortened version of an article that appeared in Nuclear Europe Worldscan, the magazine for nuclear researchers