UTILITIES

The Committee has taken a broad-based approach to utilities—aggregating electrical power, gas and oil, and water (drinking and wastewater) in this sector. Telecommunications—is discussed separately in another section of this report.

ELECTRIC UTILITIES

One of the most often asked question concerning Y2K is, "will the lights stay on?" In general, the answer is yes. However, progress in assessing, remediating, and testing is insufficient to answer this question absolutely. As with other sectors, some general conclusions can be drawn. First, the large corporations, or bulk power producers, are spending vast resources to get the Y2K problem under control. However, each of the 3200 electric utilities is at a different stage of remediation, and many may experience problems. All of the evidence seems to indicate that there may be isolated and diverse electrical outages across the country. The questions now are: Where will they occur, how long will they last, and will they be significant enough to affect the overall grid?

ELECTRICAL POWER IS KEY TO EVERY OTHER SECTOR: THE LIGHTS MUST STAY ON!

The Committee made electric utilities its top priority because of its critical importance to everything else—without electric power little else will work. As a result, the status of electric power is the number one concern for all other sectors.

Overview

There are about 3,200 independent electric utilities in the United States including about

- 250 investor-owned or private utilities,
- 10 government-owned utilities,
- 2,000 other publicly owned utilities, and
- 900 cooperatives.

Nearly 80% of the nation's power generation comes from the 250 investor-owned public utilities. The federal government generates another 10% of the nation's power, primarily through large facilities such as the Tennessee Valley Authority and the Bonneville Power Authority. There are another 2,000 non-utilities, or privately owned entities, that generate power for their own use and/or for sale to utilities and others.

Electric power is generated from the following sources:

- 51% by coal
- 20% by nuclear energy
- 15% by gas,
- 10% by hydro, and
- 4% by other sources.

The approximately 900 cooperatives

generally have limited power-generation capacity and focus primarily on distribution systems.

The electric power industry is complex and highly automated. It is made up of an interconnected network of generation plants (nuclear, fossil fuel, gas, hydro, etc.), transmission lines (commonly referred to as the "grid"), and distribution facilities. There are three independent interconnections or grids that provide electricity to every household and company in North America (See figure 1.)

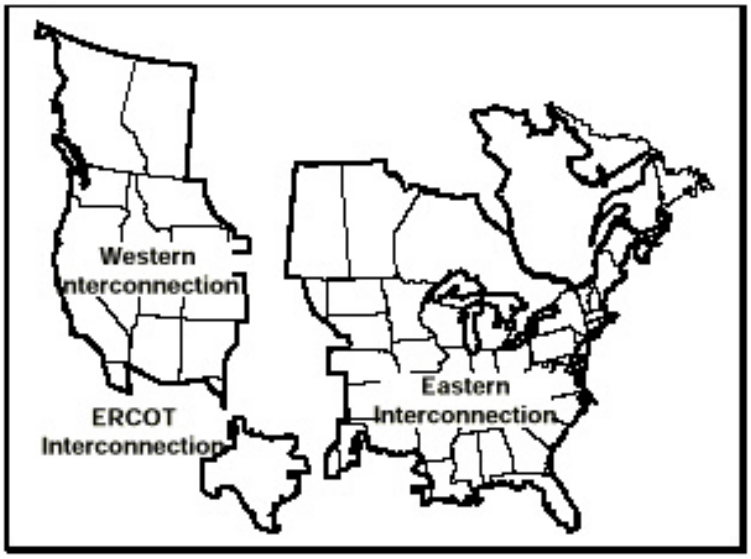

Figure 1: North American "Grids"

In its simplest form, each of these grids operates as a single machine, constantly making adjustments to balance the amount of power being generated with the amount being used. These adjustments are critical because electric power cannot be stored. Too much power could literally melt transmission and distribution lines; too little power could result in brown outs.

It takes a high degree of automation to operate the grid. On one hand, it is this high degree of interconnectedness that gives the system its unprecedented reliability and efficiency. On the other hand, the interconnectedness makes the grid fragile and susceptible to Y2K disruptions. An outage in one part of the grid can cascade causing ripple effects on other parts of the grid. For example, a generation plant could go out in Maine, affecting power in Florida.

The basic structure of an electric power transmission and distribution system consists of a generating system, a transmission system, a sub-transmission system, a distribution system, and a control center. Power plant generation systems may include steam turbines, diesel engines, or hydraulic turbines connected to alternators that generate AC electricity. This configuration is illustrated in figure 2.

In most respects, the electric industry faces the same Y2K challenges as every other industry. Y2K anomalies could lead to the malfunction of software programs on mainframe computers, servers, PCs, and communications systems. Corrupted data could be passed from one application to another causing erroneous results or shutdowns. This means computer programs used for accounting, administration, billing,

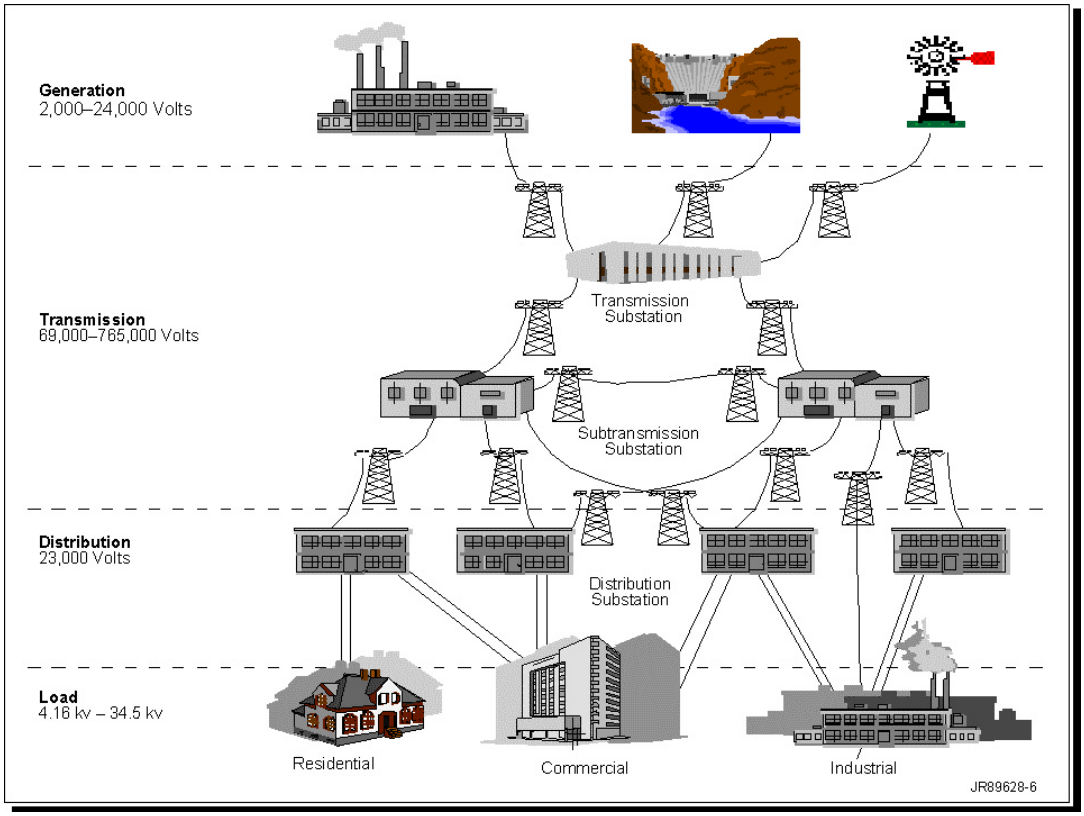

Figure 2: Electric Power Components

and other important functions could experience problems.

Of greater concern to the electric power industry are embedded computers—small electronic chips or control devices. These chips are used extensively in all parts of the electric power industry including generating plants, transmission lines, distribution systems, and power control systems. Even though only a small number of these embedded devices will have a Y2K problem, it is impossible to tell which ones until each chip has been checked and tested—a time consuming venture.

Making matters worse, electronic chips are generally mass-produced without knowing the ultimate application of the chip. A single circuit board can have 20–50 of these chips from various manufacturers. Because of the diversity of chip suppliers, one vendor may use a different mix of chips even within devices labeled with the same name, model number, and year. Many of these chips have built-in clocks that may experience date change anomalies associated with Y2K

There are numerous mission critical systems essential to the production, transmission, and delivery of electric power. Y2K risks in electric power can be grouped into five areas.

1. Power Production Systems

Generating units must be able to operate through critical Y2K periods without disruption. Units that are scheduled to operate must be able to start up and deliver electricity as planned. The threat is most severe in power plants with Digital Control Systems (DCSs). Many older plants operating with analog controls may be less problematic. Numerous control and protection systems within the DCS use time-dependent algorithms, which may result in generating unit trips when encountering a Y2K anomaly. Digital controllers that have been built into station equipment, protection relays, and communications may also pose risks.

2. Energy Management Systems

There are approximately 200 bulk electric control centers in North America. From these control centers, system operators monitor and control the backbone of the electrical systems and dispatch generation to meet demand. Computer systems within these control centers use complex algorithms to manage the operations of transmission facilities and to dispatch generating units. At any moment in time, a percentage (usually 10–20%) of generating units may be on automatic control for the purpose of following load and regulating interconnection frequency. Many of the control center software applications contain built-in time clocks used to run various power system monitoring, dispatch, and control functions. Some energy management systems are dependent on time signal emissions from Global Positioning Satellites. Beyond the 200 operating centers, there are hundreds of additional control centers used to manage subtransmission and distribution systems. These systems are typically operated using a subset of an energy management system, called Supervisory Control and Data Acquisition (SCADA).

3. Telecommunications Systems

Electric power systems are highly dependent on microwave, telephone, VHF radio, and satellite communications. If the control centers are the "brains" of the electrical grids, communications systems are the "nervous system." Telecommunications is the single most important area in which the electric systems depend on another industry. Many of the telephone, microwave, and network services used for communications in the electric industry are provided by telephone companies and other communications and network service providers. The dependency of electric supply and delivery systems on external service providers is a crucial factor in successful performance during Y2K transition periods.

4. Substation Control Systems

Throughout electric transmission and distribution systems there are substations that contain control equipment such as circuit breakers, disconnect switches, and transformers. Remote terminal units (RTUs) in substations serve as the communications hubs for the substations,

allowing them to communicate with the control centers. Substations also contain most of the transmission and distribution system protection relays, which serve to operate circuit breakers to quickly isolate equipment should an electrical fault occur on a line, transformer, or other piece of equipment.

5. Distribution Systems

Distribution systems deliver electricity from the transmission network to customers. There is a lot of commonality in the types of substation equipment in distribution compared to transmission. Distribution systems have additional equipment outside substations (for example, along a distribution feeder) that may have electronic controls. Examples include reclosers (relays that open and close a feeder in rapid succession to allow a fault to clear), capacitors, voltage regulators, and special monitoring devices.

Although the five areas outlined above focus directly on the production and delivery of electricity, other support systems are essential to sustained operations of the electrical service provider. These systems have been grouped under the heading "Business Information Systems" in this report. They include among others customer service call centers, supply and inventory systems, and accounting systems.

Major Players

Several federal organizations are involved in various aspects of the electric power industry. Primary are the Department of Energy's (DOE) whose mission is to formulate a comprehensive energy policy encompassing all national energy resources, including electricity; and the Federal Energy Regulatory Commission (FERC), an independent agency overseeing the natural gas industry, the electric utilities, non-federal hydroelectric projects, and oil pipeline transport. Other federal agencies that oversee the electric power transmission and distribution industry include

- the Nuclear Regulatory Commission (NRC),
- the Rural Utility Service (RUS),
- the Environmental Protection Agency (EPA), and
- the Securities and Exchange Commission (SEC).

At the request of DOE, the North American Electric Reliability Council (NERC)—a non-federal entity—has assumed the primary role in monitoring the overall Y2K preparedness of the electric power industry. NERC is a logical choice for this role because it is the organization most involved in keeping the lights on in North America.
Formed in 1968 in response to a cascading blackout that left almost 30 million people without electricity, members are drawn from all ownership segments of the industry—investor-owned, federal, state, municipal, rural, and provincial. NERC is a nonprofit corporation composed of ten regional councils.

The members of the regional councils are electric utilities, independent power producers and electricity

marketers that account for most of the electricity supplied in the United States, Canada, and Mexico.

State public utility commissions (PUCs) play the most significant role regulating the electric power industry. PUCs control the rate structure for all municipal utilities, investor-owned utilities, and rural electric cooperatives that own, maintain, or operate an electric generation, transmission, or distribution system within a state. By controlling what constitutes an allowable charge, classifying accounts, and structuring rates, the PUCs can exert significant influence over utilities. The PUCs also regulate reliability for both operational and emergency purposes, oversee territorial agreements, and resolve territorial disputes between utilities.

Other significant Y2K players in the electrical power industry include the:

- American Public Power Association (APPA)
- Electric Power Research Institute (EPRI)
- National Rural Electric Cooperative Association (NRECA)
- Edison Electric Institute (EEI)
- Nuclear Energy Institute (NEI)
- Canadian Electric Association (CEA)

Major Initiatives

The Senate Year 2000 Committee held its first hearing on energy utilities on June 12, 1998. We received testimony from Administration officials and key players in the electrical power industry including John Koskinen, Chairman, President's Council on Year 2000 Conversion; Elizabeth Moler, Deputy Secretary DOE; Shirley Ann Jackson, Chairman, NRC; Michehl Gent, President, NERC; and Dr. Charles Siebenthal, Manager Y2K Programs, EPRI. In addition, because of the lack of data on the overall status of the electric power industry, the Committee conducted a survey of large electric and gas and oil utilities.

The Committee's survey results clearly indicated that electric utilities did not have an accurate picture of their current state of Y2K readiness. Most utilities had just begun to assess their systems and embedded devices

John Koskinen outlined the structure of the President's Y2K Council and reported that DOE would head the electric power sector.

DOE testified that it lacked the regulatory authority to force industry compliance. DOE asked NERC for help in building an understanding of Y2K efforts in the electric power industry. NERC also assumed responsibility for surveying the industry.

APPA, where members include many state and local municipal electricity providers, is coordinating information sharing and surveys of its members, as well as smaller non-member public power utilities. APPA is assisting NERC in the industry-wide readiness review of electric distribution systems.

EPRI is focusing its Y2K program on embedded systems and the associated Y2K technical and project management issues. Over one hundred companies are participating in the EPRI information-sharing program, representing over 74 percent of the electric power consumed in North America.

EEI represents investor-owned utilities. It has established a program to address Y2K technical, regulatory, and liability issues. EEI is also assisting in the readiness review of electric distribution systems.

NRECA is coordinating Y2K readiness assessments and information sharing among its membership, which includes nearly 1,000 rural electric systems.

NEI is coordinating the assessment of Y2K readiness of U.S. nuclear facilities and is providing that information as part of the NERC surveys.

CEA is assisting NERC by coordinating efforts in Canada, particularly to address the readiness of electric distribution systems and Canadian nuclear facilities.

Assessment

At the time of the hearing, there was a lack of industry-wide survey data of the electric power industry. As a result, the Committee staff surveyed five large electric and five large gas and oil companies to obtain cursory readiness information. Figure 3 below displays the result of the survey.

Based on the survey results, the Committee concluded that the utilities were proceeding in the right direction, but the pace of remedial efforts was too slow and there was so much remaining to be done that there was significant cause for concern. Only two of the eight firms reported completion of assessment, making assertions of Y2K compliance by December 1999 highly suspect. Committee concern was heightened because the most difficult tasks—renovation and testing—were yet to come.

The utilities' lack of information regarding Y2K compliance of their major suppliers, vendors, and service providers created additional concerns about the utilities assertions of readiness. The survey results raise significant levels of concern given that the firms surveyed were among the largest utilities and were dedicating many resources to Y2K (collectively over $400 million). Smaller firms with fewer resources are presumably further behind in their Y2K remediation efforts.

On September 17, 1998, three months after the Committee's hearing, NERC issued its first comprehensive report of electrical power industry readiness based on survey data collected at the end of August. It has issued two monthly updates since that time. Participation by the 200 bulk electric operating entities increased from 144 in August to 155 and 188 in the September and October surveys, respectively.

Company	Date Aware	Establish Formal Project	Assessment Complete	Percent Systems Mission Critical	Status of Service Providers/ Vendors	Legal or Liability Concerns	Contingency Plans Complete	Contacts By Creditors	Contacts by Investors	Will You Finish In Time
1	1995	Yes	No	54	?	Yes	No	Yes	-	Yes
2	1995	Yes	Yes	5	?	Yes	No	Yes	Yes	Yes
3	1996	Yes	No	?	?	Yes	No	No	Yes	Yes
4	1992	Yes	No	30	?	Yes	No	Yes	Yes	Yes
5	1995	Yes	Yes	50	?	No	No	Yes	Yes	Yes
6	-	Yes	No	?	?	Yes	No	Yes	Yes	Yes
7	1996	Yes	No	?	?	Yes	No	Yes	Yes	Yes
8	1996	Yes	No	25	?	No	No	Yes	Yes	Yes
9	1996	Yes	No	35	?	Yes	No	Yes	Yes	Yes
10	1996	Yes	No	18	?	No	No	Yes	Yes	Yes

Figure 3: Committee Survey Results

About 2,200 of the 3,000 distribution entities, i.e., the actual electric utilities have participated in the NERC process by responding to data gathered by APPA and NRECA and providing it to the appropriate bulk electric operating entity. NERC's overall survey results are depicted in figure 4.

While the NERC surveys clearly show progress in August, September, and October, the question is whether there is sufficient time to complete Y2K remediation efforts. The data presented in the NERC report do not seem to support the optimistic tone contained in the report's executive summary. Of particular concern is that, with only a little over a year to go, 34% of the firms are operating without a written plan.

In addition, the assessment phase is only 75% complete (federal agencies are 99% complete with this phase). Remediation and testing is only 36% complete. Given that Y2K experts contend that between 40 and 70% of the total effort will be expended in testing alone, there may not be sufficient time to complete this.

The highly interconnected nature of the grids raises concern about cascading failures. This in turn obviates the need for contingency plan-

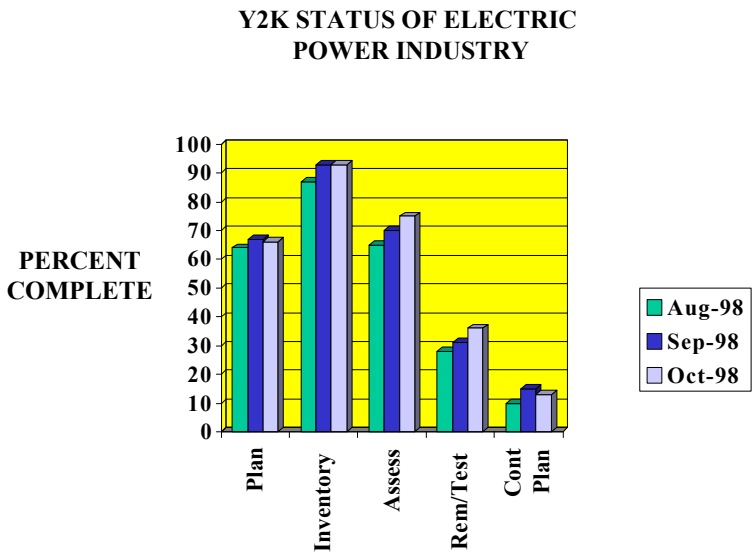

Figure 4: NERC Monthly Status Reports

ning, particularly plans for addressing capacity shortages and overages—of which only 13% of the firms surveyed have in place.

Although nuclear plants are addressed in the overall NERC study, public concern about their safety dictates that the Committee provide specific information regarding the overall Y2K preparedness of these plants. Nuclear facilities are lagging behind other electric facilities in their Y2K assessment and remediation efforts.

In general, nuclear facilities contain very old analog technology and, as a result, have fewer Y2K issues than the more digital and modern fossil fuel facilities. Nevertheless, assessments to date have revealed varying degrees of problems in areas such as plant process control, feed water monitoring, refueling, turbine control, and building security and access control.

While these problems should not affect plant safety, they could cause serious electricity production problems. While NRC has legal authority only to address plant safety issues, it is working closely with NEI to assess nuclear plants. NRC plans detailed Y2K assessments of 12 of the nearly 70 nuclear facilities. It has completed assessments on six of these plants, and has issued reports on the first three. These reports are publicly available on NRC's web site.

Concerns

- While complete power grid failure and prolonged blackout is highly unlikely, failure of at least some parts of the electric power industry, e.g., local or regional outages, is possible. The 3200 electric utilities are at various stages of remediation. The likelihood of outages in a given area is directly related to the overall preparedness of the individual electric utility serving that area.

- Overall Y2K remediation progress has been slow due to the industry's late start, the complexity of the power grids, and the magnitude of the problems. As a result, power companies must

step up their efforts, and develop workable contingency plans in the event their best efforts fall short.

- The interconnectivity of the electric generation and transmission entities making up the grids is a strength and a weakness. On the one hand, interconnectivity provides flexibility in that electricity can be routed around trouble spots. On the other hand, outages in one part of the grid could affect power in other parts of the grid. There are no comprehensive studies concerning the number of entities that would have to fail to put the entire grid at risk, but some experts suggest that it may be a very small percentage if in key locations.

- The interrelationship of the electric power sector with other sectors it depends on—telecommunications, natural gas and oil supplies and pipelines, and rail transportation for coal supplies—requires close coordination. There are signs that this coordination is beginning, but efforts need to be stepped up so that the electric utilities can engage in more meaningful contingency planning.

- The bulk power entities are spending large amounts of money on Y2K remediation and most are making good progress. Of greater concern are some of the smaller and medium-sized distribution entities that may not have sufficient resources to devote to the problem. Each is an essential link to the overall success of the industry.

- State public utility commissioners must play an active role in ensuring that the electrical utilities under their purview are taking appropriate Y2K remediation, risk reduction, and contingency planning actions. In addition, they should keep the public informed about the status of the utilities.

- Nuclear plants are at various stages of Y2K remediation. Some have only recently begun to assess the systems within their plants. Even if for no other reason than to allay public concern, NRC needs to expand its detailed Y2K assessments to include all nuclear plants. In addition, not withstanding the NRC charter of addressing safety issues only, it needs to broaden the scope of its Y2K assessments to include operational issues as well.

- The electric industry is in the middle of a major restructuring to introduce wholesale and retail competition for electricity. Attention has been on competing in the marketplace, cutting costs, mergers, reorganizations, and survival. The industry must find a way to ensure that all of this restructuring activity does not interfere with the more immediate concerns of timely Y2K remediation.