A Road Map To The Next Level Of Reliability

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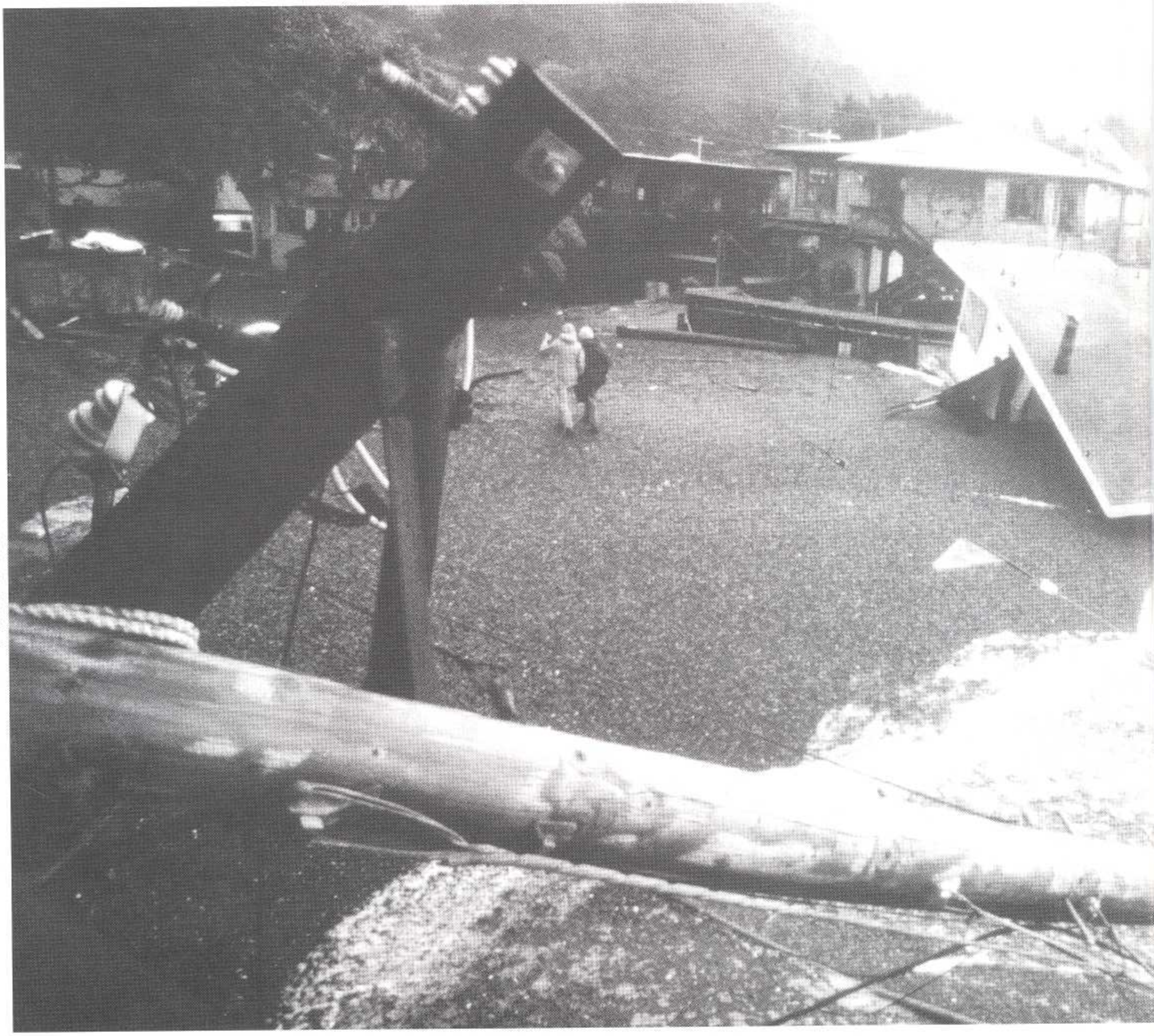
A Road Map To The Next

Reliability is a high-profile political topic these days. Secretary of Energy Bill Richardson has called electric reliability one of his chief concerns, as evidenced by speeches rolling out the findings of his Power Outage Study Team that was formed last year to investigate summer 1999 power outages. Attorneys general in New York and Illinois have initiated public inquiries into the causes and remedies for very visible power outages like the Washington Heights network failure in New York City and the Jefferson Street substation failures (and others) in Chicago. Regulators in several states have issued orders on electric reliability, calling for increased reporting; mandated programs, penalties or fines; and, in some cases, independent management audits focused on reliability.

Along with this new regulatory focus on reliability has come an increased level of



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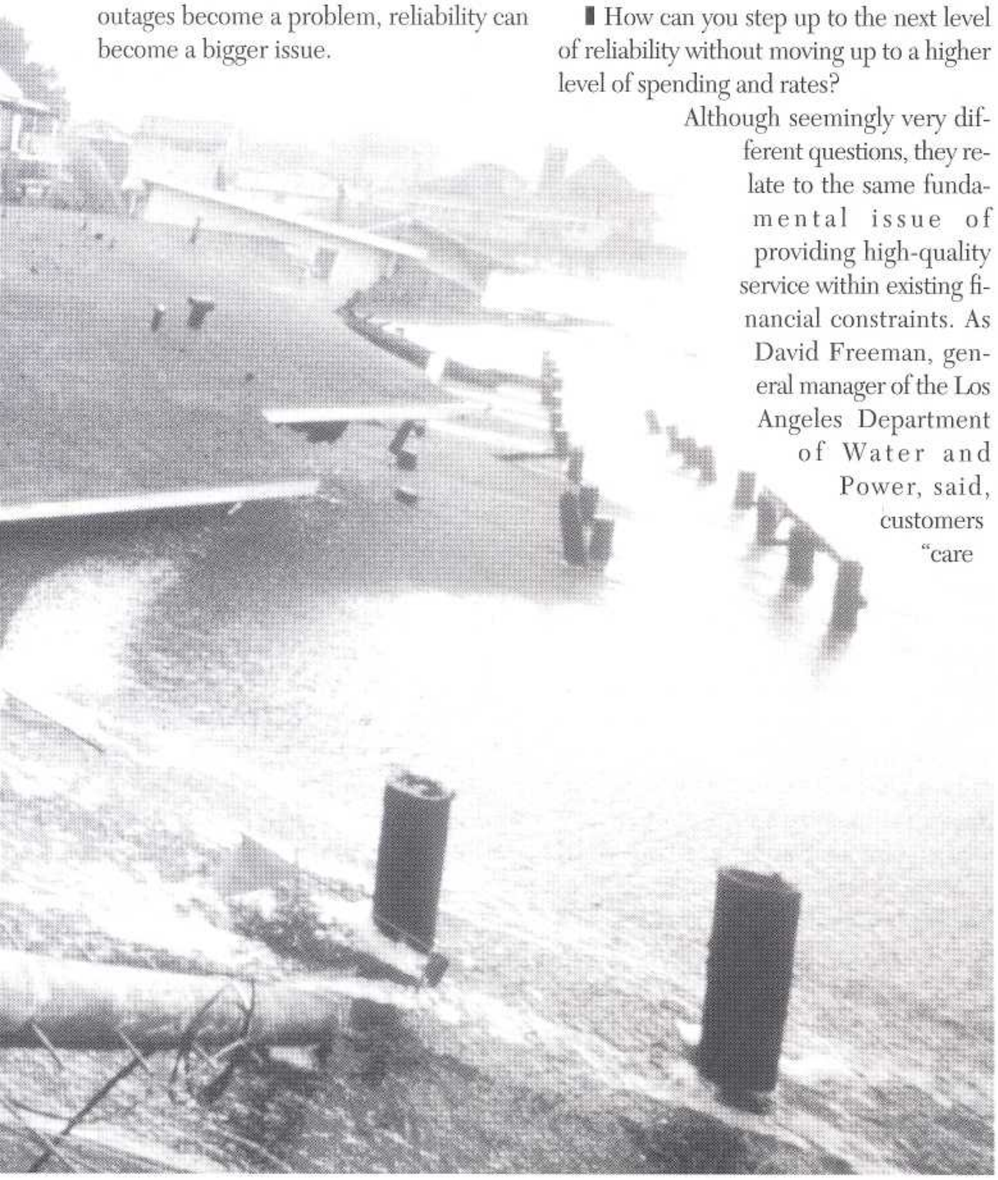
Level Of Reliability

concern among customers, the public and the media. Mayors in major cities have begun to publicly flog local utilities about noticeable electricity outages in their cities, in some cases calling for new management to restore public confidence. In states with electricity deregulation initiatives, even when public power entities are not directly involved, the spirit of choice and competition is raising the public's awareness that they could have options in power supply if they are not satisfied. In that regard, price can be an issue. But if outages become a problem, reliability can become a bigger issue.

It is clear that all of this public discussion and activity has raised the bar for all utilities. Every utility needs to see what it might take to step up to the next level of reliability demanded by increasingly critical customers, media and public officials. The key questions for public power officials and city managers are:

- What should you do to prepare for such intense public scrutiny of reliability?
- What can you do to strengthen public confidence in your reliability performance?
- How can you step up to the next level of reliability without moving up to a higher level of spending and rates?

Although seemingly very different questions, they relate to the same fundamental issue of providing high-quality service within existing financial constraints. As David Freeman, general manager of the Los Angeles Department of Water and Power, said, customers "care about smooth power these days and we have a revolutionary interest in reliability."



An internal assessment of utility reliability can provide answers to these key questions. Such an assessment would focus on the same issues that an external auditor would examine, but without the rigidity of a mandated audit. It would provide an opportunity to address problems before they become an issue for the community or the media. It also would provide an opportunity to identify improvements that would enhance electric reliability. Typical items to cover in the assessment would be:

- Performance benchmarking,
- Material condition inventory,
- Maintenance practices,
- Reliability improvement plans,
- Capacity planning,
- Budgeting and priorities for reliability projects,
- Organization and staffing,
- Storm restoration plan and procedures,
- Information systems and technology that support reliability, and
- Linkage to customer satisfaction and public approval.

Performance benchmarking is a useful way to gauge how a utility's performance compares to others. It is important to compare apples to apples. There are difficulties with many existing blind benchmarks of standard data on frequency and duration.

For example, in one state where the public utility commission asked for SAIFI, CAIDI and SAIDI, the first survey showed some of the large investor-owned utilities with much worse reliability than many municipal systems. On further analysis, it was discovered that many utilities were reporting the statistics in the only way they had them—at the circuit breaker only, thereby not counting all the blown fuses and line recloser lockouts that others were counting. Thus, a first-quartile SAIFI of, say, less than 1.0, was really a third- or fourth-quartile SAIFI of greater than 2.0.

One of the best ways to avoid this problem is to supplement the blind benchmark data with the growing database of publicly available named-company data on SAIDI, SAIFI and CAIDI. Navigant Consulting recently gathered this data from California, Texas, New York, Pennsylvania, Florida, Illinois and other states, resulting in a database of more than 40 utilities. We called each utility and interviewed staff about how they assemble and keep their data, revealing key differences like the circuit breaker-only distinction described above. Normalizing for such differences allows for a true apples-to-apples comparison.

In addition, it is important to consider territory and system characteristics. For example, if a utility has a primarily overhead radial system, it will be significantly misled if it compares system performance with that of an underground network.

Conducting a material condition inventory provides valuable insights into the current condition of lines, poles, substations and equipment. Surprisingly, many utilities do not even have accurate current measurements of the number of miles or customers on each of their feeders, to say nothing of accurate counts of:

- Trees by type and last trim date,
- Poles by age and last inspection,
- Transformers by type and estimated loading,
- Animal and lightning protection, and
- Underground cable lengths by age, type, number of previous failures, etc.

Many of these system characteristics can be used to predict failure for various types of equipment and can guide priorities for reliability improvement programs.

Inspection and maintenance practices are coming under increasing regulatory scrutiny. In many cases, commissions have mandated program details like tree trimming and pole inspection cycles. A utility's own evaluation of maintenance practices should include examination of:

- Tree trimming and right-of-way mowing/spraying,
- Pole inspection and repair/replacement,
- Equipment inspection and overhaul cycles—e.g., circuit breakers, load tap changers,
- Infrared inspections for hot spots,
- Padmount lock inspections,
- Underground maintenance hole and vault inspections, and
- Partial discharge monitoring (or better, mapping) for underground cable.

Since many utilities are moving toward reliability-centered maintenance, a good case can be made for moving from fixed maintenance cycles to an approach more oriented toward monitoring and targeting the equipment with the greatest impact on reliability. Tree trimming, for example, need not be on the same cycle or specification for an entire circuit. It makes sense to trim the backbone (non-fused) portion of the circuit more aggressively than the laterals, even though it may slightly raise the cost per mile, because mainline outages cause lockouts of the entire feeder.

Starting with material condition, and integrated with optimized inspection and maintenance, every utility should have reliability improvement plans that address known problem areas such as:

- Worst-performing circuits,
- Devices with repetitive outages,
- Worst-performing pocket of customers,
- Root cause analysis of outages (trees, lightning, animals, etc.), and
- Replacement programs for problems like deteriorating underground cables.

Unfortunately, few utilities track the effectiveness of remediation programs and instead simply spend dollars where they hope to do the most good. There are numerous examples of ineffective remediation, including some that led to lower reliability.

Production and delivery capacity planning might have alleviated some of the reliability problems of the last three summers. While thermal overload can be treated as a root cause, it also makes sense for voltage support and for avoiding major equipment losses to plan for adequate capacity. This needs to be separated into adequacy of supply and ability to deliver. The typical approach is to model the system (network first, then feeder by feeder) to determine the impact of load growth on a power delivery system's capacity. Key factors to note are:

Reliability Measures

Typical measures used to gauge reliability performance include:

SAIDI—System Average Interruption Duration Index—the average number of minutes in a year that the typical customer is interrupted. (The total minutes divided by the average number of customers.)

SAIFI—System Average Interruption Frequency Index—the average number of times per year that the typical customer is interrupted. (The total customer interruptions divided by the number of customers.)

CAIDI—Customer Average Interruption Duration Index—the average duration of a customer interruption. (The ratio of total minutes divided by the total number of customer interruptions.)

▮ Is the method for forecasting load sufficiently detailed and accurate?

▮ Are the ratings of the equipment consistent with industry practice?

▮ How are contingencies factored in? Single? Double? More in some cases?

▮ When capacity is deemed short, are good alternative projects identified early enough?

▮ Are capacity projects typically completed in time for peak load?

▮ Is reliability of the stations, lines and equipment factored in?

Typical practice, for example, allows station transformers to be overloaded for limited durations under certain contingencies. Any utility doing this must make sure it is in line with industry practice.

How a utility allocates resources to reliability projects is critical to overall success. Some rules of thumb can help guide spending in key program areas, then detailed project priority-setting must take over. But some utilities cannot even show how much they are spending on reliability. In reviewing budgets, look for:

▮ What is the overall reliability spending, by O&M and capital?

▮ How is it broken down by program, e.g., tree trimming, pole inspection, etc.?

▮ What are the trends? If spending is down, is reliability still good?

▮ Are there activity measures matched to dollars, e.g., cost per mile?

▮ How are dollars allocated across programs?

▮ How are projects prioritized?

▮ Is there a good sense of the bang per buck?

Sometimes a program becomes a pet project, garnering more funding than objective analysis would warrant. Problems also occur when a utility takes its worst circuits and virtually rebuilds them (since building circuits is something the utility's engineers certainly know how to do). This is usually not cost-effective.

It may be surprising to find that even the most basic question often goes unanswered: "If you spent \$100,000 more (or less), what impact would it have on reliability?" Some reasonable rules of thumb are \$1 to \$2 per customer interruption minute avoided, i.e., for a utility with 100,000 customers, it would take \$100,000 to \$200,000 of incremental spending to move SAIDI one minute for the average customer. But these rules work only if the program and project spending are reasonably optimized. If the utility chooses to spend its money rebuilding lateral lines, the cost could be over \$100 per outage-minute avoided.

As utilities address the future of the industry, many have moved to re-engineer, downsize or centralize their organizations into an asset management/resource management structure. Understanding how the organizational structure enhances or degrades reliability is essential to knowing what can be done to improve reliability. In addition, utilities must demonstrate that their staffing and training are appropriate to deliver reliable service. Key questions are:

▮ Do you need to have the nightshift staffed? In all areas? For underground, too?

▮ Do you need a noon-8 p.m. shift, at least in the summer, to cover mid-afternoon storms and overloads?

▮ Are your overtime and callout practices efficient and effective?

▮ Is your call center staffed to handle outage calls?

▮ Can you tap contractors and neighboring utilities when needed?

▮ Are dispatchers trained in their territory and procedures?

Finally, a key question for staffing parallels the key question for budgeting: "If you had to improve reliability by x percent, what would that do to staffing?" Be prepared to answer that question, in terms of the call center, trouble crews, inspection and repair crews, and dispatchers. It may be that better optimization could improve service without extra staffing, but once staff levels are optimal, there would normally be a tradeoff. The answer is not simple, but it is not unknowable, either.

A utility's emergency restoration process is highly visible and therefore deserves explicit attention from utility management. A utility may have superior performance all year long, but if a storm makes it look bad, it can expect a higher level of scrutiny. Examples abound of how falling short on emergency restoration raises the ire of community officials and oversight bodies. The public can be very forgiving in a storm, or very angry. Look for the following:

▮ A clear plan, coordinated with public entities,

▮ A track record that you can use to predict overall restoration based on conditions,

▮ Communication and drills with public emergency authorities,

▮ A plan for shedding and restoring load that is sensitive to special needs,

▮ An ability to provide neighborhood-customized restoration times, and

▮ After-the-fact lessons-learned sessions (major storm audits).

Typically, a review of storm readiness reveals a series of opportunities to measurably improve practices, planning activities and performance. Addressing these opportunities can strengthen a utility's ability to respond. It also will serve well to avoid a media hatchet job.

Information technology facilitates utility communications, not only among departments but also among the various publics they serve, including stakeholders and customers. IT provides the direct means for improving reliability as well as communicating that performance both within and outside the utility. For these reasons, IT can be a critical part of a utility's approach to enhancing system performance. Key IT systems supporting reliability are:

▮ Telephone system, including interactive voice response unit and high-volume answering option,

▮ Customer information system,

▮ Outage management system,

▮ Mobile radio dispatch system,

▮ Geographic information system (automated mapping/facilities management),

▮ Work management system,

▮ Regulatory reporting system,

▮ Asset management system,

Studies show that customers do perceive differences in reliability and that, after a point, they care.

▮ Network and feeder modeling systems, and

▮ Data warehouse.

These are the big workhorses. In addition, there will be numerous functions that may or may not be integrated with these systems, like crew callout, fleet management, contractor management, purchasing, human resources, budgets, etc.

Reliability is all about customer satisfaction. If the customer is happy, then public officials and the media have nothing to complain about. Studies show that customers do perceive differences in reliability and that, after a point, they care. Studies also show that customers are willing to tolerate longer restoration times if they can get accurate, customized information about estimated restoration times. Some things to look for are:

▮ Do you survey your customers for satisfaction?

▮ Is it a 'transaction' survey only, sample of all customers, or both?

▮ How is reliability addressed? Frequency and duration?

▮ Can you relate satisfaction to performance at a customer level?

▮ What is the threshold at which customers start to care? Two per year?

▮ Are there groups of customers who are more tolerant?

We have all heard jokes about the rural customer who thanks the utility for saving him money while his lights were off and the suburban customer who calls the commission when his lights blink. The best story we've heard was of the utility manager who was notified of his rural customer's outage by post card. Today's changing demographics call those stereotypes into question. Commercial and industrial customers increasingly have a much lower tolerance for power interruptions. Media image and customer perceptions of reliability are closely linked. It is easy to treat reliability as strictly an engineering exercise and, in so doing, miss the boat.

As the industry continues its move toward a more market-based environment and tries to serve the new economy, reliability will remain in the forefront of the minds of customers, city councils, regulators, legislators and the media. Most utilities must step up to the next level. Evidence from utilities and customers shows that the bar has already been raised from 1999 to 2000, with more customers demanding higher reliability. The trick is to get there without raising rates or losing ground monetarily. That is where it takes a sharper pencil to refine and optimize programs to achieve maximum bang per buck. ■ Howard Friedman and Dan O'Neill, Navigant Consulting, Inc.