UTILITY SYSTEM PROBLEMS CAPACITY AND DISTRIBUTION

INTRODUCTION

Electric utility companies usually supply continuous, reliable, sinusoidal, ac voltages at needed levels. But utilities have limited generating, transmission and distribution capacity. Unusual loads and events can result in service interruptions, voltage reductions, voltage surges and other waveform distortions.

A heat wave may cause an unusual load to be placed on the utility system and may necessitate the implementation of controls in order to maintain service with a minimum of disruption to customers. Winds may sway or break tree limbs, causing line contact or arcing, resulting in service interruptions for all customers downstream of protective switchgear. Other unusual events include ice storms, lightning, the switching of equipment under load and vehicle accidents that result in utility system damage.

Many utility problems cause only inconvenience to consumers. The effects may not be noticed at all. Momentary interruptions and small voltage surges are common examples. But these same disruptions can have disastrous effects on other customers.

Utilities minimize disruptions by the arrangement, maintenance and protection of utility equipment and lines. Some disruptions are avoided by increasing the capacity of the system. Regional “pools” are formed to combine the capacities of member utilities. Each member supplies power to a grid, thus providing a large reserve capacity which is accessible by all systems for any local area need.

In the U.S., fast growing demands and years of only minor increases in total utility capacity have caused an overall reduction in reserves. Complicating the problem, distribution systems have become more restricted as land for right-of-ways becomes harder to obtain.

To limit system disruptions following a fault, a break in a power line or damage to equipment as from fire or vehicular accident, utilities can provide manual or automatic disconnects of power feeding the damaged section. Generally, these power outages affect relatively small isolated areas, and last for as long as it takes to make repairs.

To avoid or minimize disruptions when a catastrophic event occurs or when demands reach or exceed normal generating capacity, a utility may put older, idle, less-efficient units back on line, or may purchase additional power from other utility companies. When it is necessary to reduce loads due to insufficient system capacity, special control methods are used to minimize the effect of the disruption. These include:

- **Conservation** - Emergency appeals are made to all customers for a voluntary shutdown of nonessential electrical equipment.

- **Load Interruption** - Selected large industrial and commercial electric power users are requested to shut down during peak load periods, generally for several hours.
- **Brownout** - The utility system voltage is reduced.
- **Blackout** - Sections of distribution or transmission circuits are manually disconnected as a control to prevent serious overload on generating or transmission equipment, or both.

Some customers experience more electric power disruptions than others. Some even request multiple remote service connections to try to improve power reliability. However even then, the reliability of purchased electric power may not be satisfactory.

Means to further improve the reliability of on-site power include supplemental, private electric power supplies. Alternate considerations include nonelectric power systems such as diesel engine drivers in lieu of electric motors.

These management decisions are best handled as part of a loss control management program, such as that described in AXA XL Risk Consulting's *OVERVIEW*. Generally, the individuals responsible for Hazard Identification and Evaluation and Pre-Emergency Planning have the responsibility to review and evaluate utility disruptions, their hazards and loss potentials.

This guideline discusses the reliability of public electric power supplies and related loss control considerations. A detailed discussion of power quality (clean verses dirty power) and reliability is beyond the scope of this document. Additional information can be found in PRC.5.7.1.3.

POSITION

Assign the Emergency Coordinator the responsibility to document all utility disruptions, and to make this information available to the committees responsible for Pre-Emergency Planning and Hazard Identification and Evaluation.

Write Pre-Emergency Plans to direct prompt reviews of all utility disruptions. Include specific directives to guide actions during protracted emergencies, such as directing measures to:

- Set and update priorities.
- Prevent or mitigate unsafe conditions.
- Control damage and losses.
- Counteract impairments to protection and surveillance systems.
- Provide an effective, logical and safe plan for the restoration of power following lengthy outages.
- Expedite repairs.

Maintain an up-to-date off-premises power analysis if public utility electric power reliability is important to loss control. This off-premises power analysis should be periodically updated and reviewed by the Hazard Identification and Evaluation committee.

DISCUSSION

Utility power disruptions should be considered important to loss control if they:

- Supply critical components and systems.
- Create a hazardous situation by preventing an orderly shutdown of hazardous processes and equipment.
- Result in an impairment to an electric pump used in a fire protection water supply.
- Result in an impairment to special extinguishing system, special exhaust system, fire detection system or alarm signaling system.
- Result in significant property damage.

- Or, result in a serious interruption to business based on high time element values.

Where utility reliability is important to loss control efforts, an off-premises power analysis should be made to determine if improvements are needed. PRC.5.7.1.1 describes such an analysis. The off-premises power analysis should be periodically reviewed for updating, especially whenever a newspaper item, broadcast announcement or utility communication identifies a changed condition. Examples of such changes include a critical power situation, recent system problems, unusual demands, equipment damage and equipment or system changes.

Promptly review utility disruptions and take appropriate action to mitigate losses. Take the following courses of action:

- Implement load interruption in a way that will avoid increased hazards and impairments of fire protection equipment. The Emergency Coordinator normally handles such tasks.
- Analyze the effects of brownouts. For instance, a low voltage power supply may damage a computer. Similarly, as described in NFPA 20, the voltages to a fire pump motor and controller should not fall below specified minimums. Voltages below these levels will result in less reliable starting or breakdown during pump operation due to overheating caused by high current flow. A utility voltage reduction of less than 5% will not normally cause a problem, however each installation requires analysis. Where there is a history of brownouts and their effects on a pump are questionable, appropriate action may include testing the pump during a brownout. It may be possible to avoid low voltage problems during brownouts by changing tap connections on a supply transformer, if this does not cause excessive voltages when service returns to the normally supplied voltage. The Hazard Identification and Evaluation function normally performs these types of reviews.
- Evaluate the need for power system changes to improve power reliability. The provision of an uninterruptible power supply for a computer system is one example of an improvement made to prevent the loss of valuable data upon even a momentary power outage. The addition of a diesel engine driven fire pump to replace or supplement an electric motor driven pump might similarly be appropriate where the reliability of the utility electric power supply is questionable due to a history of power outages or blackouts. The group responsible for the Hazard Identification and Evaluation function normally performs these reviews.

Increased surveillance may be needed during blackouts and other power outages. Arranging for a fire department pumper to remain at the site may be appropriate. But also, long-term actions to improve the reliability of a power supply may be necessary. These actions may include the installation of an additional remote utility service connection and the provision of a private means of power generation.

For a facility following a Loss Prevention and Control Program similar to AXA XL Risk Consulting's *OVERVIEW*, these features are readily identified and addressed. Those responsible for Hazard Identification and Evaluation and for Pre-Emergency Planning should be satisfied that the consequences of public electric power supply losses are recognized, that the susceptibility has been analyzed, and that adequate controls are in place.