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INSURING UTILITY INTERRUPTION
A Global View

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INTRODUCTION

The growing use of technology continues to inflate global power consumption, straining an already aging electrical distribution infrastructure in many countries and challenging providers in developing countries. Utility companies and their consumers are susceptible to power interruptions and the resulting financial losses. This situation translates into increased risk for insurers that provide protection from losses resulting from power interruption.

Conversely, this environment also warrants the need for equipment breakdown coverage to be included on every property policy. In addition, increasing consumption and dependency on power affords insurers the opportunity to provide broader insurance products as well as engineering loss prevention solutions that address service interruption.

However, as more and more insurance companies are finding the need to include equipment breakdown coverage on every property policy, the service interruption component of the coverage will result in new exposures for insurers. To address these exposures, insurance companies must evaluate these new risks while taking into account affordability for insureds.

In the international market, boiler and machinery coverage was traditionally considered a solution only for large-exposure risks. However, large risks typically comprised less than 5 percent of an insurance company's property portfolio, therefore posing relatively minimal risk. In addition, companies engineered large risks for loss prevention and underwrote these accounts with severity of loss in mind.

To operate profitably in the smaller commercial market, future underwriters must increasingly rely on information about their portfolios, the age and condition of the power infrastructure including the power grids, and risk accumulation modeling in making underwriting decisions.

WHAT QUALIFIES AS A UTILITY SERVICE?

A utility is defined as *a basic service such as electricity, gas, water, or the company that provides such a service. A utility can be regulated by the government or provided by a privatized company.*

Some of the most commonly used utility services are:

- Electrical Power
- Natural Gas
- Water
- Air Conditioning/Chilled Water
- Heating
- Steam
- Telecommunications Services
- Internet Access
- Wide Area Networks (WAN) and Data Transmission
- Waste Disposal

While the focus of this paper is primarily on electrical service, it is important to understand that there are many other services that need to be considered. The examples below demonstrate how the interruption of these utility services could result in losses to businesses and the economy as a whole.

Electricity loss poses the greatest economic threat to consumers, and is the utility that is most susceptible to interruption frequency and severity. Small-scale outages caused by power line failures are the most common interruptions. Large-scale outages such as loss of a power plant, substation failure or widespread transmission and distribution line failuredue to natural perils are less common. However, large-scale power interruption can become quite severe for consumers because most homes and businesses don't have long-term electrical service backup.

Natural gas is another commonly used utility. From bakeries to manufacturing facilities, many businesses depend on natural gas to operate their machinery. If a gas line bursts, businesses could face significant losses because their operations would have to shut down.

Water supply disruption or contamination may also be considered a utility interruption for a business. Many businesses depend on water for raw product processing or for cooling. Paper mills, steelworks, breweries, laundry facilities, restaurants, and cafés are just a few examples of businesses that are dependent on a continuous water supply.

Central steam plants produce and sell steam to other locations for heating and/or processing. Usually, fossil fuel is burned in steam generators (boilers) to produce steam, which is usually piped to turbine generators to produce electricity. The exhaust steam, or steam extracted from the steam turbine at some intermediate pressure level, is then distributed to customers for heating, food processing or industrial processes. These central plants often provide chilled water for air conditioning to nearby locations as well. If the flow of steam is interrupted, locations could face loss of income due to inclement conditions, or face production losses.

Telecommunications may seem like a high exposure for utility interruption but the potential for loss is actually somewhat limited. The telecommunications industry is a well-engineered network that has proven to be quite reliable. However, the telecommunications industry is not foolproof and the potential for loss still exists (refer to 2002 IMIA paper 'Telecommunications and e-Commerce – Global Exposures").

Data transmission via the internet and networks present a large-loss potential if a utility service is interrupted. Like telecommunications, telephone lines and other high-speed networks feed these electronic data sources. Large losses may result if a power failure interrupts the utility supply, thus rendering internet websites inaccessible. In addition, computer viruses are more and more common and increasingly destructive. Viruses pose a serious threat tointernet providers and networks.

Waste disposal can be a critical utility for some industries, as well. Wastewater, a byproduct in certain industrial manufacturing operations, frequently needs to be degreased or pretreated for safe disposal. For example, chicken processing plants and slaughterhouses produce large amounts of polluted wastewater that requires special treatment. If these services become incapacitated, these businesses would be forced to shut down.

HISTORICAL INTERRUPTIONS

Globally, there have been numerous significant outages that have had serious impact on thelocal and global economies. Many of the affected locations were uninsured for service interruption. Traditionally, this coverage was designed for larger insureds, with pricing structured for larger risks. This scenario made service interruption coverage unattractive to the small commercial market. However, small commercial businesses also suffer from spoilage or business interruption losses. Though small compared to large business exposures, small business losses can be significant.

The following are some examples of noteworthy outages occurring within the last 10 years:

August/September 2004: Florida, USA

Hurricanes Charlie, Francis and possibly Ivan have created significant power outages over wide areas of Florida and other nearby states. Millions of residential and business customers have been without power for an extended period of time. The resulting losses will be largely uninsured from a service interruption perspective.

July 20, 2004: Hartford, CT

At approximately 10:30 p.m., an underground electrical system exploded causing a blackout in the central business district, affecting 7,000 locations. Luckily, the outage took place during off-peak hours and most of the area's power was restored by 3:00 a.m. the next day. Financial institutions Mass Mutual and Lincoln Financial were without power for over 24 hours. The cause of the explosion is still under investigation.

July 12, 2004: Athens, Greece

The worst blackout Greece has seen in 10 years occurred this July during the middle of a heat wave. Millions were left without power. The outage was blamed on "mismanagement" of the power grid. The blackout lasted four hours in some areas and caused enormous traffic jams due to failed traffic lights and stalled electric trolleys.

September 28, 2003: Rome, Italy

Originating from a disabled transmission line in Switzerland, a large-scale blackout occurred in Italy that left almost all of its 57 million people without power. As do other countries, Italy imports most of its power. Therefore, the entire country (with the exception of the island of Sardinia) was affected by this power outage. Hospitals and the Vatican used generators. But, other businesses suffered income loss. The public transportation system came to a halt leaving 30,000 passengers stuck on board 110 trains across the nation.

September 23, 2003: Denmark/Sweden

A rare power outage in Scandinavia caused a blackout in eastern Denmark and southern Sweden, leaving up to an estimated 5 million people without electricity for several hours. A faulty transmission line that ran between the two countries caused the outage.

August 28, 2003: London, England

A brief power outage occurred in parts of London and southeast England, paralyzing subways and trains and leaving hundreds of thousands of people stranded without power. The blackout took place during rush hour and affected nearly a half million commuters.

August 14, 2003: United States/Canada

This blackout left 50 million people in Canada and in the United States without power for up to two days. It became the largest outage ever experienced in the United States. The estimated economic loss was $6 billion. Less than $3 billion of this loss was insured. The majority of companies, primarily in the small commercial sector, were uninsured for power outage losses.

2000 and 2001: California Energy Crisis

The California Energy Crisis of 2000 and 2001 was caused by many factors, primarily deregulation. However, rapid economic growth and population increase in the region were also to blame. With the huge rise in demand, the supply grid was too fragile to keep up with the increasing load. As a result, energy producers were struggling to meet this increasing consumption. They charged significantly more for power while deregulation rules fixed consumer prices. All of these factors brought about voluntary grid shutdowns by suppliers because power would have been purchased and sold at a loss.

September 21, 1999: Taiwan

Caused by an earthquake measuring 7.6 on the Richter scale, Taiwan's semiconductor industry suffered a power outage resulting in significant business interruption losses. This was an economic catastrophe to Taiwan since microchips account for about 35 percent of the country's exports. Other industries were significantly impacted by this power outage as well, including chemical and motor industries. Taiwan's total economic loss was estimated to be €12 billion. Sale losses for the semiconductor industry alone were estimated to be between €50-100 million per day. This outage also caused considerable contingent business interruption for computer hardware manufacturers. The power failure lasted approximately seven days in the Hsinchu Science-Based Industrial Park.

July 1999: New York City

During a heat wave in the first week of July, thousands of people lost power in New York City and Westchester County. The outages were scattered as to time, place, duration, and number of customers affected. The most widespread blackout occurred in the Washington Heights-Inwood neighborhood, where on July 6, Con Edison shut down electrical service for over 18 hours after losing a series of substations in the area due to arcing.

Some high-use customers, such as Columbia Presbyterian and New York Presbyterian Hospitals, were without power longer due to Con Edison taking a stepped approach to restoring power. Power was stabilized to lower-use customers and then to the high-use consumers. After power was restored, food and medicine had spoiled because refrigerators and freezers were out of service for extended periods. Medical tissue samples that took years to cultivate were also compromised due to loss of power in a deep cold storage containment unit. Data from experiments was also lost. Both hospitals suffered large business interruption losses, as well as some extra expense.

January 1998: Canada

Severe ice storms plagued Quebec and Eastern Ontario for seven days, causing the most expensive disaster in Canadian history. Layers of ice formed onabove-ground transmission lines. The increased weight of ice on the lines coupled with winds caused thousands of pylons to snap. About 150 lines were extra high-voltage transmission lines carrying 735 kV. Five of six central feeder lines that comprise the ring used to supply the Greater Montreal area buckled. Almost 60 percent of the electrical supply to Montreal failed. More that 4 million people were without power and heat for several weeks.

Four key factors contributed to the severity and length of this event. First, power generation facilities were a significant distance away. Second, only a few transmission lines serve the Montreal area. Third, alternative energy sources, such as oil or gas, are rarely used in Quebec. Last, the urban power lines were primarily above ground exposing them to natural disasters.

There were 600,000 insured losses resulting from this catastrophe totaling about €2.5 billion. The majority of these losses were food spoilage, water damage due to frozen pipes bursting and fallen tree limbs on automobiles.

January 22, 1998: Auckland, New Zealand

Age and material defects caused one of two 110 kV underground cables supplying electricity to the Auckland business district to collapse. Three weeks later, the second line failed due to the same reasons. Auckland's worst heat wave in 30 years was causing increased demand for air conditioning, increasing the load on the other high-voltage lines. Consequently, two more 110 kV lines overloaded and collapsed. This reduced Auckland business district's electrical supply to a single 22 kV line. It took three weeks for the cable connections to be repaired. The total damage was estimated at €300 million.

September 25, 1998: Melbourne, Australia

A series of explosions occurred at the only gas production facility in the Federal State of Victoria. Shortly thereafter, the gas supply to households and commercial locations stopped for 12 days. The Australian Industry Group estimated that the losses were more thanA$60 million per day for the first week. Sales loss was estimated atA$1.3 billion. Only 30 percent of the affected businesses carried business interruption insurance and many did not carry contingent business interruption coverage to suppliers.

INDUSTRIES MOST AFFECTED BY UTILITY SERVICE INTERRUPTIONS

Certain industries are highly vulnerable to large losses resulting from a utility service interruption. Outlined below are highlights on specific industries that are particularly prone to loss.

- Steelworks and Aluminum Products Manufacturers
- Semiconductor Manufacturing
- Plastic Product Manufacturing
- Chemical Manufacturers
- Food Product Manufacturing/Storage
- Hospitals/Research
- Pharmaceutical Manufacturing
- Textiles
- Financial Institutions
- Retail/Internet Sales

Steelworks and aluminum products manufacturing plants are highly susceptible to utility interruption losses due to the extreme demand for gas and electricity. Molten material quickly solidifies when the heat supply is cut off. In addition reheat furnaces and large electrical rotating equipment are critical to production. Large manufacturing plants that are consuming large amounts of power can also have single lines of supply for gas or electricity. This increases the possibility of a large utility interruption loss.

Semiconductor manufacturing is another industry that has a high utility interruption risk. This industry uses highly sensitive equipment and requires a stable and reliable power supply. Silicone chips have a low temperature and ventilation tolerance range and processing can take up to four weeks because the chips pass through a series of diffusion ovens and ion implanters. Even a short power outage can destroy a large amount of expensive productin process. Sensitive clean rooms can become contaminated when power supply is interrupted. Semiconductor manufacturing plants are often located in seismically active regions, including Hsinchu Science-Based Industrial Park (HSBIP) in Taiwan and Silicon Valley in the United States. These manufacturing plants can also have solely supplied power, which also increases the risk for severe utility interruption losses.

Plastic product manufacturers are particularly vulnerable to utility interruptions because the processing equipment requires extensive cleaning following a power outage, and can also take a long time to restart.

Chemical manufacturers must carefully control the temperature and pressure of feedstock. The equipment is very sensitive and must be maintained at a precise temperature for proper processing.

The food industry is yet another industry that has a high potential for loss in the event of a utility interruption. Spoilage losses can be severe for food product manufacturers, retailers and large cold storage facilities. Losses vary depending on the production capacity of the manufacturer, the amount of product stored on site and how sensitive the product is to temperature change.

Small retail operations, food storage facilities and restaurants that use refrigeration are prone to costly spoilage losses.

Hospitals, especially those with research facilities, can face severe interruption losses. Medicines, blood and other perishable products can be costly to replace. Research facilities often have years invested in research tissue samples that can be destroyed in the event of an outage and are difficult to properly value.

Pharmaceutical manufacturers can produce expensive medicines that are highly susceptible to spoilage. Research and development that use cultures and animals may increase exposures to a large loss even from a short power interruption.

The textile industry faces increased exposure to service interruption losses, since time-sensitive dying processes could ruin large runs of material in the event of a power outage.

Financial institutions can be faced with considerable loss exposure in the event of an interruption. Many such institutions rely on electronic data transfers to move large amounts of money; service interruption can shut these businesses down resulting incostly losses.

Retail outlets have become very dependent on technology andinternet sales are now a large part of many operations. What might have been a small, regional specialty organization can now have global reach with new technologies.

All of these industries demonstrate the potential loss severity that can arise from an electrical service interruption. This stresses the need foran understanding of risk and accumulation control when providing equipment breakdown coverage. Service interruption is an important coverage to small businesses as well. These smaller businesses cannot easily absorb the spoilage losses that are typically associated with an interruption of service.

LOSS EXPOSURES PRESENT DURING A SERVICE INTERRUPTION

When a utility service is interrupted, it may trigger a number of coverages, such as:

- Direct (or Physical) Damage
- Indirect Damage
    - Business Interruption
    - Extra Expense
    - Contingent Business Interruption
- Spoilage

Direct damage losses come into play at the onset of a power interruption as well as when the utility comes back on-line. The frequency of physical damage losses can increase due to power fluctuations when power is being restored. Without proper surge protection in place, poor power quality is especially harmful to sensitive modern electronic equipment.

Direct damage includes the actual physical damage to equipment that results from a service interruption. The amount of physical damage can be small or large and depends on the occupancy and types of equipment used at the location. However, some degree of physical damage is likely to occur. Common equipment failures that occur due to electrical surge preceding, during, or after a period of interruption are air conditioning units, computer systems, security and phone systems, and many other types of increasingly sophisticated electronic equipment.

Indirect damage is covered under business interruption and extra expense coverages. Business interruption (or business income) provides coverage for income lost while the business is shut down following a utility interruption. The extra expense coverage includes expenses that would facilitate the repair or replacement of the damaged equipment, while trying to expedite the business to resume operations. This coverage is important and can help reduce the overall loss, if used properly.

Contingent business interruption (or dependent property) coverage is similar to business interruption coverage, except it is extended to cover the loss or damage suffered by the dependent properties of the insured, as well. The dependent property can either be a company supplying or receiving product from the insured. For example, most manufacturers, especially large manufacturers, are contracted to supply various businesses with their product. If their operation is shut down due to a utility interruption, not only does the manufacturer suffer a business interruption loss, so do all of their contracted vendors.

Spoilage is another important coverage that may also apply during a utility interruption. From sensitive manufacturing processes and large food storage facilities to the small delicatessen down the street, many businesses rely on refrigeration. During a utility interruption, these businesses are susceptible to losing large quantities of products in process, perishable goods or perishable stock. Perishable items are typically temperature-sensitive. That means if the temperature is not maintained at the appropriate level, the product could spoil and result in large losses.

GENERAL ISSUES TO CONSIDER

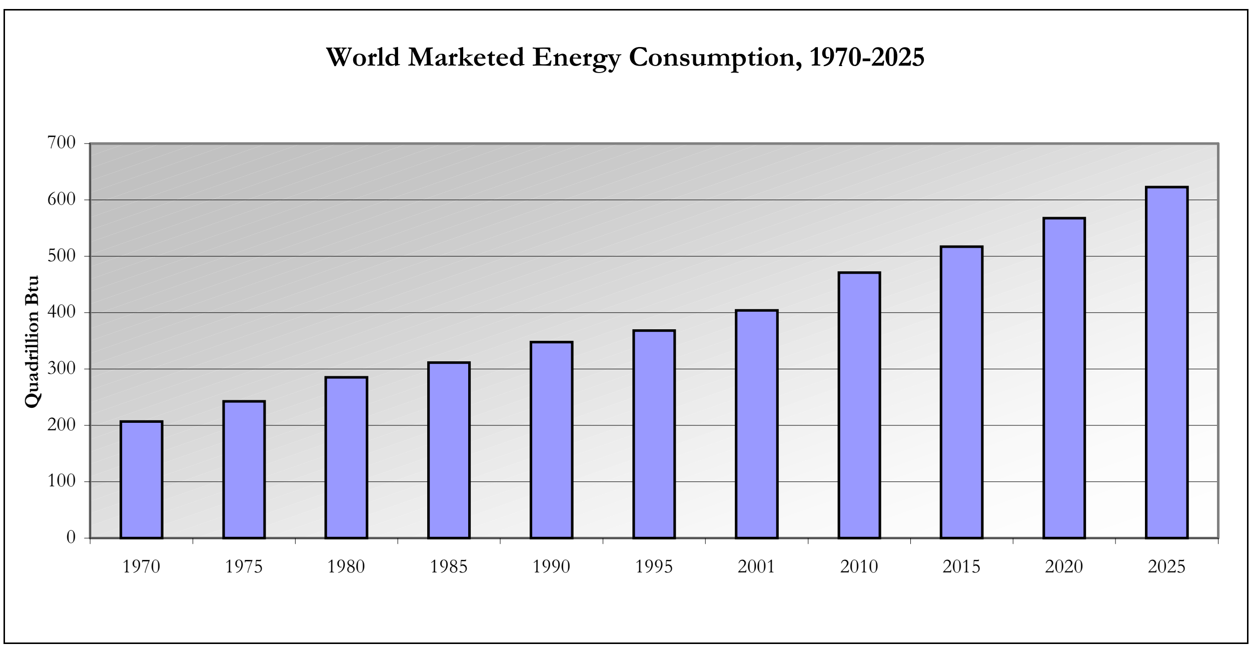
There are many issues to consider when underwriting and insuring utility interruption. Some of the important considerations follow:

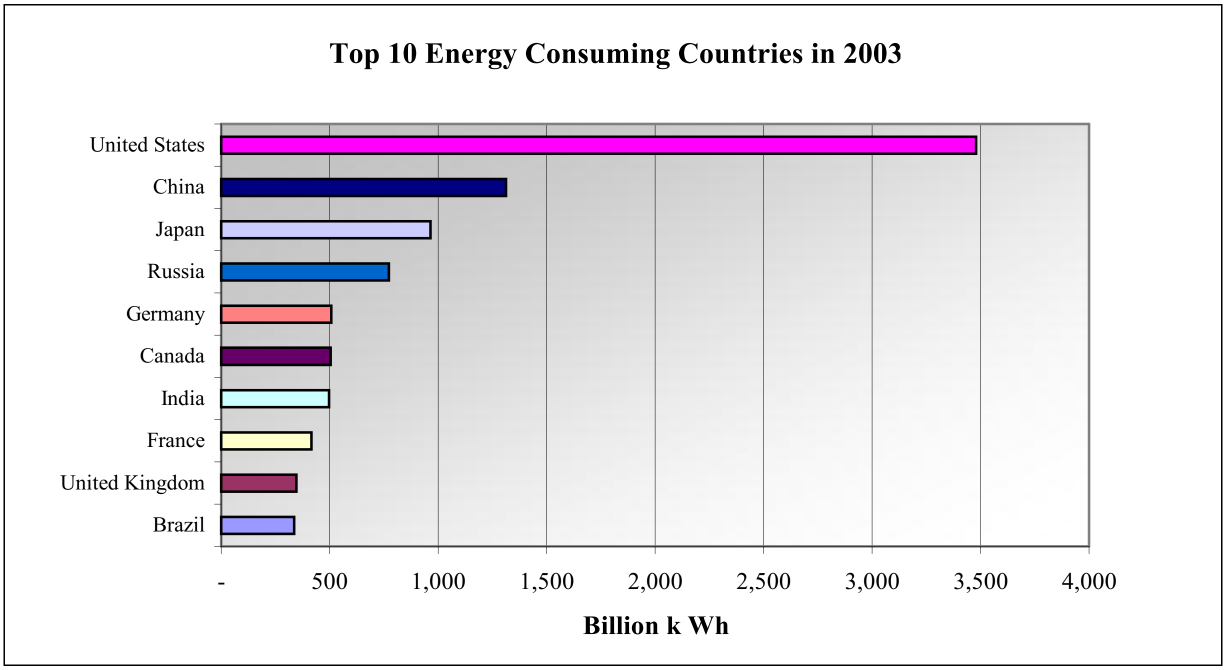
- Power supply capacity increasing at a rate slower than demand
- Economic growth
- Age/condition/capacity of the infrastructure
- Deregulation and the cost of energy
- Sensitivity of high-tech equipment
- Sensitivity of the occupancy

A major concern in the United States is that the power demand has increased roughly 30 percent in the last 10 years while the supply capacity has only grown by 15 percent. This is also the case in many other countries. Increased strain can be compared to a bottleneck of traffic with half of the lanes on the highway shut down. A similar situation is currently present in Italy, where the entire power supply is imported from another country. Following the devastating blackout in September of 2003, Italian ministers approved the construction of 20 new power stations to prevent a similar event from recurring.

Economic growth and the demand for power is also a significant issue in China. After the United States, China is the second largest consumer of energy in the world. Energy demand has grown significantly in recent years, doubling since 1980. It is expected to triple between now and 2020, representing 25 percent of the world energy demand increase.

The development of emergency and contingency plans is a way to limit the length and economic impact of supply outages. This applies to the suppliers, the authorities responsible, as well as the dependent industries.





In recent years, the United States' transmission and distribution grids have been highly criticized for being outdated and not properly maintained. This is largely due to deregulation and the fact that consumer energy prices have decreased over the last 20 years. The energy market operates on extremely thin margins, leading to minimal reinvestment into the grid infrastructure, as well as overloading transmission lines to increase profits. Deregulation had also led to electricity increasingly being transported on high-voltage T & D lines from a producer in one part of the country to customers who live hundreds of miles away, increasing the chances for more things to go wrong.

The United States' grid is also controlled by numerous, different systems, giving it an almost "patchwork" like quality. The grid has very little uniformity, which leads to problems in communication and delays in reaction when quick adjustments to grid supplies are critical. This played a major role in the scale of the August 14, 2003 outage.

Another concern is that high-technology equipment used by businesses today is becoming increasingly sophisticated and expensive. This equipment is sensitive and requires a consistent, reliable electrical supply. Now, this equipment is more and more common in smaller, lower valued businesses.

As previously stated, certain sensitive classes of business are more affected by power fluctuations than others, and are more susceptible to losses when the electrical supply is unstable. These factors must all be considered when choosing to underwrite and provide service interruption coverage.

Underwriting Considerations Associated With Service Interruption

Service interruption can be a large exposure for equipment breakdown carriers. The following are the key underwriting factors to consider when analyzing service interruption exposures:

Key underwriting factors are:

- Loss Triggers
- Deductibles
- Distance Limitation
- Waiting Period
- Sublimits
  - Service Interruption
  - Business Interruption
  - Extra Expense
  - Contingent Business Interruption
- Engineering Information for Individual Risks
- Risk Accumulation
- Reinsurance Considerations

Loss triggers or covered perils are key in underwriting service interruption. In some markets, when service interruption coverage is provided, coverage would be triggered only when a covered cause of loss, being equipment breakdown, takes place at the utility. In others, service interruption usually is not restricted in this manner and would be covered for all causes of loss at the utility (i.e. fire, earthquake, flood, wind) similar to an all-risk policy. On occasion, coverage is provided that requires no trigger whatsoever, and power interruption for any reason is covered, even manual shutdown.

Deductibles set at appropriate levels for risk are critical for profitable underwriting of this coverage, especially for epicenter risks and occupancies that have highperishable levels. They are also important for accumulation control due to the fact that electrical outages are frequent and short in duration.

Distance limitations in addition to deductibles are also found in property and equipment breakdown forms. These limits require that the electrical equipment or apparatus that suffers an accident be within a required distance of the insured. They typically range from 1,000 feet to one mile, or to the nearest contracted utility. It is yet another way to provide realistic protection to the insurance market and to manage accumulation issues.

Waiting periods are also a good way to control service interruption exposures. A waiting period is a condition of coverage that requires a given interruption to last over a certain period of time before coverage is triggered. Again, this protects against the more common interruptions of short duration. Waiting periods can vary from 12 to 72 hours or more depending upon the sensitivity of the occupancy and the reliability of the power supply to the facility.

Sublimits are also a key factor in controlling accumulation when providingservice interruption coverage. Sublimits must be set at a level that is feasible for an insurance provider to assume the risk in the event of a large-scale outage, or reinsurance protection put in place to limit the potential exposure.

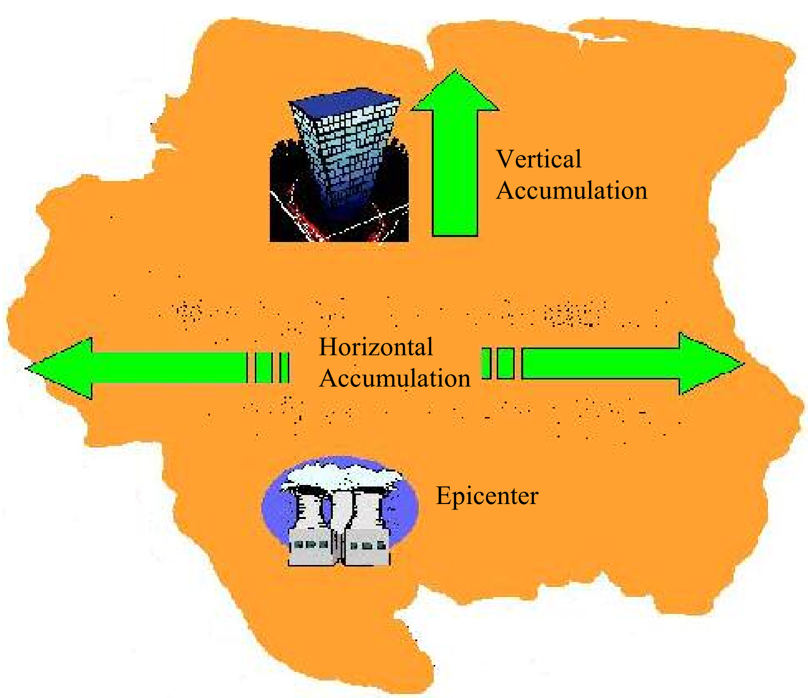
Engineering information must be gathered to help underwriters assess the individual risk. This information also enables underwriters to make educated decisions on where to set terms and conditions. This information may include:

- Is there more than one utility feed to the location?
- Are appropriate surge suppression systems installed for electrical service andsensitive electronic equipment?
- Is there any electrical power generated on the premises, including emergency generator units? If so, what kind and capacity?
- How many power outages have there been in the past three years? If so, what was the length and circumstances of the outage?

Answering these questions helps underwriters determine coverage levels, set appropriate deductible levels, and define required conditions.

Risk accumulation is another major issue to consider. Accumulation of risk can be divided into three main categories:

- Horizontal distribution - the spread of locations over a given geographical area, or on a single plane.
- Vertical distribution - the accumulation of risks on a single physical location, such as a high-rise building housing numerous insured locations.
- Epicenters - are very large valued locations that can be found anywhere, whether it is ina rural or remote area or in a large metropolitan area.



Reinsurance placement becomes important after quantifying the individual and accumulated loss exposure. The traditional facultative placement on individual accounts with large loss exposure is still needed. Another consideration is determining accumulated losses when the coverage is provided for large numbers of insureds. Reinsurers must understand the exposures in the portfolio and how to participate in a service interruption loss event. Reviewing traditional treaties (e.g., excess of loss, stop loss) and CAT treaties ensures loss retention is in line with the company's financial profile and risk appetite.

What Can Be Done To Quantify And Understand Potential Loss Exposures?

Service interruption modeling and accumulation control is a critical tool when insuring service interruption. Without loss modeling, underwriters would have great difficulty knowing what they are exposed to, given a specific event. Today, underwriters are able to quantify their portfolio's exposure much more precisely with modeling technology. It enables insurance providers to develop appropriate underwriting standards and guidelines that are in line with their risk appetite and assist in appropriate placements of reinsurance coverage.
These models can incorporate physics, meteorology, statistics and engineering, as well as other disciplines. Some variables that need to be taken into account when developing a service interruption model are:

- Initiating Events
- Exposures
- Geography
- Location Accumulations
- Grid Characteristics
- Underwriting Parameters

The initiating event would be the circumstances surrounding the supply interruption. These scenarios should include all probable loss events and should cross many different coverage levels (i.e. an outage where there is no physical damage to equipment versus a situation where equipment is damaged due to the supply interruption).

Exposures within a portfolio or class code distribution is also significant. This will determine the severity of potential losses based on the time from interruption to stock spoilage, the level of potential property damage losses, as well as business income and perishable stock losses.

Geography and location accumulations are another important consideration. Factors must be developed based on temperature zones and the time of year when the interruption occurs. These factors determine the length of time for contents to spoil. Location populations by region are also a critical consideration because economic growth has caused more and more cities to become densely populated, increasing the possibility for numerous losses in a concentrated area.

The characteristics of a power grid are a key variable, too. The grid can affect the probability of an outage occurring, as well as the length and scope of the event.

The time of day the occurrence takes place should also be factored in the model. Did the outage happen during peak or off-peak hours? Circumstances of an outage can be substantially different depending on whether an outage takes place during rush hour versus in the middle of the night.

Knowledge of the reliability of a given service provider or the dependability in a given region can greatly improve the ability to quantify an insurance provider's level of exposure and can increase loss modeling accuracy.

In the United States, the Department of Energy can provide this type of grid reliability information. Also, information is available through the North American Energy Reliability Council (NERC).

In the United Kingdom, the energy market was deregulated in 1998. Currently, the National Grid Company, which regulates and operates the transmission network, can offer information on grid reliability.

China, currently the second largest energy consumer in the world, is dealing with significant power shortages. Its rapidly growing economy is estimated to drive energy demand at a growth rate of 4 to 5 percent annually. This growth will require serious investment income, much of which will come from foreign investors, to develop and maintain a reliable grid. In China, the State Electrical Regulatory Commission (SERC) is responsible for regulating the sector. SERC has also gathered information on regional grid reliability. Also, the China Electrical Council (CEC) may be able to provide information on grid reliability.

Once these considerations are factored into the model, scenarios can then be run based on multiple underwriting parameters to measure the impact with varying time elements, dollar amount deductibles and waiting periods.

CONCLUSION

The world of service interruption insurance coverage and loss control engineering should focus on more than just traditional large manufacturing risks. Technology is changing all insureds and their dependency on utility providers to keep their businesses running. Demand is racing ahead of utility capacity. At the same time, loss prevention engineering forutilities and large risks will continue to be very important.

The challenge over the next five to ten years will be to underwrite and engineer the broad base of commercial risks that will demand service interruption insurance. This isnot just the top 5 percent of property policies, but rather including equipment breakdown coverage in 100 percent of property portfolios. As many of historical outages illustrate, the uninsured are most affected by utility interruption, and consequently incur costly damages. This has been especially true for smaller insureds, because service interruption coverage has been typically designed for larger insureds with high-loss potential

Underwriters must begin developing CAT modeling related to property damage, business interruption and extra expense for service interruption. Critical portfolio information needs to be captured to complete this modeling. This information includes:

- Initiating Events
- Exposures
- Geography
- Location Definitions
- Grid Characteristics

It's critical to measure the exposure during and after a service interruption event. Indirectlosses during the event and measuring the increase in direct losses as power comes back on line provides a picture of the entire exposure picture and determines underwriting appetite and reinsurance needs.

Engineering becomes critical before underwriting an entire portfolio. This entails identifying the utility infrastructure related to the locations of the profile and developing timelines for occupancies that have a high risk for spoilage and business income. This helps to develop loss accumulation scenarios for 10-, 20- and 100-year loss events.

We are the experts in engineered lines. Therefore, it is our responsibility to prepare for the future, because insureds are becoming more and more dependent on technologyand stable utilities to run their businesses. We need to set the standards for the industry. This is a challenge as well as an opportunity for us to become experts in establishing exposure models, coverage and underwriting parameters for 100 percent of insureds.

Exhibit A

Example of a Risk Accumulation Assessment

A. Blackout Analysis Overview

The HSB Risk Analysis Group has developed a prototype model, The Blackout Analysis Tool (BAT), to analyze loss exposures resulting from unexpected, widespread electric power blackouts. The model can either help calculate the annualized expected loss or an actual loss cost given an assumed blackout. It uses an approach very similar to industry standard natural catastrophe models. BAT uses simulation techniques to produce a distribution of outcomes with probabilities. The model can help calculate ground-up losses or losses with various time-based or actual dollar deductibles. It employs claims data as is possible. However, since historical data is sparse and not very well disaggregated, we relied heavily on expert elicitation, especially to develop factors for grid stability and time to spoilage for different occupancies.

The following bullets provide a brief overview on how the model functions, how risk factors were developed and incorporated, and the variables available to perform 'what-if' analyses. (See Annex 2 for a chart depicting the relations of model inputs, parameters and outputs.)

- *Exposures*
  For each type of initiating event, the model can help calculate the expected annual frequency and severity of applicable property damage, business interruption and spoilage claims based on grid stability, occupancy group, exposure characteristics, estimated length of the outage and the other relevant variables detailed in the following groups.
    - Property damage
    - Business interruption
    - Consequential (spoilage)

- *Geography*
  Since grid reliability varies geographically, the model accounts for these variations by assigning grid-by-grid postulated blackout rates. An expert elicitation process was used to determine these rates. The rolling 10-year grid condition projections developed by the North American Energy Reliability Council (NERC) were used as the principal information base to keep the evaluation consistent across different grids. Since ambient temperature can affect spoilage times, the model includes factors for different temperature zones and time of year. BAT can model blackout effects in a grid sub-region. BAT uses a simplified approach of permitting the user to reduce the number of actual locations by selecting a percentage range of the affected grid to approximate the impact of a partial grid blackout.
  NERC grid areas:
    - Approximation of geographic extent of outage within grids
    - Weather zones
    - Insured location zip codes

- *Location Definitions*
  BAT includes equipment and content profiles for occupancy groups that are similar to HSB's standard exposure groups. Key parameters for each group include:
    - HSB occupancy exposure groups
    - Length of time until spoilage occurs
    - Property damage loss costs
    - Business interruption loss costs
    - Spoilage loss costs

- *Grid characteristics*
  Annual failure rates for each grid were obtained by expert elicitation, relying heavily on the NERC Reliability Assessment Reports. Since the blackout's time of day can affect ground-up business interruption, users can select peak/off-peak initiation by exposure group. Other considerations include:
    - Annual outage rate
    - Length of outage
    - Failure occurrence during peak/off-peak business hours

- *Underwriting parameters*
  Because of the time-dependent nature of spoilage and business interruption claims, the model can vary time deductibles to help assess their impact for a given exposure group, number of insured locations and probability of blackout. The model defaults to producing ground-up losses, but time-based waiting periods and any dollar deductible can be imposed. Other parameters include:
    - Time-based waiting period (for business interruption and spoilage)
    - Dollar deductibles

1. Blackout Analysis (Conditional Loss Analysis)

The Blackout Analysis Tool described in section A was used to study this portfolio's electrical blackout service interruption exposure.

Total in force insured locations: 60,848
Location distribution by Regions:

Region	Number of Locations
1	55,538
2	2598
3	1901

Location distribution by top states:

State	Number of Locations
NY	20,784
PA	10,741
NJ	5,587
MA	5,344
MI	3,204
VA	2,455
MN	1,566
AL	1,425
NC	1,271
CT	1,043
MD	1,030

Regions look up:

Region	NERC Sub-regions	States
1	ISO NE ISO NY MAAC ECAR MAIN VACAR	NH, ME,VT, CT, MA, RI, NY NJ, PA, MD, DE, DC MI, IN, OH, KY, WVA WI, IL, MO, IA VA, NC, SC
2	TVA SOUTHERN ENTERGY SPP SOUTHERN AZNMSNV	TN MS, AL, GA AR, LA OK, AZ, NM
3	NWPP RMPA MAPP US SPP NORTHERN	ID, MT, UT WY, CO ND, MN, SD, NE, KS
4	NWPP	WA, OR, NV
5	ISO CA	CA
6	ISO FLORIDA	FL
7	ERCOT	TX

Insured location distribution:
89.55 percent of the locations (54,492) are in the public assembly exposure group. This exposure group has high business interruption exposures, while spoilage and property damage exposures are moderate. Retail food accounts for 9.2 percent of the locations. Retail food has high spoilage and business interruption exposures while property damage exposure is moderate. The rest of the locations (1.02 percent of the locations (760)) are distributed within the light manufacturing and heavy industry exposure groups. (See Annex 1 for the exposure group look up table)

The portfolio’s insured locations are allocated in Region 1, 2 and 3. This analysis models the extent of the outage with a log normal distribution with a minimum of 30 percent and maximum of 100 percent of the grid affected. As noted before, this analysis approximates the conditional losses for those three regions. The conditional loss is the loss estimate for a given widespread power outage. We assume that regions are not interrelated. Thus, losses within each region were considered separately.

The aggregate blackout analysis results are outlined below. It is composed of on-premises and off-premises losses. On-premises losses include property damage loss, spoilage and business interruption losses following the property damage. Off-premises losses are estimates of losses caused by covered service interruption (off-premises objects failure). It includes off-premises business interruption loss and spoilage loss.

Definitions:

a. 90 percentile loss – 10 percent chance that the aggregate loss will exceed this loss value. (e.g. 90 percentile loss is $2M means that there is 10 percent chance that the loss will exceed $2M or there is 90 percent chance that the loss will be smaller than $2M.).
It could also be interpreted as the 10-year event loss.

Aggregate Loss Summary – with no waiting period (Losses are from a single widespread outage in each region)

Description	Pct90 (10 Year)	Pct95 (20 Year)	Pct99 (100 Year)
Region 1	$1,034,818	$1,235,304	$2,026,031
Region 2	$0	$45,360	$101,271
Region 3	$0	$26,422	$65,673

Aggregate Loss Summary – with 24 hours waiting period (Losses are from a single widespread outage in each region)

Description	Pct90 (10 Year)	Pct95 (20 Year)	Pct99 (100 Year)
Region 1	$658,837	$829,659	$1,301,739
Region 2	$0	$28,237	$71,572
Region 3	$0	$13,465	$47,757

Exposure Group Look Up:

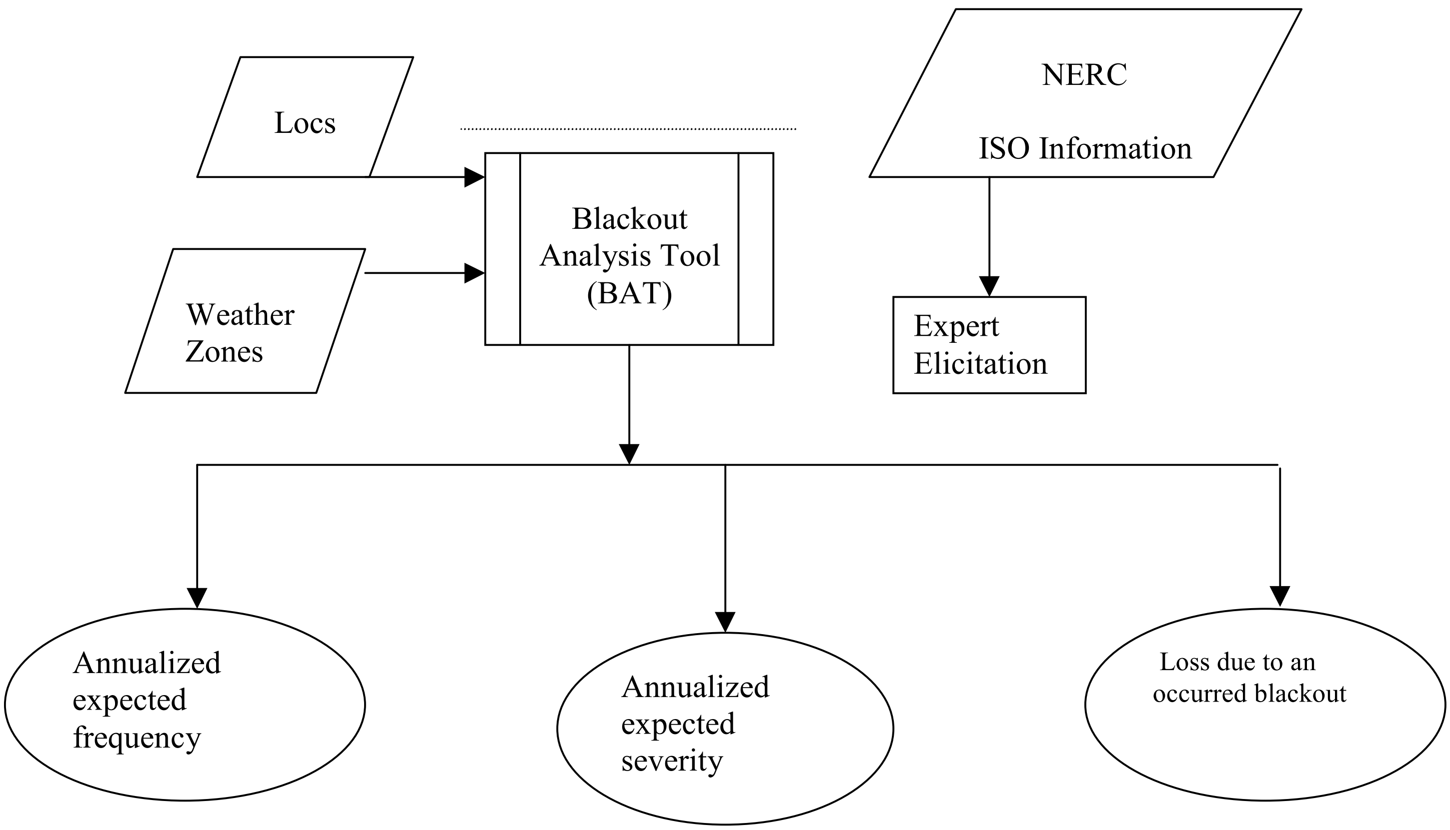
Public Assembly	T.V. & Radio Communications
	Computer Services, N.O.C
	Data Processing Operations
	Computer Software Developer
	Film Processing, Photo Finishing/Processing
	Radiological & Diagnostic Services
	Clinics
	Dentists (Offices)
	Doctors (Offices)
	Health Services, N.O.C.
	Shelters, Mens/Womens
	Dry Cleaning, Laundries & Clothes Dying
	Laundromats, Self Service
	Office Building, Owner, Offices, Owner
	Banks
	Car Washes
	Garages (Auto), Service Stations
	Warehouse (Non. Refrig.)
	Stores (Without Food)
	Auto Sales, Truck Sales, Car Sales
	Apartments, Condominiums
	Schools, Not Colleges
	Churches
	Public Assembly, N.O.C.
	Mobile Home Parks
	Prisons
	Municipalities
	Telecommunications, Regional
	Telecommunications, Local - use 380
	Telecommunications, Cell - use 380
	Internet Service Providers
	Construction: Bridge, General, Road
	Bus Line Terminals, Terminals, Bus Line
	Airline Terminals, Terminals, Airline

	Tugboat Operations
	Railroad Terminals
	Terminals, N.O.C., Navigation N.O.C., Transportation, N.O.C.
	Accounting Services
	Insurance Agent, Real Estate Agent
	Legal Services
	Offices, Tenant Only, N.O.C.
	Consultants
	Building Contractor
	Electronic Credit and Financial Services
	Amusement Parks
	Bowling Alleys
	Art Galleries, Museums
	Race Tracks
	Ski Resorts/ Operations
	Stadiums
	Swimming Pools/ Clubs
	Theaters
Retail Food	Shopping Centers, Strip
	Shopping Centers, Mall
	Convenience Stores, Fish Market, Frozen Food Stores, Ice Cream Parlor, Meat Market, Butchers, Butcher Shop, Food Stores, Retail, Grocery Stores, Supermarkets
	Amusements N.O.C., Resorts, N.O.C.
	Colleges & Universities
	Hotels, Motels
	Restaurant
	Funeral Homes
	Country Clubs
	Casinos

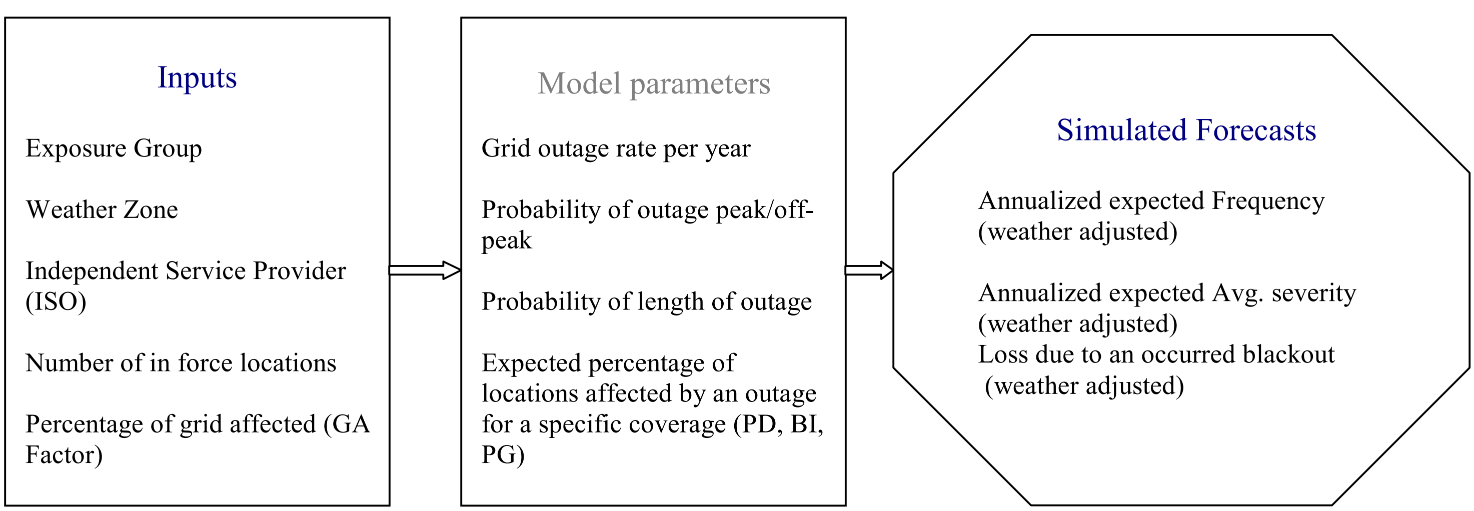
Blackout Analysis Tool

Annex 2 Rev 10.17.03

BAT Process



BAT Model



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