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How to Protect Your Computers and Data From Power Problems $^{©}$

Edward Zeidan, MBA April 23, 2001. Revised June 2, 2020

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Introduction

Computer systems and the important data they contain have become vital to the operation of most businesses. Every business owner or manager needs to plan for the possibility that the company's computers or data may be damaged or lost. There are numerous causes for equipment and data damage or loss, including power problems, fires, earthquakes, human error, theft, vandalism, etc. Preparing for such events is called contingency planning. This report focuses on one aspect of contingency planning: how to protect your computers and data from power problems.

This report is organized into three sections: Section one focuses on defining power problems and their effects on your computers and data. Section two offers suggestions on how businesses can take steps to protect their computers and data. Section Three provides links to additional resources that may be of assistance.

For further assistance, please contact us at (925) 283-5666 or support@lamorindatechnology.com.

Section 1: The Power Crisis Is Here

Our businesses are increasingly dependent upon electrical power to operate. The reality is that without power, many businesses must close their doors. Much of our accounting, customer, and other critical business information is stored on computers, which need a constant source of power to function correctly.

With California is in the midst of a serious power crisis, experts are predicting widespread rolling power outages this Spring and Summer. Rolling blackouts substantially increase the risk of damage to our computers and data.

Your Equipment and Data is At Risk[1]

A study by IBM has showed that a typical computer is subject to more than 120 power problems per month. The effects of power problems range from the subtle—keyboard lockups, hardware degradation—to the dramatic—complete data loss or ruined equipment.

Despite advances in the capabilities of modern personal computers, a momentary power outage is still all it takes to lose your data. More dangerous is the loss of previously written files, or even an entire hard disk, which can occur should a power problem strike while your computer is saving a file. Network file servers constantly writing to disk are particularly susceptible.

It's been said that there are two types of computer users: those who have lost data because of a power problem, and those who are going to. Over the past few years, we've helped create a new class... those who have recognized the need for protection and taken steps to ensure that they're prepared for the inevitable.

Common Causes of Data Loss[1]

As the chart below clearly shows, power failure and power surges are by far the most frequent cause of data loss. Fortunately, it is relatively simple and inexpensive to protect against power problems, as we'll discover shortly.

Cause	Percentage
Power Failure/Surge	**45.3%**
Storm Damage	9.4%
Fire or Explosion	8.2%
Hardware/Software Error	8.2%
Flood & Water Damage	6.7%
Earthquake	5.5%
Network Outage	4.5%
Human Error/Sabotage	3.2%
HVAC Failure	2.3%
Other	6.7%

Source: *Contingency Planning*

Anatomy of a Power Disturbance[1]

Surges, spikes, blackouts and brownouts...what really happens to your computer when it experiences an out-of-bounds power anomaly? We'll use a nearby lightning strike as an example, although it is just one of countless problems that can strike your system.

Lightning strikes a nearby transformer. If the surge is powerful enough, it travels instantaneously through wiring, network, serial and phone lines and more, with the electrical equivalent force of a tidal wave. The surge travels into your computer via the outlet or phone lines. The first casualty is usually a modem or motherboard. Chips go next, and data is lost.

The utility responds to overvoltages by disconnecting the grid. This creates brownouts and blackouts. If the voltage drops low enough, or blacks out, the hard disk may crash, destroying the data stored on the disk. In all cases, work-in-process stored in cache is instantly lost. In the worst case, password protection on the hard drive can be jumbled, or the file allocation table may be upset, rendering the hard disk useless.

Protection is Vital[2]

Power disturbances occur in many forms: surges, spikes, brownouts, and blackouts. A "Stage Three" emergency means that rolling blackouts would occur to many power grid customers across the state. These power abnormalities can cause premature failure of delicate electronic components, lost data, and even catastrophic damage to any electronic hardware.

Regardless of the level of emergency in the state of California, any disruption in electricity spells disaster for devices requiring utility power. Electricity has become as important to our economy as the air we breathe. With this importance has come a responsibility to provide protection to electrical investments.

Power Problem Definitions[3]

Sags: Also known as brownouts, sags are short-term decreases in voltage levels. This is the most common power problem, accounting for 87% of all power disturbances according to a study by Bell Labs.

    CAUSE - Sags are usually caused by the start-up power demands of many electrical devices (including motors, compressors, elevators, shop tools, etc.) Electric companies use sags to cope with extraordinary power demands. In a procedure known as "rolling brownouts," the utility will systematically lower voltage levels in certain areas for hours or days at a time. Hot Summer days, when air conditioning requirements are at their peak, will often prompt rolling brownouts.

    EFFECT - A sag can "starve" a computer of the power it needs to function, and cause frozen keyboards and unexpected system crashes which both result in lost or corrupted data. Sags also reduce the efficiency and life span of electrical equipment, particularly motors.

Blackout: Total loss of utility power.

    CAUSE - Blackouts are caused by excessive demand on the power grid, lightning storms, ice on power lines, car accidents, backhoes, earthquakes and other catastrophes.

    EFFECT - Current work in RAM or cache is lost. The hard drive File Allocation Table (FAT) may also be lost, which results in total loss of data stored on drive.

Spike: Also referred to as an impulse, a spike is an instantaneous, dramatic increase in voltage. Akin to the force of a tidal wave, a spike can enter electronic equipment through AC, network, serial or phone lines and damage or completely destroy components.

    CAUSE - Spikes are typically caused by a nearby lightning strike. Spikes can also occur when utility power comes back on line after having been knocked out in a storm or as the result of a car accident.

    EFFECT - Catastrophic damage to hardware occurs. Data will be lost.

Surge: A short-term increase in voltage, typically lasting at least 1/120 of a second.

    CAUSE - Surges result from presence of high-powered electrical motors, such as air conditioners, and household appliances in the vicinity. When this equipment is switched off, the extra voltage is dissipated through the power line.

    EFFECT - Computers and similar sensitive electronic devices are designed to receive power within a certain voltage range. Anything outside of expected peak and RMS (considered the "average" voltage) levels will stress delicate components and cause premature failure.

Noise: More technically referred to as Electro-Magnetic Interference (EMI) and Radio Frequency Interference (RFI), electrical noise disrupts the smooth sine wave one expects from utility power.

    CAUSE - Electrical noise is caused by many factors and phenomena, including lightning, load switching, generators, radio transmitters and industrial equipment. It may be intermittent or chronic.

    EFFECT - Noise introduces glitches and errors into executable programs and data files.

Section 2 Protecting Your Computers and Data

Our computers need steady, "clean" power. Power that does not sag, spike, or blackout. So how do we protect our computers and data from power problems? Since we don't have unlimited budgets, we must design a system that gives us the maximum protection that we can afford. We must inventory our systems, and decide which ones need which level of protection.

Checklist for Protecting Your Computers and Data From Power Problems

1. ☐ Inventory all electronic equipment to be protected
    a. ☐ Include total wattage required for each piece of equipment you want to connect top uninterruptible power
    b. ☐ Include physical location of the equipment

2. ☐ Draw a floor plan of your office
    a. ☐ Include locations of equipment you want to protect
    b. ☐ Include electrical outlets, plug type, circuit information and amperage

3. ☐ Decide what level of power protection to provide each piece of equipment

4. ☐ Purchase and implement power protection equipment

Understanding Power Protection Equipment

There are three basic levels of power protection equipment commonly used today. Understanding the differences will help you decide which level is appropriate for each piece of equipment you want to protect.

Level 1 protection: The Surge Protector

The most basic protection begins with combating surges and spikes. Surge protectors are inexpensive devices that filter electrical power to eliminate surges and spikes before they get to your equipment. Surge protectors are very inexpensive, starting at around $15 for a 4-outlet protector.

When purchasing a surge protector, the lower the let-through voltage, the better your equipment will be protected. It is also wise to purchase a surge protector that has a warranty that not only covers the surge protection device, but the equipment that it is protecting.

Note: Many surge protectors do not provide surge protection on every outlet they contain. Be sure to verify that each outlet you plug electronic equipment into is surge-protected.

Level 2 protection: The Uninterruptible Power Supply

The next level of protection involves purchasing an uninterruptible power supply (UPS). UPS prices start at under $100 for very simple devices that provide protection for a laptop computer, to tens of thousands for large server rooms. For a small network server room, expect to pay between several hundred to a few thousand dollars for UPS's. A UPS provides battery back up that aids in saving data by keeping computer systems running with no interruption in the event of a brownout, blackout, or overvoltage. UPS's also offer protection from surges, spikes, and sags.

When the power goes out UPS's provide from a few minutes to several days of power to keep your computers running. An important additional benefit of UPS's is that many also are equipped with special software that senses a blackout, and safely shuts down any computers connected to them, writing unsaved data to disk, and issuing shutdown commands to the operating system.

Note: Many UPS's do not provide surge protection on every outlet they contain. Be sure to verify that each outlet you plug electronic equipment into is surge-protected. If you are connecting multiple computers to a UPS, verify that it has the capability to safely shut down more than one computer.

Level 3 protection: Emergency Power Generation Equipment

A step up from Uninterruptible Power Supplies is Emergency Power Generation Equipment (EPGE). Such equipment is usually powered by Gasoline or Diesel fuel, and can provide power for extended periods. In a small installation, a portable generator is placed outside your business, and extension cords are run from the generator to critical equipment and portable lights. For more complex environments, or permanent installations, the generator is permanently mounted, and connected to the main power supply for the building.

The cost for EPGE begins at a few thousand dollars, and can rise exponentially, depending upon your needs. EPGE can also be rented or leased.

Note that EPGE needs regular maintenance and testing. Just like you're your car, your EPGE will need to be run periodically, tuned up, tested, etc.

Selecting The Right Level of Power Protection

There are four choices your must make when selecting power protection:
1. Does this equipment need power protection?
2. Does this equipment need uninterrupted power?
3. How long do I want my equipment to be able to run in case of a blackout?
4. Do I need software that will automatically shutdown my computer and save my files in the event of a blackout?

Does this equipment need power protection?

Since surge protectors are so inexpensive, and provide protection against power surges, *we recommend that all electronic equipment be plugged into surge protectors.*

Does this equipment need uninterrupted power?

If the equipment is critical to the operation of your business, or requires several minutes to safely shut down, it should be connected to an uninterruptible power supply. For example network servers are constantly writing data to their hard disks. If power were lost during a data write, the data in memory would be lost. Additionally, servers need several minutes to safely shut down. We recommend that all servers be connected to uninterruptible power supplies.

Note that uninterruptible power supplies typically have surge-protected outlets.

How long do I want my equipment to be able to run in case of a blackout?

The total wattage used by the equipment you want to keep running in case of a blackout, times the length of time you need your equipment to run will determine whether you should implement uninterruptible power supplies or emergency power generation equipment.

For most small businesses, the cost of emergency power generation equipment is prohibitive, costing several thousand dollars or more. Most businesses choose to implement uninterruptible power supplies (UPS). The size of the UPS you choose is determined by adding up the wattage required to run your computers, and any other peripheral equipment, such as tape drives, network switches, printers, etc. Normally, some additional wattage is specified to allow for expansion.

After you've determined your wattage requirements, you need to determine how much time you want your computers to be able to run in case of a blackout. Many UPS's are sized to allow computers attached to them to run for 10-25 minutes. This is sufficient time for users to logoff their computers, write unsaved data to disk, and perform an orderly shutdown of the operating system.

To survive an extended blackout, a larger UPS is required. With rolling blackouts expected to last from 2-4 hours or longer, you should consider the true costs to your business when the power goes out. Obvious costs, such as payroll, and overtime, are pretty easy to calculate. Quantifying the cost of lost data, lost sales, or lost goodwill is more difficult.

Do I need software that will automatically shutdown my computer and save my files in the event of a blackout?
Many UPS's have software that will automatically sense a power outage and perform an orderly shutdown of a computer connected to it. ***We strongly recommend automatic shutdown software for all network servers.***

Deciding Which Equipment To Protect

We have prepared the following chart to assist you in determining your power protection needs. Please bear in mind that every business is unique, and these recommendations are general guidelines only, much of the information presented has been gathered from other sources, that we deem reliable, but cannot guarantee. We would be happy to assist you in determining your particular needs.

For additional tools to help choose the proper size power protection equipment, visit https://www.apc.com/shop/us/en/tools/ups_selector/
Note: Since modems, routers, and network interface cards are connected to the public telephone network, they are susceptible to power problems and need protection.

Item	Recommended Protection Level	# of units	Wattage per unit	Total Wattage
Printers	Surge Protection			
Modems/Routers	Surge Protection			
Hubs/Switches	Surge Protection			
Network Interface Cards	Surge Protection			
Desktop Computers	UPS			
Network Servers	UPS or EPGE			
Web Servers	UPS or EPGE			
Total Wattage Needed				
X				**X**
Number of Minutes				
=				**=**
Grand Total Wattage Needed				

Selecting Your Power Protection Equipment

Now that you have determined which equipment you want to protect, and what level of protection to provide, it is time to select the power protection equipment.

Many UPS's include ports for protecting modems, and your network cards from power surges.
There are several models of surge protector that include surge-protected ports for modems and network cards.

The key factor in determining what power protection equipment to implement is physical location of the equipment you want to protect. We suggest drawing a floor plan of your business, with locations of equipment, as well as locations of power outlets and their amperage. Armed with your floor plan and the power protection chart above, you can decide where best to place the power protection equipment.

Item	Size/Features/Notes	Qty Needed	Location to Implement
Surge Protectors			
Surge Protectors with Modem/Network protection			
Uninterruptible Power Supply			
Uninterruptible Power Supply with Automatic Shutdown Software			
Emergency Power Generation Equipment			

How To Tell Which Rotating Outage Block You're Located In

At the lower left of your PG&E Bill, your rotating outage block is listed. **Warning: this number can change, so verify your number periodically.**

Your rotating outage block number is shown on your monthly bill. Look at the example below to locate your outage block number.

Outage block 50 consists of customers that are served by circuits that contain essential services, such as larger hospitals that meet certain criteria, fire departments, police stations, and other vital government functions. Normally, outage block 50 customers are exempt from rotating outages, unless conditions dictate otherwise.

Outage blocks are subject to change without notice due to operational conditions.

What Are Power Alerts?

When power reserves fall below 7%, the agency charged with managing California's electric power grid, the Independent System Operator (ISO), issues a power alert. Power alerts are issued in order to encourage power conservation, or to provide notice that rolling blackouts could be ordered at anytime. Normally, there is at least a 15-minute notice prior to a rolling blackout. Local news stations and radio stations are a good source of information about power alerts and rolling blackout notifications. There are three levels, or stages of power alert.

- **Stage 1 operating reserves fall below 7%**
- **Stage 2 operating reserves fall below 5%**
- **Stage 3 operating reserves fall below 1.5%. Rolling blackouts may occur at this level of power alert.**

Simple Steps to Take to Reduce Power Consumption

- Replace incandescent light bulbs with compact LED bulbs, which use . Fluorescent bulbs save between 67-97% while producing the same amount of light.

- Turn off equipment and lights when not in use. Equipment such as personal computers, copiers, printers, and lights should be turned off whenever they're not being used, and at the end of the day.
- Limit the use of air conditioning and heating.

Steps to Take When Rolling Blackouts Are Announced For Your Area

- Instruct all employees log off your computer network, and shut down their computers and monitors.
- Performa an orderly shutdown of your network servers.
- Unplug any electronic devices that are not connected to surge-protected outlets to avoid potential damage due to surges or sags.