

Power and Electrical Solutions that Optimize Business Operations

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Safety Protection
Grid Solutions

Power and Electrical Solutions that Optimize Business Operations

- ⚡ Power disturbances cause electrical equipment to interrupt business operations
- ⚡ Power disturbances occur when the designed characteristics of electrical voltage to a device change unexpectedly
- ⚡ Power disturbances have been present since the first electrical device was developed
- ⚡ Power disturbances can cause an electrical device to fail
- ⚡ When an electrical device fails, usually it is because conditions have stressed it beyond its maximum ratings

Different Types of Power Disturbances

- ⚡ Lightning strike
- ⚡ Power surge
- ⚡ Power quality phenomena
- ⚡ Total or partial power failure
- ⚡ Voltage fluctuation
- ⚡ Waveform fluctuation
- ⚡ Equipment failure

Who Causes Power Disturbances?

- ⚡ The power utility company is the cause of around 20% of all power disturbances
- ⚡ The other 80% of all power disturbances are caused by the business facility
- ⚡ When a facility is not properly prepared and protected against power disturbances the consequences can be:
 - ⚡ Facility wide total electrical failure
 - ⚡ Individual electrical system failure
 - ⚡ Individual electrical circuit failure
 - ⚡ Computer and network crashes

Power Disturbances

- ⚡ When these disturbances occur they usually cause some type of business stoppage, equipment replacement, equipment repair or the restarting/rebooting of the equipment
- ⚡ Computers that lockup can cause the corruption or loss of valuable data from servers, workstations, and PLC's

How Often do Power Disturbances Occur to the Average Business?

- ⚡ **72%** of U.S. businesses are interrupted by power disturbances every year
- ⚡ On average, businesses experience **3.9** power disturbances per year
- ⚡ **45.3%** of all computing, network equipment and data loss failures reported are attributed directly to power disturbances
- ⚡ **33.7%** of U.S. companies have had business operations interrupted because of lightning storms
- ⚡ **33%** of all server failures are from power disturbances
- ⚡ **31%** of computer outages are the result of power disturbances
- ⚡ When power disturbances occur, **49%** of them last less than 3 minutes, and **20%** of power disturbances last 1 Hour or more

Believe it or not but...

- ⚡ **19%** of business state they have no outages
- ⚡ **18%** of business state they have 1 outage
- ⚡ **24%** of business state they have 2 outages
- ⚡ **12%** of business state they have 3 outages
- ⚡ **8%** of business state they have 4 outages
- ⚡ **8%** of business state they have 4+ outages
- ⚡ **11%** of business state they have 7+ outages

Power Disturbance Examples, Events and Symptoms

- ⚡ **Earth Potential Rise (EPR):** In most systems, some or all of the following situations may occur: file corruption; hardware damage; data loss; data corruption; firmware damage or loss; or malfunction of the computer
- ⚡ **Electrical Line Noise:** Varying degrees of damage can occur from simple keyboard lock-ups to program failures, data crashes and data corruption
- ⚡ **Electromagnetic Compatibility (EMC), Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI):** EMC, EMI and RFI have caused events such as system lockups, temporary lapses in computing, circuit connection termination, data transmission errors, and even data corruption or loss
- ⚡ **Equipment Failures:** In most systems, some or all of the following situations may occur: file corruption; hardware damage; data loss; data corruption; firmware damage or loss; or malfunction of the computer

Power Disturbance Examples, Events and Symptoms

- ⚡ **Ground Potential Rise (GPR):** In most systems, some or all of the following situations may occur: file corruption; hardware damage; data loss; data corruption; firmware damage or loss; or malfunction of the computer
- ⚡ **Harmonic Distortion:** Harmonic distortions can cause communication errors, overheating, and hardware damage. Common maladies and failures are CPU clock errors, overheating, and premature failure of electrical components
- ⚡ **Over Voltage:** Over voltage can incur extensive hardware damage including burned-out circuit boards, component stress or loss, memory loss, data loss and data errors

Power Disturbance Examples, Events and Symptoms

- ⚡ **Partial Power Failure:** In most systems, some or all of the following situations may occur: file corruption; hardware damage; data loss; data corruption; firmware damage or loss; or malfunction of the computer
- ⚡ **Power Factor Below 1:** This will result in excess heating, which can damage or shorten the life of equipment. A low power factor can also cause low-voltage conditions, resulting in dimming of lights and sluggish motor operation
- ⚡ **Power Failure:** In most systems, some or all of the following situations may occur: file corruption; hardware damage; data loss; data corruption; firmware damage or loss; or malfunction of the computer
- ⚡ **Power Outages:** In most systems, some or all of the following situations may occur: file corruption; hardware damage; data loss; data corruption; firmware damage or loss; or malfunction of the computer

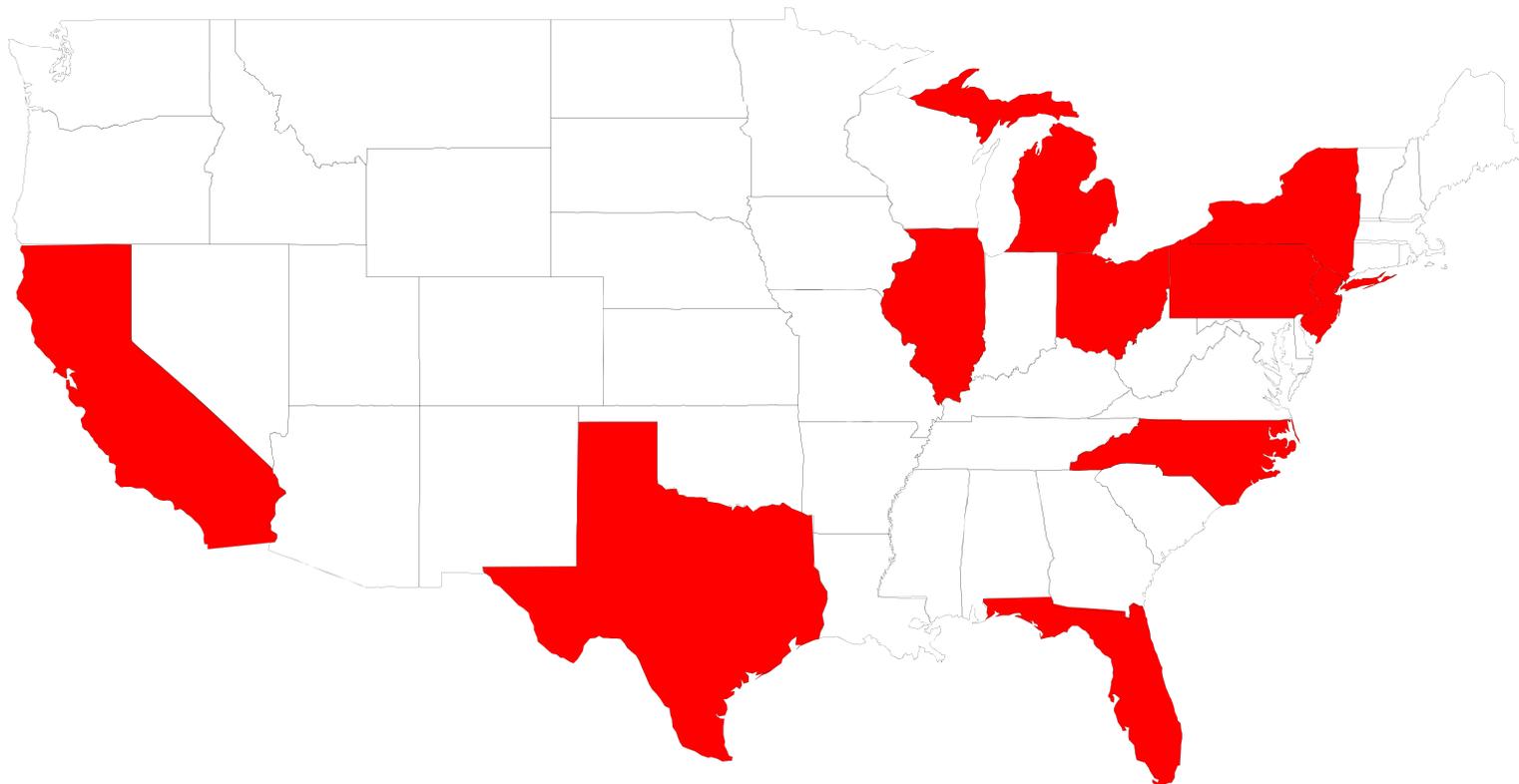
Power Disturbance Examples, Events and Symptoms

- ⚡ **Power Quality Phenomena:** An equipment failure can take place from long-term conditions such as past lightning strikes, voltage sags, surges, transients, harmonics and phase voltage imbalances
- ⚡ **Power Sag:** Power sags can cause crashes to equipment and hardware damage. Typically, the hardware damage may entail memory loss, data errors, flickering lights; equipment shut-off or malfunctions with automatic shutoff
- ⚡ **Power Surge:** Power surges, also known as “power spikes,” invariably result in both data loss and hardware damage. Typically, the hardware damage may entail memory loss, data errors, flickering lights; equipment shut-off or malfunctions with automatic shut-off

Power Disturbance Examples, Events and Symptoms

- ⚡ **Service Entrance, Service Utilization and Lighting Voltage Ranges:** Microprocessor-based devices in the pharmaceutical process including controllers, programmable logic controllers (PLCs), PC controllers, and servers are susceptible to power interruptions and fluctuations. This can result in violation of process parameters, loss of real-time data, loss of process control, loss of archiving data, loss of batch, loss of revenue, etc.
- ⚡ **Switching Transients:** Damage may be incurred in both hardware and software resulting in burned circuitry, component stress or failure, memory and data losses
- ⚡ **Time-dependent Dielectric Breakdown (TDDB):** Causes the destruction of dielectric layers of semiconductor-based micro-electronic devices
- ⚡ **Under Voltage:** The effect of the under voltage can predicate premature hardware failure, data loss and corruption

Top Ten States for Largest Annual Cost from Power Disturbances



What Power Disturbances Cost the Average Business

- ⚡ **\$1,477** for a one-minute outage
- ⚡ **\$2,107** for a three-minute outage
- ⚡ **\$7,795** for a one-hour outage
- ⚡ Data centers and workstations are more susceptible to power disturbances, and power disturbances in these environments can cost more than **\$23,000** a year

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- ⚡ A business cannot stop power disturbances from occurring, it can only prepare for them by understanding how to protect the equipment that means the most to the business
- ⚡ This means that different preparation and protection methods are needed for different types of businesses

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- ⚡ How can a business prepare and protect their facility?
- ⚡ A business cannot depend on the National Electric Code (NEC) for equipment protection
- ⚡ To follow and adhere to the National Electrical Code (NEC) provides only the **MINIMAL** accepted safety codes for personnel and property
- ⚡ According to the purpose of the NEC, little, if any, consideration is given to equipment reliability, electrical expansion, or if the equipment will actually work properly in the building
- ⚡ Business' need to correctly apply other codes and standards to fully protect their personnel and equipment above and beyond the minimum requirements set forth in the NEC

Examples of Industry Accepted Codes and Standards for Optimizing Business Operations

- ⚡ ANSI *American National Standards Institute*
- ⚡ ATIS *Alliance for Telecommunications Industry Solutions*
- ⚡ BICSI *Building Industry Consulting Service International*
- ⚡ IEEE *Institute of Electrical and Electronics Engineers*
- ⚡ NESC *National Electrical Safety Code*
- ⚡ RUS *Rural Utilities Service*
- ⚡ TIA *Telecommunications Industry Association*



The Typical Equipment Restoration Method After a Power Disturbance

- ⚡ Restore power to the device (R)
- ⚡ Repair the device (R)
- ⚡ Replace the device (R)
- ⚡ Get back on line as soon as possible
- ⚡ This method is called the *RRR method*
- ⚡ The *RRR method* provides no solution to prevent the power disturbance from affecting the equipment in the same way if it occurs again because it ignores the problem and only focuses on getting the equipment back on line as soon as possible

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- ⚡ The solution to break the cycle of the *RRR method* is to prevent, reduce, or eliminate the effect that the power disturbance has on business operations
- ⚡ To do this a business needs to utilize analysis, design and implementation of protection methods to control power disturbance events before outages and equipment failures take place
- ⚡ This method is called the *PRRR method* because it prevents (P) the following:
 - ⚡ Restoring power to the device (R)
 - ⚡ Repairing the device (R)
 - ⚡ Replacing the device (R)

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- ⚡ If outages or equipment failures take place after preventative measures were implemented then a business should document, investigate and analyze what protective measure failed and take corrective measures to prevent it from reoccurring

The PRRR Approach

- ⚡ The PRRR method is a holistic approach that uses the following:
 - ⚡ Codes and standards compliance
 - ⚡ Facility power system evaluation
 - ⚡ Service interruption analysis
 - ⚡ Monitoring of power entering the facility
 - ⚡ Calculation of the yearly planned scheduled outage costs
 - ⚡ Calculation of the service redundancy costs
 - ⚡ Calculation of the probable component failure rate costs
 - ⚡ Calculation of the protection device failure rate cost
 - ⚡ Calculation of the service outage cost (minute and hour)
 - ⚡ Updating or creation of a one line electrical drawing for the entire facility
 - ⚡ Establishing third party commissioning

The PRRR Approach cont...

- ⚡ Short circuit and arc flash analysis
- ⚡ Thermal imaging inspection
- ⚡ Determination of the type and the power quality required for all areas
- ⚡ Power system evaluation
- ⚡ Grounding system evaluation (internal and external)
- ⚡ Lightning protection system evaluation
- ⚡ Surge Protection Device (SPD) evaluation (Ac and Dc)
- ⚡ Evaluation of all cable systems entering the facility
- ⚡ Evaluation of all Dc storage batteries
- ⚡ Evaluation and testing of all backup or emergency power systems

The PRRR Approach

- ⚡ The holistic PRRR approach assures that performance goals can be met for equipment installation, performance and reliability
- ⚡ By incorporating the holistic PRRR approach at facilities, ongoing electrical equipment failures and costly downtime losses from power disturbances can be reduced and possibly eliminated
- ⚡ Once actual downtime costs are calculated and known, it can be clearly seen that prevention of outages and equipment failures actually saves a business money and continues to pay back dividends year after year

Examples of Power Disturbance Protective Devices

- ⚡ Capacitor banks
- ⚡ Constant voltage transformers
- ⚡ Generators
- ⚡ Harmonic filters
- ⚡ Isolation transformers
- ⚡ Motor controls for starters
- ⚡ Motor generators
- ⚡ Surge Protection Devices (SPD's)
- ⚡ Voltage regulators and power conditioners
- ⚡ Uninterruptible Power Supplies (UPS's)
 - Standby (offline)
 - Line interactive
 - Double conversion (online)
- ⚡ Voltage and current protection for motors



Power and Electrical Solutions that Optimize Business Operations

- ⚡ Every business should have at least one of the following:
 - ⚡ Power quality expert on staff
 - ⚡ Consultant who is a Subject Matter Expert (SME) on power quality

Case Studies

- ⚡ Case studies have proven equipment failures from power disturbances are drastically reduced or totally eliminated after these designs, standards and practices are implemented
- ⚡ In many cases businesses were losing over \$100,000 per year in equipment replacement every year just from lightning damage alone
- ⚡ Typical business equipment failures are reduced on an average of 92 percent
- ⚡ In some cases over ten years have past without another equipment outage
- ⚡ Case studies have shown that when the holistic approach has been used, the return on investment is usually less than two (2) years

In Summary we Discussed

- ⚡ Root causes of electrical equipment failures
- ⚡ The definition and examples of power disturbances
- ⚡ How often power disturbances can occur
- ⚡ How much power disturbances can cost
- ⚡ How to use a holistic approach to prepare and protect against power disturbances
- ⚡ How cost savings from equipment down time not only pays for the protection against power disturbances but increases a business' profit year after year

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⚡ We thank you for your attention

⚡ This concludes our presentation

⚡ Any questions?