Enhance the safety and reliability of your power system

Schneider Electric™ Engineering Services

se.com/us/engineeringservices

Life Is On Schneider Electric

Schneider Electric Engineering Services can address all of your power system requirements

We help ensure safe, reliable, and continuous power and are focused on helping facilities manage their energy and solve complex power system issues that may involve equipment, automation, or the utility. Our capabilities include:

Power system and NFPA 70E studies

Power system assessment

Power system design and upgrades

Our value to you:

- We have strategically-located professional engineers who are collectively registered in every state of the U.S. to meet state licensing requirements.
- Our professional engineers have in-depth knowledge of power distribution and control equipment.
  - Many of our engineers are leaders in IEEE, NFPA, and other power system standard-making organizations.
- Our team has established standardized methodologies to complete studies, analyses, and assessments, providing uniform reporting standards nationwide.
- We provide full-scope power system engineering solutions.
  - We study. We assess. We design.

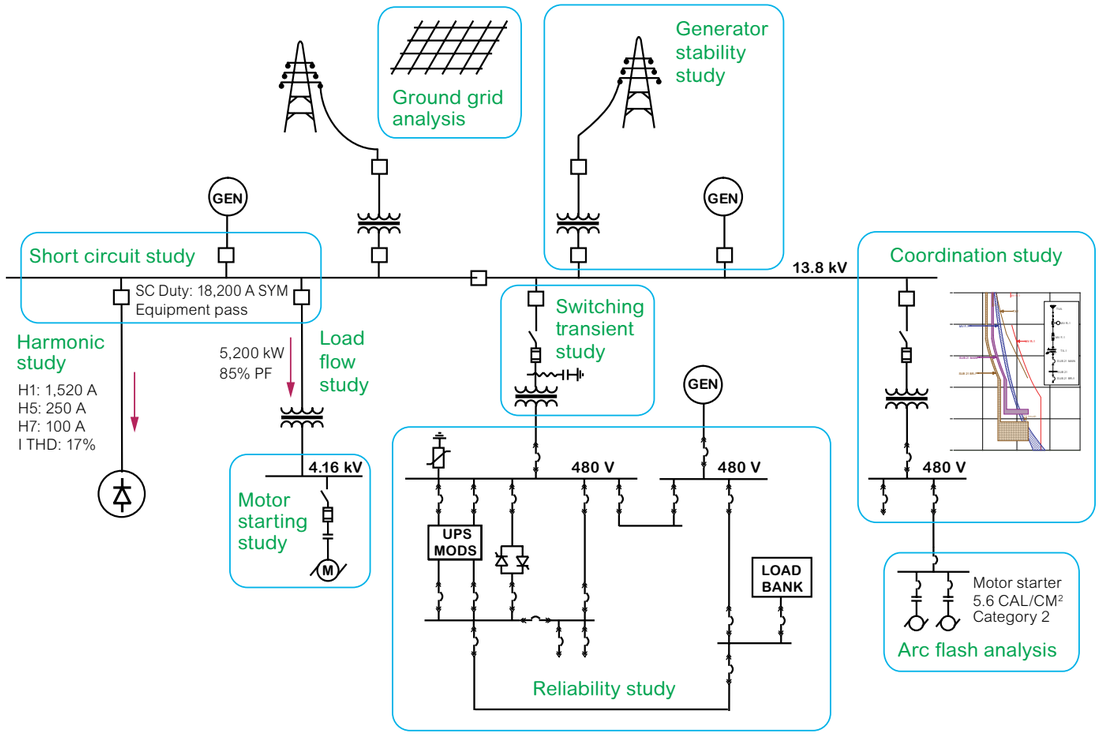
For more than 50 years we've **completed thousands of power system designs and analyses** for our customers throughout the U.S. You can count on us for consistent engineering studies and designs, thanks to our comprehensive engineering standards. These standards are in place so that all projects for your facilities are executed using the same processes and systems no matter how many locations you have.

Power system analytical studies

There's more to managing an electrical system than troubleshooting problems. It also involves identifying potential issues and either eliminating or mitigating their effects. The analysis and diagnosis of any engineered system guards against improper system operation and the possibility of catastrophic losses. Managing an electrical system and the energy it delivers requires:

- A comprehensive understanding of the system's normal and abnormal operation
- Knowledge of a wide variety of equipment
- The successful application of industry codes and standards

Our analytical studies help ensure your electrical system operates as it was designed and intended. Each study includes a detailed report of findings along with corrective recommendations to help maximize the reliability and operational efficiency of your system.



The production of a modern power system study includes a data collection phase, power system modeling, analysis, and the development of the engineering report.Schneider Electric Engineering Services offers a broad range of power system studies.

Type of analysis	Benefits
Protective device time-current coordination analysis	
The goals of a protective device time-current coordination analysis are to: • Provide power equipment with the required protection • Minimize service interruption under overload or short circuit conditions This analysis evaluates an electrical system's protective devices, including relays, fuses, and circuit breakers, and the equipment to which they are applied. The final report includes suggested settings for all adjustable devices. Composite log-log characteristic curves illustrating the resulting protection and system coordination are also provided.	• Minimizes system downtime and nuisance device operations • Increases system protection and reduces equipment damage • Isolates faulty circuits without loss of power to other parts of the system • Optimizes the protective device setting for reliability and arc flash protection
Short circuit analysis	
This analysis calculates the fault current levels throughout the electrical network. The interrupting duties of the devices being analyzed are compared with the available fault currents. Where underrated equipment is identified, recommendations are provided to help you comply with industry codes and standards. The final report includes tables comparing short circuit levels to the rating of the equipment with recommendations for improvements. A computer-generated single-line diagram of the distribution system is also provided.	• Reduces system downtime • Addresses concerns about underrated or misapplied equipment • Minimizes or eliminates equipment damage Promotes electrical workplace safety

Type of analysis	Benefits
Load flow analysis	
A load flow analysis addresses present electrical system deficiencies or identifies system requirements to meet future demand. Specifically, it: • Optimizes loading of the electrical distribution equipment • Establishes reactive power flows needed to stabilize bus voltages • Determines transformer tap settings Our load flow experts translate design load data or field measurements into an accurate system model. Key system parameters are then calculated and the results of various scenarios are distilled into easy-to-understand tabulations.	• Minimizes downtime by stabilizing system voltages • Prevents (or corrects) overloaded transformers and conductors • Optimizes equipment utilization by evenly distributing plant load • Prevents load-related nuisance tripping • Improves power factor and avoids power factor penalties from utility
Harmonic analysis	
Harmonics cause power quality problems that can reduce system efficiency and increase operating costs. Found traditionally in industrial processes, harmonics are now present in both commercial and industrial facilities due to the proliferation of non-linear loads (power electronic equipment, variable speed drives, and switched-mode power supplies). The harmonic analysis results are presented in easy-to-understand tables. Explanations are provided to highlight the issues uncovered.	• Prevents equipment overheating • Allows seamless interaction between loads and generators • Reduces or eliminates undesirable voltage distortion levels • Complies with IEEE 519 harmonic limits
Motor starting analysis	
Starting large motors across the line can cause severe disturbances to the motor and any locally connected loads. The most significant effect is the voltage sag, which extends the acceleration time of the motor being started and causes additional thermal and mechanical stresses. Voltage sags also impact other loads connected to the power system, particularly electronic loads. A motor starting analysis must be made if the motor's size > 30% of the supply transformer's base kVA rating. Studies are also recommended if several smaller motors are started together or if the power source is a local generator. This analysis calculates the electrical parameters (voltage and current) and the accelerating torque of the motor during the starting process.	• Extends motor life by reducing starting thermal stresses • Prevents the negative effects of voltage sags on other equipment • Eliminates undesirable interactions between motors and generators • Complies with the utility's motor starting requirements
Switching transient modeling and analysis	
Normal or abnormal switching and circuit breaker operations cause transient conditions in power systems. Though transients have a brief time span, the resulting voltages may damage insulation or make sensitive electronic devices malfunction. Large magnitude currents can cause equipment overheating and even melt fuse links. Switching transient analyses are commonly employed to evaluate: • The effect of switching of vacuum circuit breakers that supply power transformers • Power factor correction capacitor switching issues • Transient recovery voltages produced when a circuit breaker clears a fault Results are presented in an easy-to-understand format. Recommendations are provided to mitigate the effect of transients	• Determines stresses that system components are exposed to • Identifies alternatives to reduce system stresses, which may include: – Alternative switching schemes – Addition of components – Changes in power system configuration

Type of analysis	Benefits
Reliability analysis	
A reliability analysis quantifies the probability that a system or component will operate as intended. Without performing this analysis, the task of evaluating alternative systems and components is left to the engineer's intuition. Reliability studies are typically performed for mission-critical power systems such as data centers and Critical Operations Power Systems, as defined in the National Electrical Code®. However, the principles of a reliability analysis can be applied to any power system in order to optimize the selection and arrangement of the power distribution components. Reliability indices are presented in an easy-to-understand format. Discussions are provided on the potential failure modes of the system.	• Provides an understanding of the relative effectiveness of different power distribution schemes and/or component selections – Offers recommendations to improve reliability • Creates indices for cost/benefit analysis at the design stage • Identifies potential modes of failure in an existing power distribution system
Stability analysis	
A stability analysis evaluates various power system scenarios corresponding to switching actions or the initiation of a fault. Stability studies are typically applied to facilities that utilize large generators. The goal is to determine conditions for prolonged voltage fluctuations that would cause the system to become unstable. By changing the parameters of the system and running alternate scenarios, opportunities are evaluated to correct the deficiency. The final report provides a description of the conditions that cause the power system's instability as well as alternative equipment and system arrangements.	• Minimizes downtime by providing an understanding of the system's response to abnormal conditions • Allows better preparation for the development of a contingency plan – Comparing alternative scenarios enables mitigation of stability issues through improved system protection or switching

Solutions for OSHA® and NFPA 70E compliance

Enhance the safety and reliability of your power system.

The Occupational Safety and Health Administration (OSHA) mandates that work on electrical equipment must be performed in a manner that does not expose the worker to undue risk of injury. OSHA enforces electrical workplace safety standards outlined in the National Fire Protection Association's *NFPA 70E: Standard for Electrical Safety in the Workplace®*.

Schneider Electric™ Engineering Services advocates compliance to NFPA 70E not only for worker safety, but also equipment productivity. An arc flash accident can render equipment unusable and place the facility in a costly downtime mode. Basic compliance is established with a five-step process; a sixth step assists the facility owner with fine tuning the electrical power system, both for safety and operability.

Step 1 – Develop and audit electrical safe work practices (ESWP) policy

This written policy covers all areas of the company's electrical safety practices. Topics include: lock out/tag out procedures, method of qualifying workers, selection and application of personal protective equipment (PPE), methods of establishing a safe work area, arc flash and shock protection calculations, equipment labeling and worker audit procedures.

It also defines the requirements for safe work practices and requires audits on a three-year cycle to ensure continued compliance. If audits determine that the principles and procedures of the electrical safety program are not being followed, appropriate revisions to the training program or to the procedures shall be made. Workers must be evaluated for compliance and any deviations must be documented.

Step 2 – Conduct an arc flash risk assessment to evaluate the likelihood of occurrence and severity of arc flash hazards

At a minimum, the analysis should be reviewed every five years because changes in the electrical distribution system affect the results of the analysis. An arc flash risk assessment shall be performed to identify arc flash hazards, estimate the likelihood of occurrence of injury or damage to health, and assess the potential severity of injury or damage to health; and to determine if additional protective measures are required.

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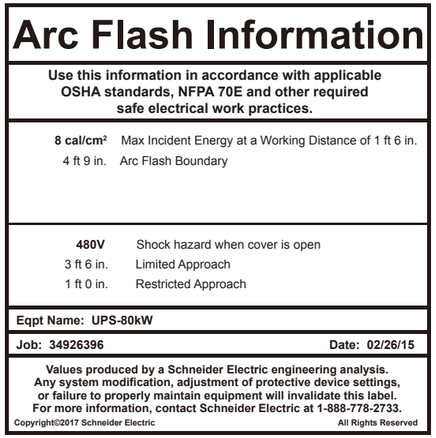


Apply Warning Labels to Equipment

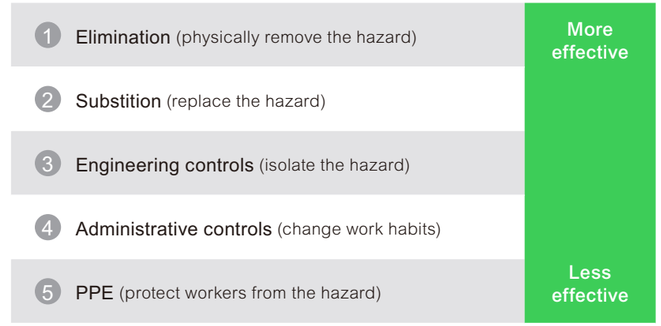
The incident energy analysis method is overseen by professional engineers who are familiar with the power distribution and control equipment, and the calculation methods required. The methodology for conducting an incident energy analysis is outlined in *IEEE 1584™ Guide for Performing Arc-Flash Hazard Calculations.*

Step 3 – Implement strategies to mitigate and control the risk associated with arc flash

NFPA 70E mandated the use of the hierarchy of risk control methods when conducting task risk assessments for electrical work.

Providing effective arc flash mitigation through substitution and engineering controls should always be conducted prior to placing workers in PPE.

The goal of arc flash mitigation is to reduce the incident energy, and thus the PPE, to a level that permits normal tasks to be performed on equipment.



Step 4 – Conduct regularly scheduled safety training and audits for all electrical workers

Electrical workers are not considered to be qualified by OSHA until they have received safety training specific to the hazards of arc flash, arc blast, shock, and electrocution. Further, the employer must verify, through regular supervision or inspection (conducted at least on annual basis) that each worker complies with the safety-related work practices required by NFPA 70E.

Our training department is staffed with OSHA Authorized Outreach Trainers to help ensure your employees are formally trained and aware of electrical hazards per the regulatory requirements.

Step 5 – Maintain all electrical distribution system components

Unless adequate maintenance is performed, overcurrent protective devices may not function and the electrical system study and the arc flash analysis may not be a correct representation of the potential performance of the power system.

Our qualified field services personnel perform on-site preventive and predictive maintenance services for any manufacturer's electrical equipment. Upon completion, a detailed report is provided that identifies potential issues along with corrective recommendations.

Step 6 – Ensure adequate supply of personal protective equipment (PPE) and proper tools

Employees working in areas where there are potential electrical hazards must be provided PPE that is appropriate for the specific parts of the body to be protected. Additional requirements include properly-rated equipment to test voltages and insulated tools for workers who perform testing and troubleshooting on energized equipment.

Fact:

Electrical hazards cause more than 300 deaths and 4,000 injuries in the workplace each year.

Source: Electrical Safety Foundation International (ESFI)

Power system assessment services

Minimizing risk to increase reliability and performance.

Removing risk is a key challenge to all daily operations. Our professional engineers provide a proactive and tailored recommendations to manage this ongoing challenge. Our assessment services provide a roadmap to optimize capital and operational expenditures today and in the future.

MPS—3 ways to address areas of risk

Electrical assessment services for your power system:

1. Modernization – Avoiding the risks of obsolete equipment
   - Identify critical assets within a hierarchy of equipment.
   - Determine the true cost of maintaining aging equipment.
   - Uncover opportunities for modernization of existing equipment.
   - Create a long-term plan for addressing obsolescence.

2. Performance – Operating and maintaining equipment to its fullest potential
   - Audit system documentation to verify the type and frequency of maintenance operations.
   - Inspect and document overall state of the equipment and its environment withing specified operation conditions.
   - Address reliability issues and process disruptions.

3. Safety – Ensuring the health and protection of personnel hold highest priority
   - Alerts to the presence of imminent hazards requiring immediate action.
   - Audit workplace safety practices and identify areas of risk that could affect personnel safety.
   - Verify and document electrical distribution equipment and its environment complies with local, state and/or federal codes.

Two levels of MPS assessment services:

1. Prime – Detailed assessment of the electrical installed base to provide a complete improvement and risk management program.

2. Enterprise – Advanced assessment that includes reliability analysis in order to generate comprehensive plans for modernization, maintenance, monitoring and management.

Equipment connectivity assessment

The Industrial Internet of Things (IIoT) is revolutionizing power systems, but system owners and operators don't always have the resources for IIoT connectivity projects. Our Power System Engineers will meet with you to understand your digitization objectives and identifies critical electrical assets. Upon identification, the Schneider Electric PSE reviews existing communication infrastructure and cybersecurity setup, and then develops a plan for digital connectivity.

Custom assess-ments

based on your need to reduce risk to your facility from:

- reliability issues
- code violations
- process disruptions
- outdated workplace safety requirements

Risk to the facility is determined by the combination of four factors:

1. The impact of the occurrence to key process elements
2. The safety hazard to electrical workers
3. The probability of an occurrence
4. The ability to respond quickly to correct the negative effects of the occurrence (vulnerability)

Results of the risk assessment are entered into a Hazard Vulnerability Analysis table, which prioritizes the findings according to the total risk to the facility.

A contingency plan identifies a power system's key components (major assets) and evaluates available alternatives, in case of a major asset loss. It also produces an action plan to be implemented should a major loss occur.

Equipment evaluation, risk analysis, and contingency planning are three separate assessment activities that may be combined.

Example of impact to a facility

The impact of a transformer loss serving a hospital's service area (kitchen, house-keeping, etc.) would be quite different – and a lower priority to restore – than the impact on critical care areas (operating rooms, ICU, emergency, etc.)

Sample Assessment Report

Item §	Finding / Deficiency Name	Technical risk	Solution	Risk Category	Findings Category	Solution Budget (k$) (*)
3.1.1	Safety Issues					
3.1.1.1	Accessible live components at switchboards A and B	- Safety	- Install a lockable door at electrical room A to avoid entrance of unauthorize persons. - All covers/doors at switchboard A and B to be closed and keyed locking devices/ mechanical interlock to be implemented to avoid access to live components, or install proper protective barriers inside the cubicle.	Safety	Accessible live parts	Internal Action
3.1.1.2	Missing filler/cover plates at panel E	- Safety	- Provide and install proper filler/cover plates.	Critical	Issue on equipment (damaged, missing covers, leakage, partial discharge)	Internal Action
3.1.1.3	Underrated circuit breakers at DP-5 and DP-7	- Safety - Extended downtime	- The circuit breakers identified as having insufficient interrupting ratings to be replaced with proper rated circuit breakers.	Safety	Underrated device	10
3.1.1.4	Arc-flash hazard warning labels were not provided on some recently installed electrical equipment	- Safety	- Arc-flash risk assessment study to be revised and includes the new installed equipment. - All electrical equipment to be labelled accordingly.	Critical	Arc-flash issue	8
3.1.1.5	There was no PPE provided for arc-flash protection in electrical rooms	- Safety	- Provide arc-flash PPE for each electrical room.	Safety	PPE issue	4

Power system grounding evaluation: risk prevention inside and out

Schneider Electric power system engineers will develop a scope of work to address your areas of concern, which may include the following evaluations:

1. Grounding system and the ground grid at the main switchyard including the switchgear room
2. Grounding system at the service entrance equipment, generators, generator panels, and automatic transfer switches (where used)
3. Grounding electrode system and bonding methods, including the structural metal used
4. Ground fault protection equipment
5. Lightning protection system (NFPA 780) and surge protection application
6. Sensitive equipment grounding requirements

We will document the baseline condition of your grounding and surge protection systems. Corrective action recommendations are provided to improve the existing grounding systems and to comply with current electrical codes and standards.

Equipment condition evaluation, risk assessment, and contingency planning

Electrical distribution equipment is subject to degradation due to age, environmental stresses, and heat. Our professional engineers produce a basic* equipment condition evaluation by visually inspecting the equipment during a walk-through of the facility. For each non-optimum condition identified during the equipment condition assessment, a measure of risk can be defined.

Power system design and upgrades

Meet requirements for the most challenging design and upgrade projects.

Serving customers in every industry segment – from data centers to steel mills – our electrical system design and upgrade expertise includes:

- Power distribution systems
- Switchgear modernization
- Protection control automation system upgrades
- Power generation system design and construction
- Power factor correction and filter design
- Grounding systems

Projects can be customized from basic design consultation to feasibility studies to a complete turnkey solution.

Power distribution systems

Our services provide piece of mind to ensure that your systems operate with optimal safety and reliability. Our engineers help with:

- HV/MV substation upgrades and expansion designs
- LV/MV equipment upgrades, expansions and designs.

We serve utilities and industrial facilities with industry-leading products and services. Our capabilities include design and construction services up to 345 kV:

- Project management
- Substation layout, elevation drawings, oil containment
- Civil and structural
- Equipment sizing and specification
- Protection and control system design
- Control house design
- Conduit and trench design
- Power factor correction and harmonic filter design
- Grounding system design
- Utility coordination and regulatory approval
- Commissioning services
- Turnkey installation
- Substation service and repair

Turnkey services include:

- Concept/feasibility study
- Front end engineering
- System equipment manufacturing/ delivery
- Installation & Project Management
- Commissioning

Switchgear modernization

Our modernization solutions will upgrade your existing switchgear or motor control centers to current technology. Our solutions are designed to minimize downtime, improve reliability, and extend equipment lifespan.

Our professional engineers provide:

- On-site engineering assessments
- Assessment of the existing maintenance and repair practices
- Evaluation of facility's present and future requirements
- Complete codes and standards compliance review
- Selection of equipment and upgrade options
- Bills of material, drawings, and specifications for procurement and installation
- Start-up and commissioning services

Protection control automation system upgrades

Our solutions to upgrade protective relaying and control systems are applicable to:

- Switchgear with electromechanical relays
  - Digital microprocessor-based relays enhance safety, increase reliability and provide digital connectivity.
- Synchronous motor control package
  - Turnkey replacement of the electromechanical control system (exciters, control system, and protective relaying)
- Arc flash reduction technologies
  - Includes addition of virtual main, light sensing relay technology, and zone selective interlock systems
- Switchgear PLC based controls upgrades

As a turnkey offer, we take responsibility for the overall project including data collection, analysis, installation, and commissioning. The result is a well-designed and commissioned system that will deliver improved reliability and operational efficiency.

Generator system design and connection

We deliver turnkey generator connection solutions for both your normal and emergency power systems. Generators are the most effective means of minimizing electrical downtime in your facility. Permanent generators enhance power system reliability and are required in healthcare and critical operation facilities. In addition, we also design and install the necessary power system equipment to facilitate connection of temporary, trailer mounted, generators.

Both new installation and upgrade solutions are available. Partner with us to maximize your return on investment.

Power factor correction and filter design

Power factor upgrades typically pay for themselves by reducing, or eliminating, utility power factor penalties. Our services include design engineering, procurement, and installation of power factor correction and harmonic filtering equipment from 480 V to 345 kV. Using power quality monitoring devices, our engineers will evaluate the harmonic and transient environment in your facility to ensure the equipment is properly sized and applied.

Grounding system design

Used in facilities with continuous, uninterrupted power requirements, HRG power systems may allow non-stop operation during a ground fault. Facilities with ungrounded (delta) electric power systems often experience equipment damage, excessive voltage transients, and high maintenance costs associated with ground faults. Converting to HRG can alleviate the damage caused by ground faults. Our power system engineers will assess, design, and apply power system conversions using component-based or packaged HRG systems.

Our design services

extend from the transmission line to the motors and equipment in your facility.

Why choose Schneider Electric Engineering Services?

Get industry-leading expertise to address all of your power system needs

For more than 50 years, Schneider Electric Engineering Services has completed over 10,000 power system assessments, studies, and designs for our customers. Our professional engineers, many of whom are leaders in standard-making bodies such as IEEE, have established a proven project management system that streamlines data collection activities to help minimize any impact on your operations. You will receive consistent engineering designs, studies, and analyses due to our comprehensive engineering standards.

Schneider Electric has established regional engineering operations, located strategically throughout the U.S. These operations are staffed by professional engineers who are licensed in the local jurisdiction and have the full support and capabilities of Schneider Electric worldwide. Having a power system engineer close by assures familiarity with authorities having jurisdiction, local codes and standards, utility systems, and operations.

Industry-leading expertise to solve power system needs

For more than 40 years, Schneider Electric® Engineering Services has completed over 10,000 power system assessments, studies, and designs for our customers, who include:

Automotive

- FCA USA
- Honda of America
- Toyota Motor Manufacturing
- Ford Motor Company
- General Motors Corp.
- Mercedes-Benz

Chemical

- Pfizer Inc.
- Union Carbide
- INVISTA
- INEOS
- Air Products

Commercial

- Disney® Corp.
- Home Depot
- Hyatt Regency®
- J.C. Penney
- Sears
- Kroger
- McDonald's Corp.
- Winn Dixie
- UPS® Corp.
- Food Lion
- Mercantile Stores

Communications

- AT&T
- Bell Telephone
- GTE
- Pacific Bell

Data Centers

- Lowe's
- M&T Bank
- The Hartford®
- Mayo Clinic
- Southern California Edison
- EMC®

Educational

- Duke University®
- Harvard University
- Kansas University
- Ohio State University
- Penn State® University
- Texas A&M
- Texas Tech
- University of Illinois
- University of Kentucky
- University of SouthCarolina

Educational (cont.)

- University of Texas®
- University of Washington
- Wichita StateUniversity
- Vanderbilt University

Food & Beverage

- Coca-Cola® Company
- General Foods
- Kraft Foods
- Nabisco Foods
- Pepsi® Cola
- Sara Lee®
- Nestlé®

Government

- Camp Pendleton
- FAA
- Ft. Campbell
- IRS
- Los Alamos National Labs
- Pentagon
- Social Security Admin.
- U.S. Federal Courthouse
- U.S. Postal Service™
- Wright Patterson AFB

Healthcare

- VA Hospital (various facilities)
- Massachusetts General Hospital
- Barnes Jewish Hospital

Manufacturing

- 3M™ Company
- Boeing Aircraft
- Caterpillar Inc.
- Martin Marietta
- Lockheed Martin
- Kimberly Clark Corp.
- Dell™ Computer Corp.
- IBM® Corp.
- Intel® Corp.
- Lucent Technologies
- Motorola
- Samsung
- Texas Instruments™
- Xerox® Corp.

Oil & Gas

- ExxonMobil™
- Shell
- BP
- OXY
- Chevron

Pharmaceutical

- AstraZeneca
- Johnson & Johnson
- Merck
- Pfizer
- GlaxoSmithKline
- Baxter Healthcare
- Wyeth
- Cordis
- DePuy

Utility

- Commonwealth Edison
- Northern States Power
- Southern Indiana Gasand Electric
- Sunflower Electric
- TVA
- Progress Energy
- Orlando Utilities

Water Treatment

- WWTP Columbus
- LTC WWTP Ph2
- Pelham WWTPExpansion
- Four Mile Creek WWTP

Any brand. Any industry. Any time.

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