



Take Control of Your Back Room

Twenty-five years ago, the average gas station owner's electrical system was nothing but a simple breaker box for his light bulbs, pumps, radio and cash register. There was little need for complex electrical distribution and power because the tools of his trade were simple. However, as Julian Fesmire explains, the petroleum market of today has changed both the owner and his station, with a shift in focus away from the simple full-service gas fill-up, to the complex arena of convenience.

Standardize and specify electrical systems

Twenty-five years ago, the average gas station owner needed only a serviceable pump, a steady supply of refined petroleum, a smile to go along with his limited knowledge of mechanical troubleshooting and his ever-present greasy red rag. His electrical system was nothing but a simple breaker box for his light bulbs, pump, radio and cash register. There was little need for complex electrical distribution and power management and protection equipment.

The petroleum market of today has changed both the owner and his station, with a shift away from the simple full-service gas fill-up to the complex arena of convenience stores and hypermarket fueling kiosks. These facilities are being stamped into the earth in just days, with a construction method that standardizes their design and their components.

Each store model within a given company—depending on the company—is nearly identical from top to bottom, except for one area: the infamous back room. This is where you typically will find an assortment of panels, wires, switches and other devices that are used for distributing electrical power to all of the electrical equipment and electronic devices needed to run the facility.

No standards, no focus

The design and installation of back room electrical circuitry and equipment have not been standardized throughout the industry, or even within each marketing company. Thus, these “catch-all” areas are typically unorganized, with individually designed layouts, such as those shown in the accompanying photographs.

Complicating the situation even more is the general lack of familiarity with power conditioning and protection equipment needed to deliver appropriate power quality to the store's electrical equipment and electronic devices. In a market where so much electronic technology is utilized, it is not unusual for the store owner to become overwhelmed by the sheer mass of circuitry required to run the store efficiently.

The lack of standardization and familiarity make it difficult for the store owner—who must deal with all of the other managerial pressures associated with owning a convenience store or even a chain of several hundred convenience stores or hypermarkets—to focus on how the electrical systems should come together to function smoothly. This lack of focus can lead to some very expensive problems.

To address this difficulty, it is necessary to educate not only the convenience store owner, but also the electrical engineer who designs the store's electrical system, and even the electrician attempting to design a wiring system for the back room. Such education should start with understanding the common problems associated with poor power quality.



Inside view of a conventional breaker panel.

Power quality problems

Commercial power comes into the store heady and strong, full of such disturbances as surges, spikes and brownouts (all of which can disrupt operations), and not at all ready to run the delicate micro-circuitry required to maintain operations. The constant switching (on and off) of heavy electrical gear such as refrigeration equipment, compressors, generators, heating and air conditioning units and canopy lights is felt throughout the electrical system and is known as inductive switching. Inductive switching causes surges and spikes resulting in component degradation of sensitive electronic circuit boards, revealing such common symptoms as memory loss and equipment lock up.

In the middle of this hostile electrical environment is a sensitive network of electronic petroleum equipment. This network consists of all electronic equipment required to dispense product and process the related sales transactions. This equipment can be identified by tracing the data communication wiring that interconnects the equipment.

Data communication ports and the quality of the data communicated are extremely susceptible to disturbances related to electrical problems. To have a reliable petroleum equipment operating environment, the electrical circuits must be specified, protected, grounded and installed properly. Petroleum network equipment should be connected to a common ground. Otherwise, voltage can develop on the ground for some equipment and cause what is referred to as a noisy ground.

Such improper grounding can generate a “ground loop” that causes voltage to develop on the data lines that connect two pieces of equipment together. When this happens, a voltage greater than normal is applied to the input or output of the electronic equipment and problems occur.

Specifications for the wiring of a convenience store should require that all electronic equipment be connected to a single point ground, as recommended by the Institution of Electrical and Electronic Engineers.

Wiring trough with the cover removed. Note the unmarked, jumbled wires making it difficult to identify wires to circuits



Typical use of a cable trough in a conventional AC application. This is a sore point with many store managers, as space is wasted and collects clutter.



Wiring requirements

Successful power quality management begins with some essential but often overlooked facts. About 90 percent of the electrical system's performance is dependent upon the electrical engineer's design of the system, the electrical subcontractor's wiring of the facility and the extent to which they both are aware of and follow the electrical requirements of the equipment manufacturers. All too often, the electrical engineer and contractor do not fully understand the specialized electrical needs of the convenience store/petroleum dispensing facility and its wiring requirements. The convenience store cannot be wired like a home, office building, warehouse or a factory. It is much more electrically diverse and requires a specialized level of knowledge.

Proper installation of the appropriate electronics, including proper wiring of isolated grounds, power protection and conditioning equipment, will reduce power problems. As electronics become more sophisticated and as more equipment becomes networked together, the number of difficulties attributed to power line problems will continue to rise. Moreover, as electronic components continue to shrink, the voltages they use are also becoming smaller, which makes the circuits and components even more susceptible to power line disturbances.

Standardization of the proper electrical framework for convenience stores will alleviate the problems in the back room and allow the intricate technology of the future to have a proper foundation from which to grow. Standardization should help ensure that each facility is outfitted with the appropriate framework for smooth power distribution: properly designed and installed wiring, power protection and power conditioning equipment. Significant savings would result from avoiding damages to sensitive electrical equipment and reductions in equipment down time.



Typical extension cord nightmare

Educate yourself

Awareness of the major power issues, such as power surges, power outages, inductive switching, improper grounding and improper selection and installation of wiring and power protection equipment, is just part of the picture. The other part is answering the question, "What kind of power distribution, protection and conditioning equipment is needed?" Beware of any answer to this question that involves something about an expensive black box that will fill all of the owner's needs while answering none of his questions. Awareness of the facts can keep you from making costly and time-consuming mistakes.

Within the last few years, new equipment and systems have been designed and brought to market to assist in providing clean, reliable power to the convenience store and petroleum dispensing facility. The idea is to provide a "wall of protection" specifically engineered for each application.

Part of this wall of protection are pre-wired electrical distribution panel and power protection systems, such as single point grounding, isolated pump controls and surge suppression. When used along with telephone line protectors and uninterruptible power supplies, such a system is adequate to solve all power problems and provide the proper power quality.

Pre-engineered panels

The convenience store owner usually specifies the equipment it takes to run his operation. He specifies the manufacturer of the dispensers, the canopy, the type of lights, type of island form and, in some cases, the type of nozzles on his dispenser. The only area he leaves unspecified is the back room that powers all other equipment in his store.

Using a pre-engineered electrical distribution panel can give the convenience store owner the means for controlling and holding responsible parties accountable for proper installation. It is important to work with a company engineering this type of equipment—a company that has the experience and knowledge to understand not only the electrical needs of the petroleum equipment, but also the level of susceptibility this equipment has inside the convenience store environment.

When a power surge occurs, whether it be from the power company, a lightning strike or inductive switching, that surge has to be suppressed to prevent it from scrambling data, locking up software, knocking out circuit boards, shortening the life of electronic components or even destroying electronic equipment entirely.

Another illustration of the lack of standardization in electrical systems.



Power surge suppression

A distinction must be made at this point between parallel and series surge suppression. In parallel surge suppression, a single suppressor is wired to many different loads or circuits. This can create problems because only a portion of the surges are suppressed, while a direct line between the power source and the electrical device being protected is still open. A surge can still travel down this line in the event of a suppressor failure and damage the equipment. In series surge suppression, a suppressor protects the line to each piece of equipment, minimizing the possibility of equipment damage. In the event of a series-connected suppressor failure, the power will be severed, preventing surges from damaging the equipment.

In a series-connected, four-stage surge suppressor, an EMI/RFI (electromagnetic interface/radio frequency interface are typical sources of electrical noise that, when used in the surge suppressor, reduce the amount of noise) filter grabs a surge of energy and slows it down as soon as it enters the suppressor. A zener diode steps in and starts stealing the energy. Then a metal oxide varistor takes over and soaks up even more of the load. What's left goes on to a gas discharge tube, which has a strong enough level of energy dissipation to handle the greater majority of strong surges and spikes. In the event that a surge is powerful enough to overcome this four-stage process, such as a close proximity lightning strike, the suppressor is sacrificed and blows in the same manner as a fuse.

Four-stage surge suppression provides the optimum protection from power surges and is recommended by some of the largest petroleum equipment manufacturers for the protection of individual pieces of electronics. It also must be said that series suppressors are less expensive to replace (in the unlikely event of failure) than larger parallel suppressors, and both are far cheaper to replace than the delicate electrical circuitry they protect. This type of surge suppression system can,

and should, be incorporated in the pre-assembled electrical distribution system.

As part of a complete power quality solution, protection of incoming telephone lines must be considered. These incoming lines provide a pathway for external power disturbances to affect the petroleum equipment network. The suppressor needs to provide multiple stages of protection so that it can prevent the effects of various types of surges.

Uninterruptible power

Uninterruptible power supplies (UPSs) can also serve an important function. Critical loads, such as point of sale terminals and communication devices, may require continuous power. In the event of a total power outage, the UPS can maintain continuous power for a short period of time to finish the current transaction.

When properly specifying a pre-engineered electrical distribution system, a UPS should be included. It is important for everyone associated with the design and construction of the convenience store (as well as the owner) to realize that proper electrical distribution encompasses the need for proper power protection. Every second of downtime in the convenience store industry is costly. Every part of the petroleum network is valuable to the smooth operation of the facility.

Contingency planning research has shown that 45 percent of accidental data loss is due to power anomalies. In a world of statistical evaluation and electronic based accounting, data loss and network malfunction can be expensive. Imagine reducing these problems. This is why proper electrical planning and engineering is imperative.

Problem solved?

So the issues related to power quality, power protection and non-standardization of electrical distribution systems need not continue to plague convenience stores and service stations. The owner of the modern day convenience store must take control of his electrical distribution system. He can do this by specifying a pre-assembled electrical distribution system that, if engineered properly, has the correct power management equipment and will be wired to meet local and state requirements as well as Underwriter's Laboratory (UL) safety standards. Such systems should be specified along with all other key equipment in the operation.

Standardization of convenience store electronics and electrical systems can be achieved, giving the owners who want to open one or many stores the opportunity to have the same properly engineered power quality in each location.

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