Electrotek CONCEPTS

Power System Modeling & Simulations for Customer Facilities

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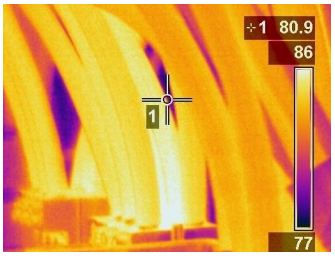
Benefits of Power Quality Modeling & Simulations

Power quality (PQ) modeling and simulations can predict unexpected outcomes associated with facility, their plant electrical systems, and non-linear loads that can cause serious damage along with failures of electrical and electronic equipment. Facility engineers and designers that recognize the importance of taking the proactive step, understand the benefits:

- Controlling financial losses associated with electrical and electronic equipment failures.
- Reducing the likelihood of PQ-related catastrophic failures of electrical infrastructures, and equipment.
- Helping to ensure reliability of plant electrical systems, and the production of goods, along with overall profitable plant productivity.
- Avoiding voltage and current stresses when operating electrical equipment.
- Determine if components are properly rated for plant operation when disturbances occur during production, and schedule plant downtimes.
- Validate the energy performance of a system and its non-linear loads—operation of these loads increase power consumption as well as harmonics, and lowers power factor.

Electrotek's expert PQ engineering team is well-known and world-renowned, in the PQ industry. Our team not only solves complex problems, but also engages in the development of industry standards that impacts modeling and simulation

Catastrophic transformer failure in an industrial plant.



Over heated power cable to a circuit breaker.

Proactive Simulations: Avoiding Financial Losses

Most customers wait until a catastrophic PQ event has occurred to engage in having expert PQ engineers simulate their power system.

Customers are constantly altering their systems—adding new circuits, and non-linear loads to improve plant operations, reduce energy costs, and expand their production capabilities. Such upgrades are likely to cause PQ problems, which often go undetected until a catastrophic failure occurs.

Engaging in proactive PQ simulations through Electrotek will provide critical, cost-saving knowledge to facility managers and engineers, regarding plant operations. It will also help them understand system limitations when loads are added and operated.

Investing in a proactive PQ simulation saves 100 times the cost of cleanup. there—it's worth it!

PQ Monitoring—Adds Value to PQ Simulations

PQ monitoring at a 3-phase main switchgear at a university field house.

Monitoring alone does not solve PQ problems. It provides data indicative of facility PQ critical to the success of PQ simulations.

Use of monitors in customer facilities is still increasing as customers learn their value. Electrotek's PQView software can import data from over 50 different monitors and system devices, like relays and smart breakers. Regardless of a monitor's manufacturer and model number, our simulations utilize PQView data, making simulations more representative of the plant itself.

Monitoring at critical points allows us to analyze source and load conditions across a plant. Often, a fault is caused by multiple undesirable conditions, and impacts a system at multiple points.

Electrotek's keen understanding of PQ monitoring, data analysis, modeling and simulation can equip facility managers and engineers with information critical to maintaining uninterrupted plant operations ,while minimizing overall operating and maintenance costs.

Customer interested in PQ monitoring as a proactive tool should contact **Dranetz Technologies**—our sister company.

Simulations Can Incorporate VFDs & Their Mechanical Loads

"Simulations can be used to determine how dynamic time-changing loads impact plant PQ."

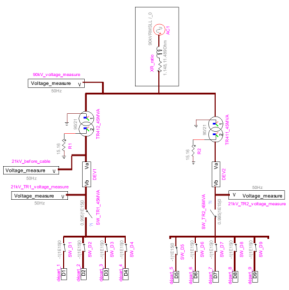
Plants are constantly installing VFDs to improve reducing energy costs, improve motor, and process performance. VFDs power motors, which drive mechanical loads. Loads are dynamic. Meaning, VFD input power is dynamic, creating a varying profile of harmonic voltages and currents and their effects on the plant's power system.

Electrotek simulations incorporate the effects of dynamic loads on plant power quality. The flow of harmonic currents from one area of a plant may very well affect the voltage delivers to VFDs in another area of a plant.

Many plants have dozens, if not 100's of VFDs—all on one large power system. The effects of each VFD on the power system can be included in a simulation, allowing Electrotek engineers to analyze voltage stability, and the likelihood of undesired resonance conditions.

Engaging in a simulation will determine how dynamic non-linear loading will impact plant power quality, extending the life of VFDs and their motors.

System Models & PQ Data—A Plant's "Medical" History



Parts of a plant model used to determine transformer energization.

Every plant experiences multiple PQ problems and equipment failures with no known causes. Establishing the first electrical model and collecting PQ data for a plant's electrical system establishes the skeleton for its baseline PQ.

The old adage, "An ounce of prevention is worth a pound of cure." is 100% true when it comes to PQ preparedness before a costly PQ event occurs. Customers and ISO auditors will appreciate a plant's investment in establishing a model of a system, and its loads. This sends a message to the customer—"We value our productivity enough to baseline our system performance and its PQ." No PQ preparedness plan is 100% effective. However, in the event of a catastrophic equipment failure, having that baseline model, along with the system's expected PQ performance will save money, and days of downtime while Electrotek engineers get to the bottom of a failure. That baseline is part of the "insurance" a plant can utilize when needed.

PQ Thresholds as Alarms when System Performance Changes

System performance changes as electrical infrastructure and loads age, that's just the Laws of Physics. Simulating a plant's baseline PQ performance allows Electrotek engineers to identify critical areas a plant manager must watch as plant production and loads change.

Combined with PQ monitoring, a simulation allows engineers to establish "built-in" alarms, which are set into Electrotek's *powermonitoring.com* service. Plant managers and engineers receive an email notification when specific PQ parameters are exceeded, preventing possible catastrophe's.

In addition to increasing system losses and loosening connections, introducing errors and unknown damage to wiring and grounding systems can manifest themselves when source, system, and load conditions change.

PQ alarms can also be updated as plant conditions, production, and loads change. Why is this important? As infrastructure ages and is exposed to damage from day-to-day operations, a plant may react differently when load is low. Low loads can occur when lines are taken out of service.

Photo of a damaged grounding electrode to a water pipe at an industrial plant.

Simulating Increases in Plant Load Will Help Prevent PQ Problems

Additions to industrial plants require additional non-linear loads—VFDs and specialty equipment, with converters or inverters. Load increases typically require adding onto existing switchgear, installing a new electrical service and main, or possibly both.

Regardless of which method, including a simulation of new loads with PQ monitoring and simulation of existing electrical systems will identify potential PQ problems before equipment is purchased and installed.

Customers undergoing expansions don't include budget for identifying and solving PQ problems. There's nothing worse than having a PQ problem crop up during startup. Engaging in a PQ study to simulate new plant load will help ensure smooth startup. Avoiding unplanned downtime when increased revenue is critical for early profits.

Electrotek engineers have experience in working with both building, and electrical system designers, during plant design stages.

"Increasing loads during plant expansions increases the likelihood of a PQ problem."

30 Years of PQ Modeling and Simulation at Electrotek Counts

Having modeled and simulated 100's of utility and customer electrical systems, our service brings value to repeat, and new customers. Although every simulation is unique, there's not a PQ situation that Electrotek engineers haven't analyzed and solved accurately.

When customers must select an engineering firm to help prevent another catastrophic failure or solve an existing one, hiring an experienced, well-known PQ engineering firm with the right tools is vital.

Electrotek utilizes its own advanced PQ software platforms combined with experience from modeling 100's of customer electrical systems, to solve the most complex PQ problems.

Known and respected in the PQ industry, Electrotek works closely with manufacturers of modeling and simulation software to add new functions, test new releases, and train new engineers to use different types of software platforms. This includes development of new load modules and libraries.

New module representing a new type of VFD being installed in industrial plants.

Electrotek CONCEPTS

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PQView®

Electrotek's Power Quality Engineering Services Center is a world-renowned facility for power systems, and power quality engineering. Our Center includes an Advanced Power Quality Testing & Research Laboratory.

Learn about our Center by visiting: www.pqengineering.electrotek.com

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Simulating PQ Problems Includes These PQ Phenomena

The power of modeling and simulation PQ problems varies and is vast. Today's software allows Electrotek engineers to model and simulate all types of PQ problems and phenomena. Our engineers can model and simulate:

- Insulation coordination
- Switching surges
- Ferro-resonance
- HVDC systems
- System protection
- Shaft torsional stress
- Synchronous machines
- Power electronic systems
- Flexible AC Transmission Systems (FACTS)
- Wind generation
- Solar PV generation
- Lightning surges
- Network analysis
- Series compensation
- Switchgear
- Harmonic current flow
- Power factor correction
- Voltage sag studies
- Capacitor switching transients
- Voltage swells
- Temporary overvoltages (TOVs)
- Harmonic voltage distortion
- Harmonic current distortion
- Resonance
- Coordination
- Energy consumption
- Reactive power management

About Electrotek

Founded in 1984, Electrotek Concepts, Inc. is world renowned for its research, developmental, applications and problem-solving work in understanding, identifying, analyzing and preventing power quality (PQ) problems. Our knowledge expertise extends from the utility generators, to inside the electrical/electronic load inside a customers' facility. The experience of Electrotek's team of PQ engineers extends from experts in utility power systems, to participants on IEEE and IEC standards boards regarding PQ standards, and to designers of end-use electronic equipment. Our engineers are armed and equipped to address any PQ problem, at any level. The future of reliable and available power, along with customer equipment in today's modern technological society depends on compatibility between utility power, the customer's facility electrical system, and the end-use equipment that customers depend on to carry out their day-to-day business activities.