

01 Power Quality for Improved Power Delivery Performance

Program Overview

Program Description

Electric utilities worldwide consistently report that power quality (PQ) is a fundamental, but under-leveraged component of the three key utility business performance metrics: system performance, economic performance, and customer satisfaction. The member-developed EPRI Power Quality Program Research Master Plan lays out a 10-year comprehensive strategy for PQ to profoundly improve these three metrics, allowing PQ managers and T&D asset utilization and system planning professionals to use PQ-related technology, knowledge, and expertise to improve their organization's bottom-line performance. The program's four project sets are carefully structured to provide a comprehensive PQ research program:

Improving PQ and Reliability with T&D Design, Maintenance, and Planning (PS01A) combines improved understanding of fundamental processes, system modeling, and standards to produce state-of-the-art optimization and design tools delivered through the PQ Diagnostic System.

Integrating PQ Monitoring and Intelligent Applications to Maximize System Performance (PS01B) performs fundamental research in the area of data monitoring, storage, and visualization—resulting in a new release each year of the highly regarded PQView data visualization and analysis software package.

Achieving Cost Effective PQ Compatibility Between the Electrical System and Loads (PS01C) combines technology assessment and fundamental research into understanding the compatibility between the power system and loads, culminating in the Industrial Design Guide tool that can be used for engineering and to educate users on optimization of system compatibility between electric power and end use.

PQ Technology Transfer and Knowledge Development (PS01D) uses the ongoing and historical work of the above research and the rest of the PQ world with an ongoing stream of cutting-edge reports, case studies, tools, and multimedia content, as well as a 500+ document electronic library delivered via the MyPQ.net website.

Industry Needs and Issues Addressed

- Power quality is essential for improved system performance, both for remediation of problems as they occur and for prevention of problems before they occur.
- Power quality is becoming an important economic driver for modern electric utilities, enabling improved efficiencies in system operations, planning, and visualization.
- Power quality is fundamental to improving customer satisfaction and appears as a priority on virtually all utility customer satisfaction surveys.

Impact

The member-developed EPRI PQ Program Research Master Plan has defined approximately 20 long-term goals that the EPRI PQ research program is striving to achieve through direct research, coordination with other EPRI research, and support of other industry efforts. Some highlights of these goals include:

- Within ten years, models and tools will be available to identify the most cost-effective utility-side strategies for improving reliability and power quality, and it will be possible to quantitatively estimate the PQ and reliability improvements provided by any specific improvement project (Project Set 1A). The program is currently addressing this goal by dramatically improving models of how electric system investments affect PQ performance.

- Within ten years, benchmarking of system power quality and reliability performance will be a dynamic, ongoing function, rather than a one-off project (Project Set 1A). This project is addressing this issue by researching the critical gaps that must be overcome to fully integrate disparate but essential utility database and records resources, including weather, maintenance, operations, and GSM.
- Within ten years, a world-class power systems monitoring database management and analysis system will be available (Project Set 1B). The program is working actively on a universal “next generation” utility data platform and the next generation of PQView software that will take advantage of it.
- Within ten years, systems will detect and locate faults on a map, preferably from PQ or other readily available data sets (Project Set 1B). Fault location has emerged as one of the early-adopter applications for improved utility performance based on PQ expertise.
- Within ten years, there will be a universal equipment immunity standard for electronic equipment (Project Set 1C). Facilitating creation and adoption of a universal end-use PQ immunity standard will yield a profound economic and customer satisfaction benefit.
- Within ten years, the means to deliver PQ information to the right audience will be automated (Project Set 1D). Customization of content and delivery is fundamental to increasing the impact of PQ knowledge resources.

Key Accomplishments

- PQView is the premier power quality data visualization and analysis tool in the world. This tool enables members not only to better detect and diagnose PQ issues, but also to dramatically improve the speed of fault location and to better communicate the grid impact of voltage sags. Utilities implementing preliminary fault location algorithms using PQView have reduced average feeder downtime by approximately 1 hour per fault event.
- The PQ Diagnostic System (PQDS) is a top-flight suite of tools for improvement of PQ and reliability grid-wide, including tools for designing PQ and reliability into grids proactively. Many of these tools are designed to work with commercial industry packages such as PSCAD/EMTDC and EMTP-RV. Users of these tools report significant reductions in design time and precision, estimated to be worth approximately 0.5–1 full-time equivalent (FE) per year.
- The Industrial Design Guide (IDG) is the world’s most authoritative design tool for hardening end-user processes to be resilient in the face of PQ phenomena. Users of the IDG are able to provide training to key account reps and end-use clients in a quick, efficient, and convincing way that was not available before, saving resources estimated to be worth approximately 1–1.5 FE per year.
- MyPQ.net, the web-content-delivery site for the PQ Technology Transfer and Knowledge Development project set, provides over 500 detailed technical documents and case studies in its online library. Collaborative research in creation of this library is estimated to save each participating utility approximately \$500,000 per year in development and deployment costs.

Current Year Objectives

- Updates to PQView based on input from PQView Users Group and members
- New and updated information and tools in the areas of transmission and distribution (T&D) design, maintenance, and planning; power quality and reliability benchmarking and standards; power quality monitoring; fault location; stray and neutral-to-earth voltages; power quality compatibility; and power quality technology assessment
- Delivery mechanisms such as a comprehensive collection of technical and information publications and products, educational forums, technical support, and web-based services

Industry Involvement

- Estimated 2009 funding: \$2.8M

Program Technical Lead

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Summary of Projects

PS01A Improving PQ and Reliability with T&D Design, Maintenance, and Planning (062088)

Project Set Description: This project set provides the information and tools needed to improve the design and operation of transmission and distribution (T&D) systems as the needs of customers continue to evolve and new technologies become available to improve system performance. Note that this project set is managed jointly with a project set in the Distribution Program. These coordinated projects are described here as well.

Project Number	Project Title	Value
P001.001	T&D Design & Maintenance Practices for PQ and Reliability	Improves quality and reliability through transmission and distribution system design, operations, and maintenance; improves utilization of transmission and distribution assets; and maintains or improves power quality and reliability at a lower cost
P001.002	PQ and Reliability Benchmarking and Standards	Improves understanding and adopts industry standard approaches for performance assessment; and enables coordination with new industry standards development
P001.003	Support and Development of PQ and Reliability Analysis Tools	Reduces investigation expenses and increases end-user satisfaction through interaction with a trained, well-informed power quality staff, as well as provides access to the tools, support, and training needed to make the most effective use of both EPRI and commercial PQ and reliability analysis software

Project Descriptions

P001.001 T&D Design & Maintenance Practices for PQ and Reliability (055700)

Issue

Electric power distribution systems continue to become more complex as demands for improved performance increase. Utilities can no longer rely on costly “trial and error” approaches to assessing the impact of T&D system design and maintenance practices on power quality (PQ) and related phenomena. Rather, a set of expertly developed tools and resources is needed to ensure success at the assessment and design stages (rather than after the fact), focusing on evaluating and optimizing transmission and distribution system design, operations, and maintenance practices, with the goal of improving power quality and reliability.

Description

This project quantifies the power quality and reliability impacts of various T&D design standards and operations practices. The project provides guidelines and cost/benefit analysis tools for improving quality and reliability through T&D system design, operations, and maintenance. Power quality and T&D engineering, design, operations, and maintenance professionals can more cost-effectively improve utilization of their assets and maintain or improve power quality and reliability at a lower cost. This is an ongoing project that builds on multiple years of research and application guide development.

The 2008 effort in this project focused on risk and variability in reliability planning—one of the success statements in the Master Plan. The 2009 work plans include focus on worst circuit programs, including the following:

- Inspecting lines
- Using outage data and other historical data
- Evaluating cost effectiveness of options
- Targeting
- Justifying expenditures
- Inspecting and maintaining trees
- Whether to apply reclosers or other sectionalizing
- Evaluating the performance of prior efforts

Value

Utilities implementing T&D design and operations approaches can design improved system PQ performance into new designs, saving significant costs in post-construction modifications. Improved performance of new and updated T&D systems using these resources is expected to improve asset utilization for new and existing systems, again resulting in significant economic benefits for members.

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by assimilating them prior to undertaking a new T&D system design or when modifying an existing system.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Improving PQ and Reliability with T&D Design, Maintenance, and Planning: Application of Cost/Benefit Analysis Tool: Technical report on T&D design and maintenance practices for PQ and reliability	12/31/2009	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Improving PQ and Reliability with T&D Design, Maintenance, and Planning: Improved Approach for Cost/Benefit Assessments: Lessons learned from example applications will be used to improve algorithms and methods for cost/benefit assessments of PQ/reliability improvement approaches.	2010	Technical Update

P001.002 PQ and Reliability Benchmarking and Standards (058585)

Issue

Reporting of power quality (PQ) and reliability performance is a critical requirement for electric utilities informing internal planning processes, enabling performance benchmarking, and accommodating external reviews required by regulators. Standards for PQ and reliability offer opportunities for improved system performance at reduced capital cost.

Description

This project area provides tools and guidelines for effective performance assessment and reporting methods. It helps utilities understand and adopt industry standard approaches for performance assessment and provides coordination with new industry standards development. The project will track and contribute to industry standards development related to power quality and reliability indices and reporting methods. It will also develop tools and advanced methods for analyzing system performance as a means to help improve performance. These tools and methods include advanced approaches such as the service quality index pioneered in this program; statistical characterization methods; and methods for normalizing performance according to system characteristics (e.g., lightning).

The project will also track regulatory issues and standards development around the world to understand priorities for benchmarking and characterizing performance. New methods for applying statistical characterization methods and normalizing results will be documented and addressed in an annual workshop on reliability and PQ benchmarking developments.

Work planned for 2009 includes data collection for a DPQ/TPQ project—a combined distribution and transmission power quality benchmarking study. This study will move beyond EPRI's previous benchmarking studies by developing the infrastructure to automatically collect and benchmark data (a priority in the Master Plan).

Value

- Helps utilities effectively apply industry standard methods for characterizing performance, which can significantly reduce the cost of these activities.
- Provides advanced system performance measures to help provide a better basis for making system performance improvement investment decisions, thereby improving the cost-benefit ratio of these activities.

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by assimilating them and applying them to recommended power quality and reliability characterization and reporting methods in their external reviews of—and internal planning on—reliability and power quality performance.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
PQ and Reliability Benchmarking and Standards: Technical report on PQ and reliability benchmarking and standards	12/31/2009	Technical Update
PQ and Reliability Benchmarking Workshop	12/31/2009	Technical Resource

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
PQ and Reliability Benchmarking and Standards: Technical report on PQ and reliability benchmarking and standards	2010	Technical Report

Product Title & Description	Planned Completion Date	Product Type
PQ and Reliability Benchmarking Workshop	2010	Workshop, Training, or Conference

P001.003 Support and Development of PQ and Reliability Analysis Tools (048303)

Issue

Expert software resources for power quality (PQ) and reliability are difficult to find in industry, but essential for understanding of complex phenomena and cost-effective problem solving. The time and cost of developing these tools is prohibitive and the technical expertise required to create them can be very difficult to find.

Description

This project will continue to provide special-purpose tools to improve the accuracy and efficiency of reliability and power quality analyses. The project will provide development and support for EPRI PQ and reliability tools, as well as development and support for commercially available tools that analyze reliability and quality issues. Utilities typically need to perform specific analyses to evaluate the reliability and PQ characteristics of specific power systems. The simulations may evaluate specific problems (e.g., transients, harmonics, voltage regulation, and flicker) or they may evaluate system designs to improve reliability and quality.

New tools will be developed as modules of commercial software packages, such as EMTP-RV, and new approaches will be implemented in advanced tools like the Distribution System Simulator. Real-world problems and objectives will be identified and used as the basis for developing new evaluation approaches and tools.

Members identify priorities each year. Recent years have focused on analysis tools for capacitor switching transients, lightning protection for customer systems and transformers, flicker evaluations (2007) and motor starting (2007), as well as an overview of commercially available reliability assessment tools. New developments in 2009 focus on additional EMTP-RV modules, where priorities include ferroresonance, cable protection, and simulation of voltage sags.

Value

- Improves the accuracy and efficiency of PQ and reliability evaluations through application of special- purpose tools and methods
- Improves characterization of power quality and reliability
- Supports response to regulatory inquiries and response to customer PQ and reliability issues
- Improves utility staff productivity through training and workshops

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by assimilating the results and applying the newly developed software tools along with application information and support. An annual workshop provides training and updates in the latest capabilities in EPRI tools and commercial simulation tools.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Support and Development of PQ and Reliability Analysis Tools: New tools will be developed as modules of commercial software packages (such as EMTP-RV) and new approaches are implemented in advanced tools like the Distribution System Simulator. Real-world problems and objectives will be identified and used as the basis for developing new evaluation approaches and tools.	12/31/2009	Technical Update
PQ and Reliability Analysis Tools	12/31/2009	Software
Support and Development of PQ and Reliability Analysis Tools	12/31/2009	Workshop, Training, or Conference

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Support and Development of PQ and Reliability Analysis Tools: This tool implements advanced weather normalization features for evaluating reliability performance from outage databases and weather databases (based on technology developed in industry standards groups and EPRI research).	2010	Software

PS01B Integrating PQ Monitoring and Intelligent Applications to Maximize System Performance (062089)

Project Set Description: The objective of this project set is to implement monitoring system advancements that will not only enhance the benchmarking and reporting functions of monitoring systems but also provide the basis for advanced applications that can improve equipment and system reliability. This project set works to enhance distribution reliability to meet the increasingly diversified requirements of a competitive energy marketplace, including changing regulations and open-access requirements.

Project Number	Project Title	Value
P001.004	Integration of Data from Multiple Sources	Helps increase the value of monitoring systems by integrating information from many different devices and equipment that may provide increased value to overall power quality data management and analysis applications
P001.005	Advanced Applications for Monitoring Systems	Enables integration of alarms and reports with system maintenance procedures and operations to more efficiently resolve problems and improve equipment reliability; improves system reliability and reduces maintenance and operation expenses
P001.006	Monitoring System Development and Management	Allows utilities to realize the full benefits of the other research projects in this project set via application in actual software systems.

Project Descriptions

P001.004 Integration of Data from Multiple Sources (060443)

Issue

The EPRI PQ Program Research Master Plan has identified issues relating to power quality (PQ) data and monitoring as fundamentally important to the success of electric utilities in the coming years. One paramount challenge to realization of the Master Plan vision is to take data from many different sources and integrate it into common resources that can be used to inform decisionmaking and offer close support for operation of modern utility T&D systems.

Description

In this project, EPRI plans to work with the IEEE Power Quality Subcommittee to transfer EPRI's specification for storing PQDIF records in a database format. EPRI also plans to work with the IEEE Task Force by authoring chapters of the IEEE application guide and XML specification annex. The project develops a new data handler for PQView that can read PQDIF files in binary, XML, or database format, based on EPRI work with IEEE's P1159.3 Task Force and with instrument vendors. The resulting new data handler includes a logging function that provides feedback to PQView users on problems with noncompliant PQDIF files.

The IEEE 1159.3-2003 PQDIF standard provides a file format for exchanging measurements between power quality systems. To increase its adoption, IEEE is writing annexes on the PQDIF application and extending its file format to XML. In 2007, EPRI wrote a PQDIF application guide with examples containing measurements in PQDIF structure in binary, XML, and database format. The database format is an innovative means of storing PQDIF definitions, observations, and instances. It includes updated code examples to illustrate how to write files in this format. The new XML version of PQDIF is not supported by PQView's PQDIF data handler. The IEEE Task Force needs help to write its PQDIF application guide and XML format annex.

Value

- Integration of data from multiple resources is of great value to modern utilities.
- The analysis and decision-making enabled through data integration can improve operational efficiency significantly.

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by assimilating them and applying the ability to capture the added monitoring value that is routinely being integrated into such non-monitoring components as relays, meters, switches, reclosers, circuit breakers, and regulators. Such integrated devices are often referred to as "intelligent electronic devices."

2009 Products

Product Title & Description	Planned Completion Date	Product Type
PQDIF and COMTRADE Technical Reports and Data Handlers: This research supports the EPRI PQ Program Research Master Plan's goals of allowing ready access, transparency, and broad analysis of many different data sets and repositories.	12/31/2009	Software

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
PQDIF and COMTRADE Technical Reports and Data Handlers	2010	Software

P001.005 Advanced Applications for Monitoring Systems (062153)

Issue

The EPRI PQ Program Research Master Plan has identified issues relating to power quality (PQ) data and monitoring as fundamentally important to the success of electric utilities in the coming years. Power quality monitoring systems have tremendous amounts of data describing the performance of the power system and the condition of power system equipment. These data have traditionally been available only for historical analysis and reporting. However, advances in communications systems are making this data available in near real-time and integration of data from additional intelligent devices in the system is resulting in the capability to collect data from throughout the system. However, considerable barriers remain to realizing the benefits from these advances.

Description

This research increases the value of PQ monitoring systems through the development of advanced applications that can directly benefit the operation and maintenance of the system. The applications build on existing monitoring system platforms to minimize the additional investment required to achieve these benefits. They also take advantage of the tremendous amount of data available in power quality monitoring systems that can be used to assess the condition of equipment and the system with appropriate analytical methods and system interfaces.

This project expands the value of PQ monitoring systems by using the data to develop important information about the health of the overall system and individual components. Alarms and reports can then be integrated with system maintenance procedures and operations to more efficiently resolve problems and improve equipment reliability. The net effect can be a dramatic improvement in system reliability and a reduction in maintenance and operation expenses—the most important justifications for monitoring systems in the future.

Work will focus on the following:

- General processor for trended PQ data to identify abnormal conditions based on control chart theory
- Methods for resampling voltage and current waveforms for facilitating Fourier analysis or for long-term storage in databases
- Voltage regulator performance module
- Fault protection and coordination assessment module
- Circuit breaker performance assessment module
- Transformer loading and lifetime assessment, including harmonics
- Arrester performance for transient events
- Advanced fault analysis and incipient fault identification
- Harmonic resonance assessment for capacitor banks
- Capacitor bank switching performance assessment
- Customer PQ interface assessments (implementation of limits for harmonics and flicker)
- Customer equipment performance assessments based on monitoring information from intelligent meters

Value

- Application of PQView is of great value to modern utilities.
- The value of the analysis and decision-making enabled through application of PQView can significantly improve operational efficiency.

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can apply the results of this research by assimilating them and applying them to existing and future PQ data resources.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Continued Development of Actual Monitoring System Data Management and Analysis Systems: This research supports the EPRI PQ Program Research Master Plan's goals of facilitating analysis, decision-making, and enhanced utility system performance through analysis of PQ and related data.	12/31/2009	Assembled Package

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Continued Development of Actual Monitoring System Data Management and Analysis Systems	2010	Assembled Package

P001.006 Monitoring System Development and Management (058586)

Issue

Acquiring, storing, and analyzing power quality (PQ) data is an increasingly important but daunting task for modern electric utilities. The challenges of this process are many, including dealing with massive amounts of data in varying formats and quickly analyzing these data to acquire the knowledge necessary to make informed decisions that can save utilities many millions of dollars in expenses, troubleshooting, and reduced downtime.

Description

This project provides ongoing development of new, advanced features and capabilities for managing and analyzing large power quality monitoring databases. This project's developments will be implemented in the PQView software for managing power quality monitoring systems; they are also implemented for convenient interface to other PQ management systems.

PQView is the premier power quality data visualization and analysis tool in the world, enabling contributors not only to better detect and diagnose PQ issues, but also to improve dramatically the speed of fault location and to better communicate the grid impact of voltage sags. The software is in use by more than 50 utilities around the world, and the research effort is coordinated closely with the PQView Users Group to help prioritize development efforts.

Members help prioritize important functions to be included in the power quality monitoring system, including the following:

- Easier data importing into PQView with new PQDIF-format data handlers
- Voltage regulator performance module
- Fault protection and coordination assessment module
- Automated power quality and reliability reporting methods
- Transformer loading and lifetime assessment, including harmonics
- Arrester performance for transient events

Value

- Utilities implementing preliminary fault location algorithms using PQView have reduced average feeder downtime by approximately 1 hour per fault event.

How to Apply Results

Power quality managers, engineers, and technicians receive software updates through the PQView Users Group. Software updates based on the research also undergo EPRI SQA testing. The deliverables also include updated software documentation and annual workshops for tech transfer of new developments.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Updated PQView Software: This work will update the world-class PQView data visualization and analysis software package—the best-in-class solution for data handling, visualization, and analysis.	12/31/2009	Software

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Updated PQView Software: This work will update the world-class PQView data visualization and analysis software package—the best-in-class solution for data handling, visualization, and analysis.	2010	Software

PS01C Achieving Cost Effective PQ Compatibility Between the Electrical System and Loads (062092)

Project Set Description: This project set helps EPRI members ensure electrical compatibility between the power system and the end-use customer's equipment. Power quality mitigation solutions significantly reduce electrical disturbances at the transmission, distribution, and end-use level by integrating advanced energy storage technologies with power electronics. By enabling members to provide high-quality and highly reliable power to their end-use customers, the project set enables power quality to serve as a strategic value creator for the utility industry—and specifically program members—in a highly competitive energy market.

Project Number	Project Title	Value
P001.007	System Compatibility Research	Provides firsthand knowledge of end-use equipment susceptibility, design guidelines for manufacturers, and immunity performance standards
P001.008	Emerging PQ Technology Assessment	Enables proper application of emerging power quality mitigation technologies and increases end-user productivity

Project Number	Project Title	Value
P001.009	Industrial Design Guide	Helps train new power quality engineers, refresh skilled representatives, and enhance the credibility of all employees in the presence of end users

Project Descriptions

P001.007 System Compatibility Research (062349)

Issue

The EPRI PQ Program Research Master Plan has identified a number of 10-year objectives relating to better understanding and improving the compatibility between electric power supply and end-use loads. A key barrier to achieving these successes is understanding the sensitivity of not only today's end-use loads, but also anticipating new and emerging end-use loads.

Description

This research area involves characterizing compatibility issues between end-use equipment, power conditioning technologies, and power system performance. It includes establishing evaluation criteria (e.g., testing protocols), evaluating failure mechanisms, and identifying solutions. This important research relates to the EPRI PQ Program Research Master Plan, which includes a 10-year goal of achieving system compatibility for end-use equipment. This research will acquire and distribute seminal compatibility information and knowledge. As issues are studied and uncovered, solutions will be developed and applied by the other projects in this project set.

A second area of research will continue previous work with end users, vendors, and energy companies to establish power quality standards in the automotive, machine tool, and food-processing industries. Work has been ongoing in the food processing area, where food-processing groups have already expressed an interest in adopting the SEMI F47 standard as a beginning step. In addition, work is progressing in the automotive industry, where standards are a very important platform for their operations. One promising approach is to work toward adoption of a ride-through recommendation which used by organizations such as the IEEE. This approach allows the adoption of standards for many industries simultaneously, rather than one industry at a time. These efforts can be coordinated with the International Electrotechnical Commission (IEC) to ensure international acceptance. Another approach is to press for expansion of electrical codes to encompass performance issues. As more industries become willing to adopt the F47 curve, the end result will be a universal, one size-fits-all type of standard.

A third research area involves development of a guidebook for designing equipment to avoid power quality problems. The guidebook is identified specifically in the PQ program Master Plan, and it dovetails with the overall Master Plan regarding the need for embedded solutions to achieve system compatibility over a 10-year period.

Value

- Improved customer satisfaction among key industrial and commercial customer categories
- Reduced incidence of end-use customer process interruptions
- More efficient and cost-effective development by end-use equipment manufacturers of equipment that meets PQ performance standards using the Equipment Design Guidebook

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by using the results of system compatibility testing and the associated guidelines to help end-use customers solve PQ-related issues and achieve higher productivity.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Development and Promotion of Industry Standards: Fostering sound industry equipment immunity standards is a central tenet of the PQ Master Plan.	12/31/2009	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Development and Promotion of Industry Standards	2010	Technical Update

P001.008 Emerging PQ Technology Assessment (062350)

Issue

The EPRI PQ Program Research Master Plan has identified a number of 10-year objectives relating to better understanding and improvement of the compatibility between electric power supply and end-use loads. A working knowledge of technology solutions as they become available is critical to the overall effort of solving power quality (PQ) problems. Because power quality mitigation technologies are always evolving, staying abreast of the latest developments is challenging.

Description

This multiyear project conducts unbiased technical assessments of emerging power quality mitigation hardware in the areas of voltage sags, momentary interruptions, transient protection, and harmonic filtering. The assessments focus on understanding the technologies, reviewing technical specifications, conducting controlled laboratory testing to evaluate performance, and obtaining operational knowledge from field demonstrations. This is one of the beginning steps necessary to achieve the EPRI PQ Program Master Plan 10-year goal of system compatibility. A working knowledge of the latest solutions is critical to the overall effort of overcoming PQ problems. Since PQ mitigation technologies are always evolving, this effort must continue throughout the 10-year period, and beyond.

Value

- Collaborative research significantly reduces the contributor cost for each PQ mitigation technology tested.
- Identification of effective mitigation technologies prior to installation can result in significant net savings.
- Improved customer satisfaction can be achieved among key industrial and commercial customer categories.

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by assimilating them to help their end-use customers answer questions on new technologies using unbiased third-party results.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Technology Assessment and Application Guide for Emerging PQ Technologies: New PQ mitigation technologies are introduced to the market every year. This project undertakes the process of evaluating PQ mitigation technologies vis-à-vis their performance claims.	12/31/2009	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Technology Assessment and Application Guide for Emerging PQ Technologies	2010	Technical Update

P001.009 Industrial Design Guide (048281)

Issue

The EPRI PQ Program Research Master Plan has identified a number of 10-year objectives relating to better understanding and improvement of the compatibility between electric power supply and end-use loads. Members will benefit from a centralized set of information that helps them show customers the causes of, and solutions for, the power quality (PQ) problems they are facing. This challenge is particularly acute in the industrial sector, which consists of a diverse range of processes, equipment, and power quality issues.

Description

The EPRI Industrial Design Guide (IDG) provides a technical basis for working with industrial end users in power quality, distribution, and economic development activities. This authoritative guide to industrial processes describes in detail such industrial processes as injection-molded plastics and CNC machining, includes electrical diagrams of the processes and sub-processes, and discusses the economics of process-associated downtime. The descriptions and drawings are interactive, leading the user to important power quality considerations such as sensitive components, test protocols, solutions, and applications. The web-based format makes it easy to use. Each year, additional modules describe a specific process in a given industry. As the main repository of power quality site investigation knowledge and lessons learned, this product is the main tool to meet the Master Plan goal of understanding clearly what problems are faced in different industries.

Value

- Helps members train new power quality engineers, refresh seasoned representatives, and enhance the credibility of all employees in the presence of end users.
- Improves the relationship between the customer and energy company by demonstrating that the company has invested the time and resources needed to research these problems in depth.

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by assimilating them and applying the Industrial Design Guide with industrial customers to show the causes of, and solutions for, the PQ-related issues they are facing.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Updated Industrial Design Guide: The IDG is the definitive reference to use when designing industrial processes to maximize productivity and minimize production and equipment losses attributable to PQ phenomena. Each year, this project adds modules to this first-in-class tool.	12/31/2009	Software

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Updated Industrial Design Guide: The IDG is the definitive reference to use when designing industrial processes to maximize productivity and minimize production and equipment losses attributable to PQ phenomena. Each year, this project adds modules to this leading tool.	2010	Software

PS01D PQ Technology Transfer and Knowledge Development (063526)

Project Set Description: The EPRI PQ Technology Transfer and Knowledge Development project set has been completely restructured over the last three years to deliver increased value for all program contributors. The program provides a wealth of high-impact resources in a well-designed, readable, and accessible format. Paramount among these are numerous documents covering a wide range of power quality (PQ) topics, written not only for use by busy PQ professionals, but also to be shared with important end-use customers and internal utility management. The program’s web site, www.MyPQ.net, is the most comprehensive electronic PQ resource available, providing 24/7 access to hundreds of PQ case studies, nearly 300 PQ technical documents, PQ standards references, indexes, conference presentations, and other resources. PQ Technology Transfer and Knowledge Development is one of the most highly used project sets within the EPRI family, creating over \$500,000 in new content each year and matching individual contributions by at least 20-to-1. The project set is designed to be an essential and valuable part of any PQ program or customer support organization.

Project Number	Project Title	Value
P001.010	PQ Knowledge Development and Transfer	Provides high value to PQ managers, engineers, and technicians, creating more than \$500,000 worth of new content each year and leveraging individual contributions by at least 20-to-1 Provides the ability to access EPRI experts and network with industry peers (both inside and outside the utility industry), easily justifying the project’s annual cost

Project Descriptions

P001.010 PQ Knowledge Development and Transfer (065541)

Issue

The EPRI PQ Program Research Master Plan has identified a 10-year objective to enable customization of PQ information and improve the flow of this information. Management of power quality (PQ) issues has never been an easy task, but it has grown even more difficult with deregulation, reregulation, increasingly scarce technical and strategic tools, and a conspicuous lack of unbiased resources for information, collaboration, advice, and problem solving. Moreover, with the ever-increasing use of sensitive digital and electronic equipment in today's economy, end-use customers are not only demanding higher quality power, but also are calling upon utilities to help resolve PQ problems within customer facilities.

Description

This project provides the knowledge and information electric service providers need to meet these demands cost-effectively. This project leverages EPRI's extensive collaborative research in power quality to provide a wealth of easy-to-use, informative PQ resources for utility staff—as well as materials they can use to inform end-use customers.

This project offers a comprehensive collection of technical and informational publications and products, educational forums, technical support, and web-based services. The project provides the essential information and resource tools needed to help minimize economic losses and more effectively compete in today's marketplace. It also serves to build a knowledge base of the latest power quality products and expert insights into power quality.

Value

- Provides extremely high value to PQ managers, engineers, and technicians, and utilizes individual participant contributions by at least a 20-to-1 ratio
- Provides the ability to access EPRI experts and network with industry peers both inside and outside the utility industry.

How to Apply Results

Power quality and T&D engineering, design, operations, and maintenance professionals can best apply the results of this research by assimilating them to establish improved relationships with the full range of power quality constituents—utility, vendors, investors, and end users—and improve cost effectiveness by providing essential information, resource tools, and peer-to-peer knowledge. The PQ Hotline uses the capabilities of existing staff.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Subscription to EPRI's PQ Knowledge-Transfer Electronic Publications and Resources: This project provides high-impact resources in well-designed and accessible formats. The project's materials cover topics ranging from PQ basics to cutting-edge mitigation technologies and sophisticated measurement and data analysis methodologies. These documents are written not only for busy PQ professionals, but also are ideal for sharing with important end-use customers and internal utility management.	12/31/2009	Technical Update

Product Title & Description	Planned Completion Date	Product Type
PQ Hotline: Members are provided up to 20 hours of hotline access for technical support in the areas of power quality. Access to the PQ Hotline provides best-in-class problem-solving resources, while a PQ Hotline Database provides an unparalleled archive of a range of solutions and industry experience.	12/31/2009	Technical Resource
Power Quality Online Resources via MyPQ.net website: Addition and maintenance of online PQ knowledge delivered via the project set's MyPQ.net Web site provides a number of important problem-solving resources for busy power quality professionals. This website is the most comprehensive and unbiased online PQ resource available, providing 24/7 access to hundreds of PQ case studies and over 500 PQ technical documents, case studies, standards references, conference presentations, and a variety of other resources.	12/31/2009	Technical Resource
Discounted Registration for PQA/ADA 2008 North America Conference and Exhibit: The PQA/ADA North American Conference and Exhibit is the premier international PQ conference.	12/31/2009	Workshop, Training, or Conference
North American PQIG Workshop: This utility-sponsored workshop provides end-user focused solutions and insights, making it ideal for education and outreach.	12/31/2009	Workshop, Training, or Conference

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Subscription to EPRI's PQ Knowledge-Transfer Electronic Publications and Resources: This project provides high-impact resources in well-designed, readable, and accessible formats. The project's materials cover topics ranging from PQ basics to cutting-edge mitigation technologies and sophisticated measurement and data analysis methodologies. These documents are written not only for busy PQ professionals, but also are ideal for sharing with important end-use customers and internal utility management.	2010	Technical Update
PQ Hotline: Members are provided up to 20 hours of hotline access for technical support in the areas of power quality. Access to the PQ Hotline provides best-in-class problem-solving resources, while a PQ Hotline Database provides an unparalleled archive of a range of solutions and industry experience.	2010	Technical Resource
Power Quality Online Resources via MyPQ.net website: Addition and maintenance of online PQ knowledge delivered via the project set's MyPQ.net Web site provides a number of important problem-solving resources for busy power quality professionals. This website is the most comprehensive and unbiased online PQ resource available, providing 24/7 access to hundreds of PQ case studies and over 500 PQ technical documents, case studies, standards references, conference presentations, and a variety of other resources.	2010	Technical Resource

Product Title & Description	Planned Completion Date	Product Type
Discounted Registration for PQA/ADA 2008 North America Conference and Exhibit: The PQA/ADA North American Conference and Exhibit is the premier international PQ conference.	2010	Workshop, Training, or Conference
North American PQIG Workshop: This utility-sponsored workshop provides end-user focused solutions and insights, making it ideal for education and outreach.	2010	Workshop, Training, or Conference
