



EPRI

ELECTRIC POWER
RESEARCH INSTITUTE

EPRI Power Quality

2013 Research Portfolio

Bill Howe, PE, CEM
Program Manager

Project Set Managers

Harish Sharma

Tom Cooke

Mark Stephens

EPRI and Power Quality

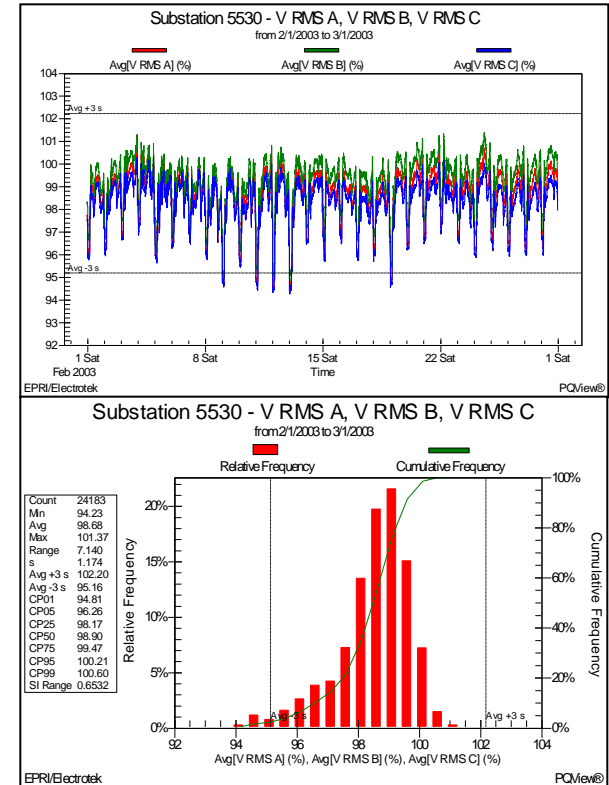
How are We Unique?

- **Legacy:** EPRI initiated utility-sponsored PQ research over 20 years ago
- **Experience:** We have directed literally US\$10's of Millions in PQ research
- **Depth of Bench:** We have over 60 PQ professionals on staff, ranging from experienced technicians to several PhDs.
- **Technically Competent:** We do over 90% of of our research with in-house staff and facilities
- **Testing Facilities:** We have extensive laboratory facilities for distribution, transmission, and end use equipment evaluations

EPRI Power Quality – Base Program Research

PQ in the Era of the “Smart Grid”

- **Improving PQ in T&D (PS1A)**
 - Guided Diagnostics/Analytics
 - Phenomena and Benchmarking
 - Impact of SG on PQ
- **PQ Monitoring and Intelligent Applications (PS1B)**
 - Getting intelligence from data
 - Measurement accuracy
 - Managing data
 - Advanced Data Analysis/Applications
- **System Compatibility (PS1C)**
 - Impact of new loads on Grid PQ
 - Expert tools for Site Investigations
- **Knowledge Transfer (PS1D)**
 - Training and Education



Improving PQ in Transmission and Distribution

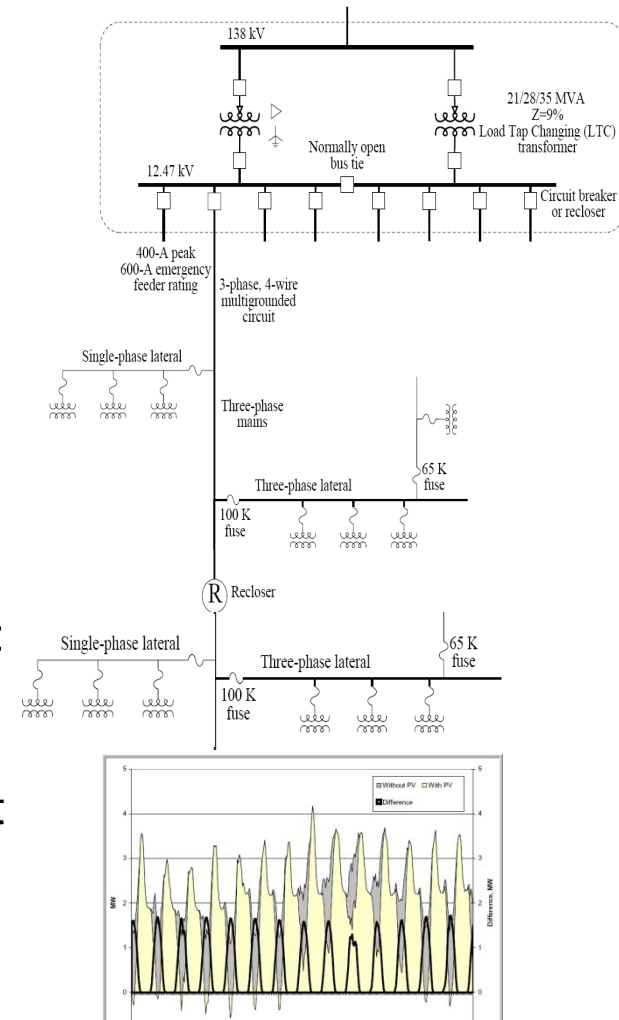
Project set 1 (PS1A)

Research Needs

- **Future PQ Levels:** Need to estimate future PQ grid harmonics levels on transmission and distribution grids
- **Smart Grid Impacts:** Understanding the impact of Smart Grid and new loads on Grid PQ
- **Benchmarking** of system PQ performance
- **Harmonics:** Solving the distribution harmonics problem

Approach

- **Grid-IQ:** Develops estimates and analysis of **future levels of harmonics and other PQ phenomena** based on application of EPRI-developed load and grid models. **Assessment of DR integration issues.**
- **Benchmarking:** Provides guidelines for assessment of current and future grid PQ performance
- **Guided Analytics:** Develop and support the EPRI Power Quality Diagnostic System and other analysis tools



PQ Monitoring and Intelligent Applications

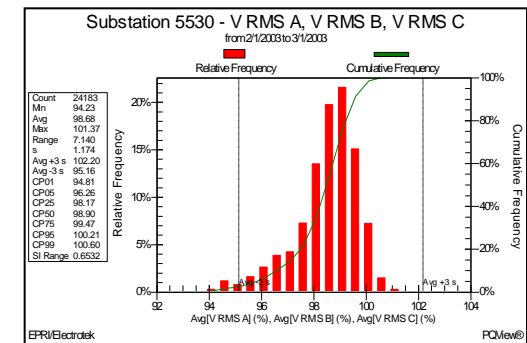
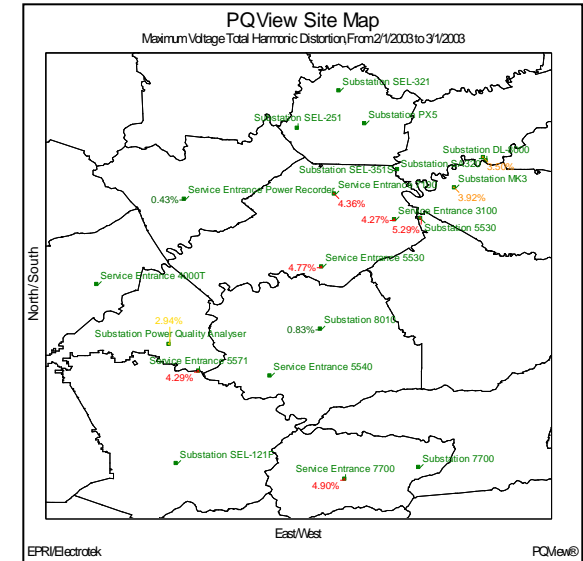
Project set 2 (PS1B)

Research Needs

- **Proliferation of New Data Sources:** Need for integration of many and growing data resources utility wide
- **Managing the Smart Grid “Data Tsunami”**
Management and analysis of existing and new data streams
- **Getting “Smart Grid” with Data:** Using data resources to improve grid and economic performance

Approach

- **Data Source Assessment:** Assessment of the Quality and Usefulness of PQ Data from emerging sources, including **strategies for getting useful PQ data from Smart Meters**
- **Data Visualization:** Assessment and Development of PQ data visualization tools
- **Advanced Applications** for PQ and related data



PQ Compatibility Between the Electrical System and Loads

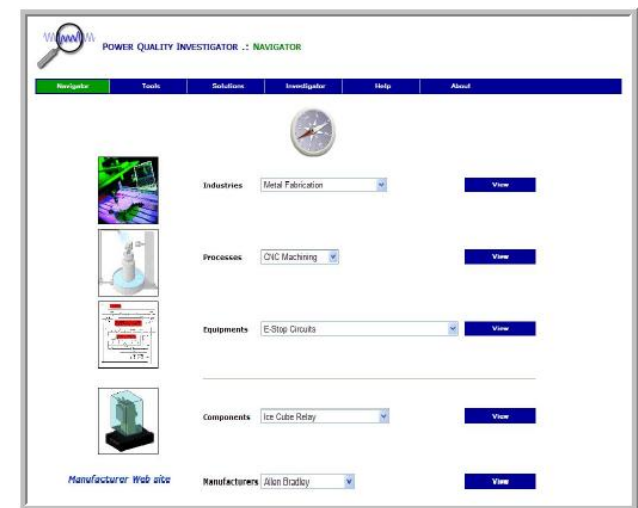
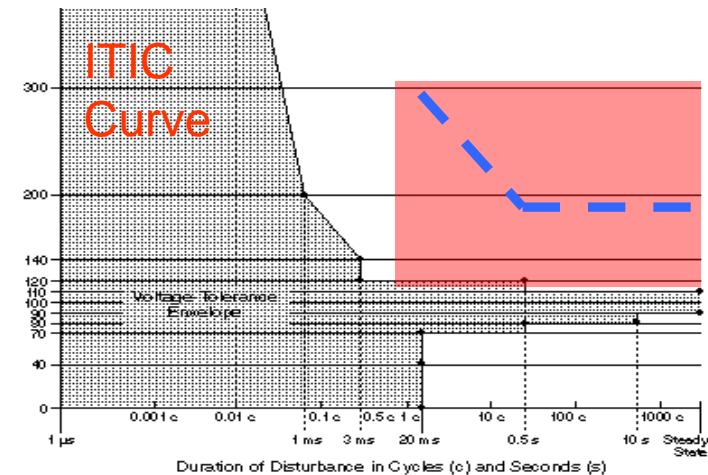
Project set 3 (PS1C)

Research Needs

- **Solutions:** Quickly solving end-use PQ compatibility issues
- **Prevention:** Understanding end-use power quality source and sensitivity issues

Approach

- **Equipment testing and modeling:** PQ sensitivity and PQ contribution of new and changing end-use devices
- **Mitigation testing and modeling:** Laboratory testing of new and changing PQ mitigation technologies
- **Technology development:** Creation of new solutions and innovative technologies
- **Expert resources:** Development of expert tools for understanding and solving common PQ compatibility problems through **development and application of the PQ Investigator expert software**



PQ Investigator

PQ Knowledge (PS1D)

Research Needs

- Utilities seek knowledge and information to meet the demands for providing power quality cost-effectively

Approach

- Provide Access to Expert Resource via the PQ Hotline
- Publish technical and informational briefs and products
- Develop educational forums, technical support, and web-based services
- Develop customized knowledge delivery capabilities
- Over 600 unique EPRI-authored documents in the PQ Knowledge On-Line Library

2013 Research

- **New PQ documents, 25 – 30 per year**
 - Enhanced Case Study Library (flicker and harmonics)
 - PQ TechWatch and PQ Encyclopedia development
 - PQ Hotline Call of the Month
- **On-line Library – Over 600 EPRI-authored articles**
- **PQ Hotline**
- **Conferences and Training**
- **MyPQ.epri.com: On-line 24X7 access**



2013 1D and 1.010

EPRI Power Quality

Expert Facility Investigations

- We specialize in solving PQ Problems In all Manufacturing Sectors
- Focus on Reducing End Use Customer Losses by improving machine robustness to voltage sags through:
 - Testing (lab and field)
 - PQ Walkthroughs
 - PQ Audits
 - Consulting
 - Training
 - Portable Test Hardware



How Did We Obtain Our Expertise?

- Began Building Knowledge Base from System Compatibility Research Project in Mid 1990s
- Power Quality Walkthroughs and Audits Worldwide
- Performed Hundreds of On-Site Tests of Machines and Process Equipment in many industries.
- Years of collaboration with Utilities, industry and equipment providers
- Active in Power Quality Standards development



PLCs

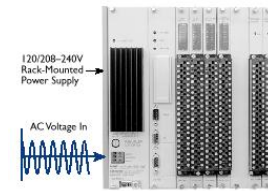


Figure 1. A rack-mounted PLC power supply that requires AC voltage (120/208-240 volts)



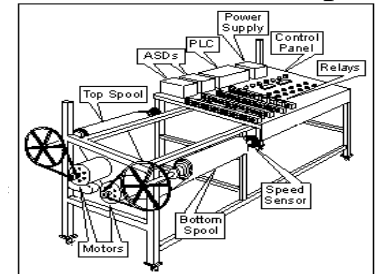
Power Supplies



Sensors



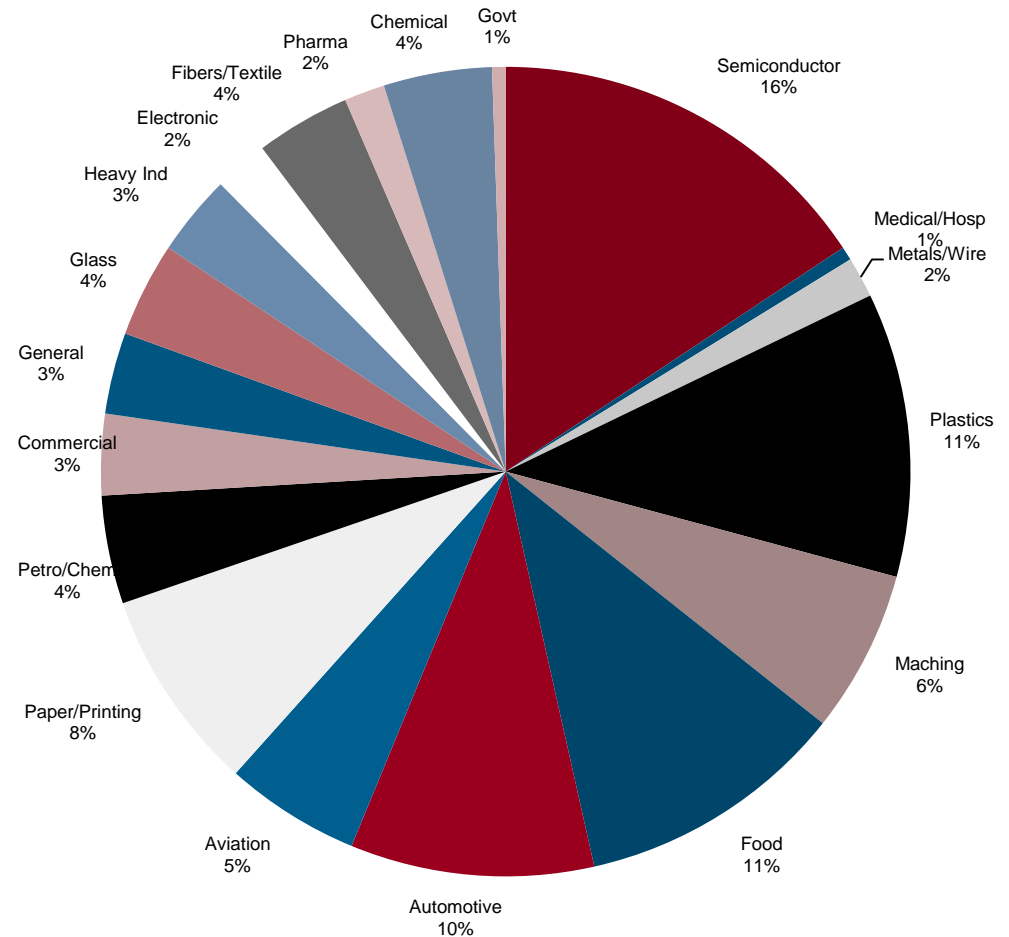
Process Mockups



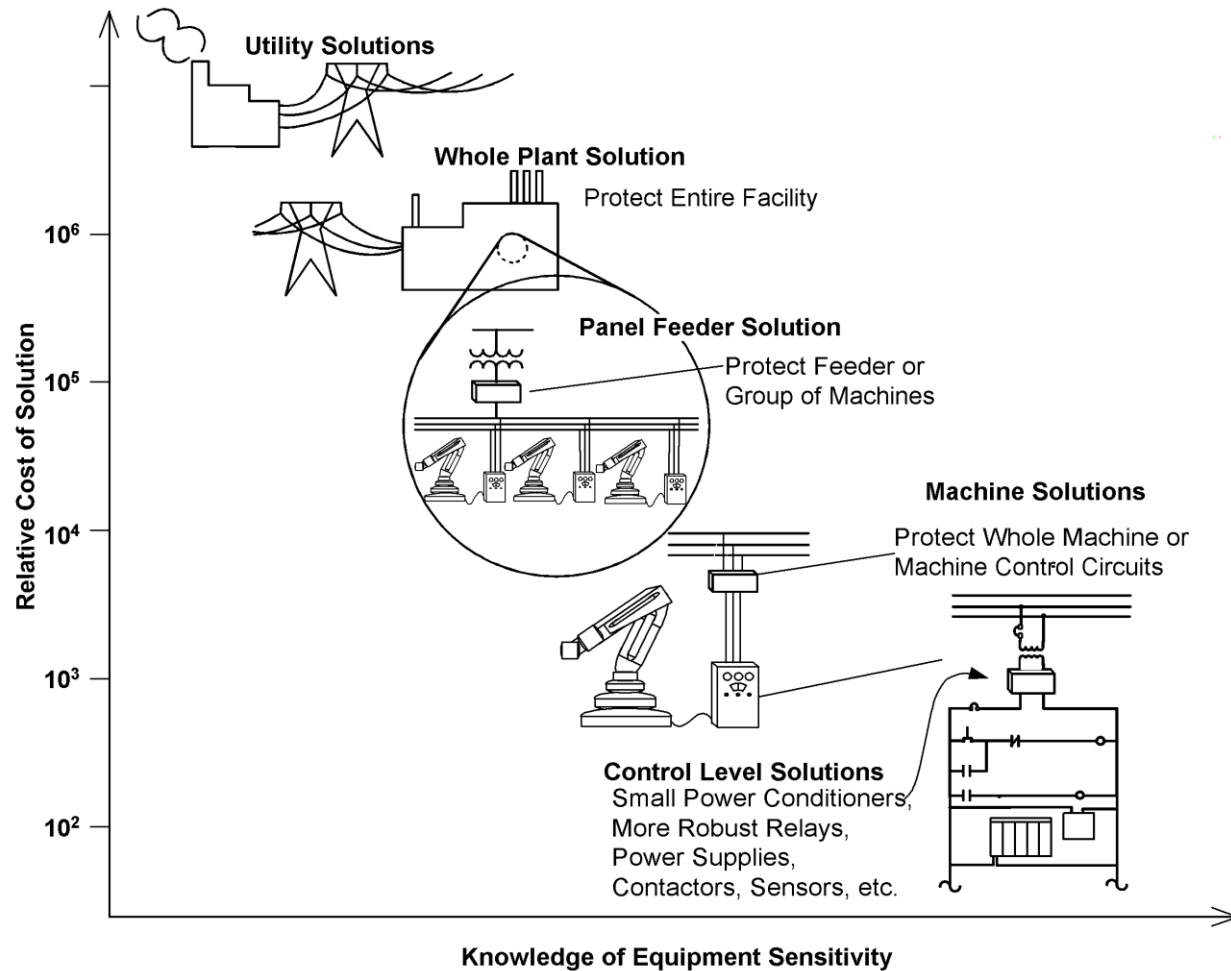
Relays, Contactors, Motor Starters

EPRI Voltage Sag PQ Investigations 1996-2012

Industry	Sites	Percentage
Semiconductor	29	16%
Plastics	21	11%
Food	20	11%
Automotive	18	10%
Paper/Printing	15	8%
Maching	12	6%
Aviation	10	5%
Chemical	8	4%
Petro/Chem	8	4%
Fibers/Textile	7	4%
Glass	7	4%
Commercial	6	3%
General	6	3%
Heavy Ind	6	3%
Electronic	4	2%
Metals/Wire	3	2%
Pharma	3	2%
Govt	1	1%
Medical/Hosp	1	1%
Total Sites	185	
Average/Year	12	



Increased Knowledge Leads to Lower Cost Solutions



Common Weak Links – AC Powered Relays, Contactors, Motor Starters, PLCs

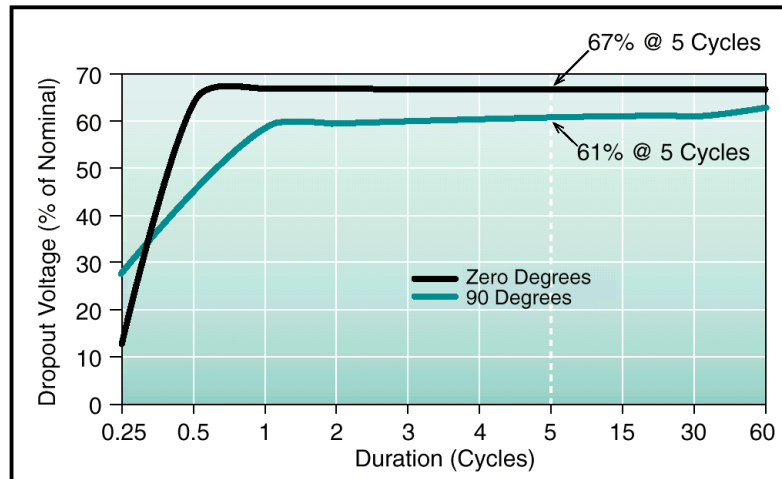


Figure 5. Composite Low-Voltage Tolerance of Relays

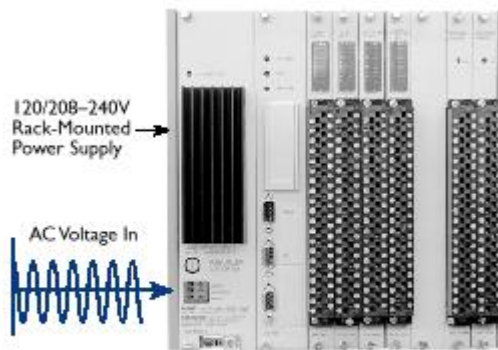
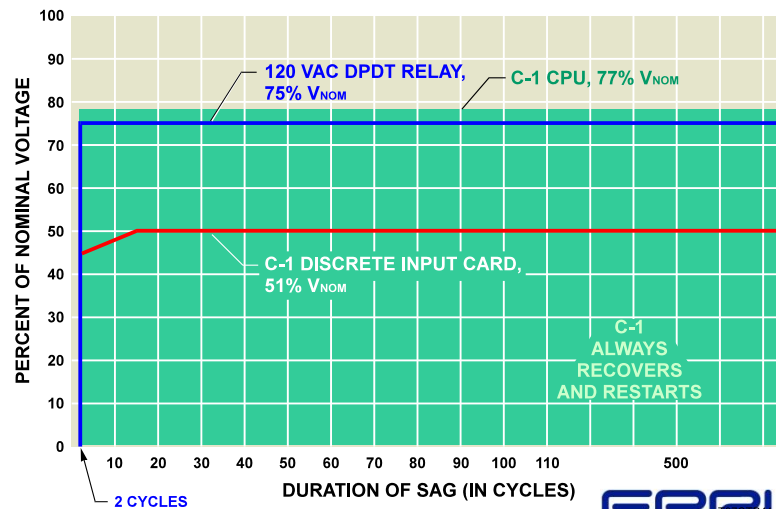


Figure 1. A rack-mounted PLC power supply that requires AC voltage (120/208-240 volts)



PQ Facility Assessments

For More Information Contact

Mark Stephens, PE, CEM, CP EnMS
EPRI | Senior Project Manager
Industrial PQ & Energy Efficiency
942 Corridor Park Blvd, Knoxville, TN 37932
Desk: 865-218-8022
Mobile: 865-773-3631
Web: www.epri.com
f47testing.epri.com
mypq.epri.com



mstephens@epri.com

Together...Shaping the Future of Electricity