Pacific Gas and Electric Company

Power Quality Standards

IEEE Standard 141-1993, *Recommended Practice for Electric Power Distribution for Industrial Plants, aka the Red Book.* A thorough analysis of basic electrical-system considerations is presented. Guidance is provided in design, construction, and continuity of an overall system to achieve safety of life and preservation of property; reliability; simplicity of operation; voltage regulation in the utilization of equipment within the tolerance limits under all load conditions; care and maintenance; and flexibility to permit development and expansion.

IEEE Standard 142-1991, *Recommended Practice for Grounding of Industrial and Commercial Power Systems, aka the Green Book.* Presents a thorough investigation of the problems of grounding and the methods for solving these problems. There is a separate chapter for grounding sensitive equipment.

IEEE Standard 242-1986, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems, aka the Buff Book.*
Deals with the proper selection, application, and coordination of the components which constitute system protection for industrial plants and commercial buildings.

IEEE Standard 446-1987, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications, aka the Orange Book.*
Recommended engineering practices for the selection and application of emergency and standby power systems. It provides facility designers, operators and owners with guidelines for assuring uninterrupted power, virtually free of frequency excursions and voltage dips, surges, and transients.

IEEE Standard 493-1997, *Recommended Practice for Design of Reliable Industrial and Commercial Power Systems, aka the Gold Book.* The fundamentals of reliability analysis as it applies to the planning and design of industrial and commercial electric power distribution systems are presented. Included are basic concepts of reliability analysis by probability methods, fundamentals of power system reliability evaluation, economic evaluation of reliability, cost of power outage data, equipment reliability data, examples of reliability analysis. Emergency and standby power, electrical preventive maintenance, and evaluating and improving reliability of the existing plant are also addressed.

IEEE Standard 519-1992, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.* This guide applies to all types of static power converters used in industrial and commercial power systems. The problems involved in the harmonic control and reactive compensation of such converters are addressed, and an application guide is provided. Limits of disturbances to the AC power distribution system that affect other equipment and communications are recommended. This guide is not intended to cover the effect of radio frequency interference.

IEEE Standard 929-1988, *Recommended Practice for Utility Interface of Residential and Intermediate Photovoltaic (PV) Systems.*

IEEE Standard 1100-1999, ***Recommended Practice for Powering and Grounding Sensitive Electronic Equipment, aka the Emerald Book***.
This is the first revision of the original edition in 1992. Recommended design, installation, and maintenance practices for electrical power and grounding (including both power-related and signal-related noise control) of sensitive electronic processing equipment used in commercial and industrial applications.

IEEE Standard 1159-1995, ***Recommended Practice for Monitoring Electric Power Quality.*** Monitoring of electric power quality of AC power systems, definitions of power quality terminology, impact of poor power quality on utility and customer equipment, and the measurement of electromagnetic phenomena are covered. Key chapters include: Monitoring objectives, Measurement instruments, monitor application techniques, and interpreting monitoring results.

IEEE Standard 1250-1995, ***Guide for Service to Equipment Sensitive to Momentary Voltage Disturbances.*** Computers, computer-like products, and equipment using solid-state power conversion have created entirely new areas of power quality considerations. There is an increasing awareness that much of this new user equipment is not designed to withstand the surges, faults, and reclosing duty present on typical distribution systems. Momentary voltage disturbances occurring in ac power distribution and utilization systems, their potential effects on this new, sensitive, user equipment, and guidance toward mitigation of these effects are described. Harmonic distortion limits are also discussed.

IEEE Standard 1346-1998, ***Recommended Practice for Evaluating Electric Power System Compatibility with Electronic Process Equipment.*** A standard methodology for the technical and financial analysis of voltage sag compatibility between process equipment and electric power systems is recommended. The methodology presented is intended to be used as a planning tool to quantify the voltage sag environment and process sensitivity. It shows how technical and financial alternatives can be evaluated. Performance limits for utility systems, power distribution systems, or electronic process equipment are not included.

All the above IEEE standards are available from The Institute of Electrical and Electronics Engineers, Inc.
Their web address is http://www.standards.ieee.org

SEMI E-10-1999, ***Standard for Definition and Measurement of Equipment Reliability, Availability, and Maintainability*** defines the sag ride through capability.

SEMI F-42-1999, ***Test Method for Semiconductor Processing Equipment Voltage Sag Immunity*** defines the test methodology to confirm compliance to the standard.

SEMI standards are available from Semiconductor Equipment and Materials International (SEMI), 805 East Middlefied Road, Mountain View, CA 94043. The web address is http://www.semi.org/***.***

UL 1449 second edition, 1998. Underwriters Laboratories, Inc. standard 1449 is a safety, construction, and performance standard for transient voltage surge suppressors. The second edition revision includes withstand for loss of neutral condition without damage to the suppressor. UL local address is 1655 Scott Boulevard, Santa Clara, CA 95050-4169. Telephone: (408) 985-2400.
Web address: http://ulstandards info net.ul.com

NFPA 70-1999, *National Electrical Code.* Published by the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. Available in most book stores. The NEC is basically a safety code to protect electrical distribution circuits from faults and overloads. It is not a performance code.

ANSI C84.1-1995, *Electric Power Systems and Equipment - Voltage Ratings.* Published by NEMA, National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, Virginia 22209. Telephone: (703) 841-3200. This voluntary standard was first approved in 1954 as a joint effort by the Edison Electric Institute and the NEMA to recommend voltage ratings for both electric systems and equipment to promote compatibility. ANSI stands for American National Standards Institute. This ANSI standard establishes the steady state voltage delivery window of +/- 5% at the point of delivery. It also recommends a tolerance window of +6% and -13% for end use equipment. The standard also establishes a tolerance window for voltage unbalance of +/-3%.

NEMA MG 1- 1998, Motors and Generators. *National Electrical Manufacturers Association, 2101 L Street, N.W. Washington DC 20037.* This standard gives technical specifications used by manufacturers. Power quality concerns that can be referenced include: voltage and current unbalance tolerance, over and under voltage tolerance, electrical starting characteristics, and insulation values.

NEMA Standards Publication No. LS1-1992, *Low Voltage Surge Protective Devices.*
This is a good standard for quality construction of the device.